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THE

ENCYCLOPÆDIA BRITANNICA

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A GENERAL INDEX,

AND NUMEROUS ENGRAVINGS.

VOLUME XVIII.

ADAM AND CHARLES BLACK, EDINBURGH;
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ENCYCLOPÆDIA BRITANNICA.

PLATA, LA.

LA PLATA is the name of an extensive tract of country in South America, extending from the eastern declivities of the Chilian Andes, to the great rivers Paraguay, Parana, and La Plata. During the latter period of Spanish domination, it formed the viceroyalty of the Rio de la Plata, or Buenos Ayres, having then annexed to it Bolivia or Upper Peru, Paraguay, and the Banda Oriental. By subsequent changes these have been erected into independent states, and the remaining territory has been constituted a republic under the name of the Argentine Republic, or the United Provinces of the Rio de la Plata. It is a federal state, consisting of a number of provinces, of which Buenos Ayres is the head. Before describing this country, we shall briefly glance at its past history.

To the Spaniards belongs the honour of first discovering this part of the South American continent. In the year 1515, Juan Dias de Solis or Salis, having been furnished by the court of Spain with two ships for the purpose of exploring Brazil, arrived, on his voyage thither, at the mouth of the Rio de la Plata. Touching on the north coast between Maldonado and Monte Video, he took formal possession of the land in name of his sovereign; but, thrown off his guard by the deceitful friendship of the natives, he was slain, along with a few attendants who had followed him on shore. The coast was immediately abandoned by the survivors on board of the vessels; but in the year 1526 a fresh expedition, under the celebrated Sebastian Cabot, then in the service of Spain, entered the river, and cast anchor opposite the present site of Buenos Ayres. This took place at the time when a Spanish captain called Garcia was making discoveries in other parts of the same river. Advancing about a hundred and twenty leagues upwards, Cabot discovered a fine river flowing into the main stream. Up this he sailed with his fleet, and disembarking his men, built a fort, in which he left a garrison; whilst he himself, with his remaining followers, pursued his discoveries still farther up the river. The Indians with whom he came in contact exhibited abundance of gold and silver plates, particularly the latter, brought by them from the eastern parts of Peru; but the circumstance led Cabot to believe that mines of the precious metals existed in the country in which he then was, and accordingly he gave the name of Rio de la Plata, or River of Silver, to the noble stream by which it was watered. The Spaniards soon determined on colonizing this valuable acquisition; and, to prevent any interference on the part of the other nations of Europe, Don Pedro de Mendoza, with two or three thousand followers, was sent from Spain to secure the possession, and establish a relationship between it and the mother country. He landed upon the western shore of the La Plata in the year 1535, and founded the city of Buenos Ayres, which he so named from the salubrity of the climate. Pursuing his way into the interior, he conquered all the country as far as Potosi, at which mines of silver were discovered nine years afterwards. The first settlers at Buenos Ayres were most unfortunate; their town was burned by the Indians, and after suffering every privation, they were shortly afterwards compelled to abandon the place. Previously to this event, Assumption, the capital of Paraguay, had been founded; and thither the wretched remains of the expedition retreated. A second armament was fitted out, and an attempt made to rebuild the town, in 1542; but it was overwhelmed by a calamity similar to that which had overtaken the former. The chief attention of the Spaniards was for some time directed to forming settlements in Paraguay, in order to facilitate their communication with the mines of Peru, where Pizarro and his successors were gathering in a golden harvest. Contentions with the Indians were frequent and bloody, for the inhabitants of the vast plains upon either bank of the La Plata proved much more difficult to subdue than the timid and tractable Peruvians.

It was not until the year 1580 that the Europeans succeeded in their attempts to found a town upon the site chosen by Mendoza. Before this period, however, they had established themselves at Santa Fe, Mendoza, and some other places in the interior; so that, as Dr Southey observes, the history of this part of South America differs from that of any other colony in one remarkable circumstance: The first permanent settlement was formed in the heart of the country, and the Spaniards colonized from the interior towards the sea. But they were not permitted quietly to enjoy the success of their third attempt to found Buenos Ayres.

Stimulated by the recollection of their previous triumphs in demolishing the works of the invaders on the same ground, the Indians once more attacked it, and were so far successful as to set fire to the tents and temporary erections of the settlers. Their leader, however, being slain, they were compelled to retreat with loss; and before they were in a condition to renew the work of demolition, the town was so well fortified and garrisoned as to bid defiance to their efforts. Again the leader of the savages fell, and his force was completely defeated and put to flight. From this period the city began to prosper, and the ship which carried to Castille the intelligence of its refoundation took home a cargo of sugar, and the first hides with which Europe was supplied from the wild cattle which now began to overspread the country, and soon produced a total change in the manners of all the adjoining tribes. The immense pampas of La Plata appear to have been originally stocked with cattle from a few which had been brought by the earliest settlers; and so rapidly had they multiplied, that, about the year 1610, no less than a million is said to have been driven from the country in the neighbourhood of Santa Fe into Peru.

In the year 1620 Buenos Ayres was erected into a bishopric; but for nearly two centuries it continued to be a place of little note, and comparatively scanty population. From the first period of the colonization of this country till the year 1778, the government was dependent on that of Peru, although the chief of Buenos Ayres had the title of captain-general. A false idea of what constitutes wealth led Spain to estimate the value of her possessions by the number and richness of their mines of gold and silver; and Buenos Ayres being deficient in these, its more solid advantages of a fertile soil and a salubrious climate were consequently overlooked. The pernicious system of political economy practised by Spain towards her colonies was the main cause why this city remained for such a length of time almost entirely unknown to Europeans. Apprehensive lest commodities might be introduced into Peru by way of Buenos Ayres, and thus prejudice the sale of the cargoes imported by the fleets which they sent to Panama, the early traders solicited and obtained from the government the prohibition of every kind of commerce by the Rio de la Plata. Those whom this measure most nearly affected put in a strong remonstrance against it, and were so far successful that, in 1602, permission was granted them to export for six years, in two vessels belonging to themselves, and on their own account, a certain quantity of flour, tallow, and jerked beef, but only to two ports. Upon the expiration of the term an indefinite prolongation was solicited, with an extension to all kinds of merchandise, and liberty to trade also with other ports. This application was vehemently opposed; but notwithstanding, in the year 1618, the inhabitants of the shores of the Rio de la Plata were authorized to fit out two vessels, not exceeding one hundred tons burden each. Several other vexatious restrictions were imposed on them; and, to prevent any traffic with the interior of Peru, a custom-house was established at Cordova del Tucuman, where a duty of fifty per cent. was levied upon all imports. This custom-house was also designed to prevent the transmission of the precious metals from Peru to Buenos Ayres, even in payment for mules furnished by the latter city. By an order of 1622 this permission was prolonged for an indefinite period; and, with a view to promote the prosperity of the country, a royal audience was established at Buenos Ayres in 1665.

Under such a miserable system of policy, it is not surprising that the provinces of the Rio de la Plata languished in indigence and obscurity. But the resources of so extensive and fertile a territory could not remain for ever concealed. As the population and wealth of the country increased, the continual remonstrances of the people at last opened the eyes of the Spanish government to the importance of the colony, and a relaxation took place in the system of commercial monopoly, which had hitherto been rigorously adhered to. Indeed the absurd restrictions had been followed by their natural consequence, smuggling; and to such a height was the contraband trade carried, that, in order to put a stop to it, the government of Castille gave permission to register ships to sail under a license from the council of the Indies at any time of the year. The flota which hitherto had embarked from Spain once a year, and was the only legitimate means of communication with America, dwindled away from 15,000 to 2000 tons of shipping; and in 1748 it sailed for the last time to Cadiz, after having carried on the trade of Spanish America for two centuries. The register-ships now supplied the market with European commodities at a cheaper rate and at all seasons of the year; and from that time Buenos Ayres gradually rose into importance. Other relaxations in the mercantile system followed soon afterwards. In the year 1774 a free trade was permitted between several of the American ports; and this was subsequently followed by additional liberties.

The improvements which took place in Buenos Ayres by this enlargement of its commercial relations were frequently interrupted by circumstances which carry us back to an early period of its history. The Spaniards and Portuguese have, by a singular coincidence, been destined to be rivals, not only in the Old, but in the New World. The neighbouring territory of Brazil belonged to Portugal, and bitter hostilities frequently took place between the two countries. It is computed that, in the hostile incursions which the Brazilians made into the Spanish possessions in this quarter of America, they destroyed upwards of four hundred towns and villages. These marauders, born of Portuguese, Dutch, French, Italian, and Brazilian women, were called Mamelucos. Their principal object was to carry into slavery the Indians whom the Jesuits had partially civilized; and in exercising their inhuman trade they committed the most horrid enormities. It is asserted, that in one hundred and thirty years two millions of Indians were slain or carried into captivity by the Mamelucos of Brazil, and that more than one thousand leagues of country, as far as the river Marañon, were almost depopulated. It may well be believed that the settlements of the Rio de la Plata did not escape the same cruel devastation. But it does not appear that the acts of these marauders were authorized by the government which they professed to obey; for repeated decrees were passed in favour of the oppressed Indians. These, however, were seldom or never observed; and governors and others, who profited by the captivity and sale of the native tribes, winked at the traffic. But the rivalry and animosity of the Portuguese were productive of other evils besides those consequent on hostile incursions. We have alluded to an extensive contraband trade, originating, in the first instance, in the blind policy of Spain. This was chiefly carried on by the Portuguese, who were enabled, by means of the immense and thinly-inhabited territory of the Banda Oriental, to organize a system of smuggling which ultimately almost annihilated legitimate commerce. But the government having gained over Artigas, one of the most daring of the contrabandists, were at length enabled, with his assistance, to crush the illicit trade, and to put an end to the atrocities which it had inflicted on the country.

In the year 1778, the provinces of the Rio de la Plata, Paraguay, Tucuman, Los Charcos, and Chiquito, were erected into a viceroyalty, of which Buenos Ayres was constituted the capital. At the same time it was thrown open to free trade of every description, even with the interior of Peru; and such was the effect of this wholesome measure, that the number of vessels trading with South America was at once augmented from fifteen to one hundred and seventy. They kept gradually increasing from year to year; and, in 1796, sixty-three vessels from Old Spain alone arrived in the single port of Buenos Ayres, with cargoes valued at nearly three millions of piastres; and fifty-one sailed from it for the mother country, fourteen to the Havannah, and eleven to the coast of Africa. The value of the exports was about five millions and a half of piastres, including upwards of four millions in gold and silver. During the war which broke out between Great Britain and Spain, the trade of this colony suffered severely; indeed for a time it was all but annihilated. Immense quantities of hides and other native productions, pent up in the warehouses of Buenos Ayres and Monte Video, were allowed to rot, there being no outlet for them; whilst at the same time many kinds of European goods rose to exorbitant prices, or were not to be procured at any cost. This situation of affairs afforded the people of the United States of North America an opportunity of carrying on a contraband trade, by which the inhabitants of the provinces of the Rio de la Plata were supplied with European commodities; and this traffic was connived at by the Spanish government. The fortune of war, however, in a few years placed Buenos Ayres for a short time in the hands of the British, and an end was put to the trade with the great western republic.

In the year 1806, a British squadron, under the command of Sir Home Popham, appeared in the Rio de la Plata. From this armament a body of troops was landed, for the purpose of taking the capital. The British force was small, but, by the culpable negligence of the viceroy, the Marquis de Sombre Monte, who does not appear to have made any attempt to defend this important city, General Beresford accomplished his object on the 26th of June. This rash and unauthorized enterprise was fortunate in the first instance, but exceedingly disastrous in its issue. The viceroy having retired to Cordova, Don Santiago Liniers, a Frenchman in the service of Spain, put himself at the head of all the troops he could collect on both banks of the Plata, and on the 12th of August attacked the city at several points. So vigorous and successful was the assault, that the British general and his troops were compelled to surrender themselves prisoners of war. The disgraceful retreat of the viceroy having completely alienated from him the esteem of those over whom he ruled, they accordingly stripped him of his authority, and made the most strenuous efforts to obtain the office for Liniers, but without success. He was covered with honours, but a new viceroy arrived from Spain. Never was there a more favourable opportunity for these provinces entirely throwing off the yoke of the mother country; but no spirit of revolt existed in the country. The fact is, that, at the period of this invasion, Spain nowhere possessed more faithful subjects than those who peopled the banks of the Rio de la Plata. There cannot be a doubt, however, that this successful repulse of an enemy common to both, taught the people of Buenos Ayres "a deep lesson;" and it ought to be regarded as the first step to that revolution in which the power of Spain in America was completely overthrown.

In the mean time, British reinforcements arrived from the Cape of Good Hope, whence the original expedition had sailed; and Sir Home Popham, after making an unsuccessful attempt on Monte Video, took Fort Maldonado, at the mouth of the river Plata. But the intelligence of the first capture of Buenos Ayres was so well received by the British public, that government resolved on maintaining possession of the banks of the Plata; and an armament was therefore fitted out for effectually reducing the country. The first body of troops, which were commanded by Sir Samuel Auchmuty, enabled the British to undertake the conquest of Monte Video, which was carried by storm in February 1807. In May following, General Whitelocke arrived at the head of a formidable force; and about a month afterwards these were joined by a further reinforcement under General Crawford. The army now amounted to 8000 men, and the chief command was confided to General Whitelocke, a man destitute alike of courage and ability. The reduction of Buenos Ayres was now resolved upon; but if the British had acquired sufficient local and political knowledge of the country, they would never have attempted the conquest of that city. The attacking army sailed up the river, and, disembarking below the capital, marched towards it, but met with a reception which was little anticipated. The inhabitants of Buenos Ayres had made every preparation for a desperate resistance. The streets were intersected by deep ditches, defended by cannon, and the windows and house-tops were thickly planted with armed men. No sooner had the British troops begun to penetrate the streets in columns, than they were assailed by grape and musketry, under which they perished in great numbers, without being able to retaliate on the citizens. The cool, determined valour of the troops, and the heroic energy of the leaders of the several columns, were exerted in vain. About one third of the British army was either killed, wounded, or taken prisoners, without any material advantage having been gained. In these circumstances, it would have been madness to persist in such a mode of operation; and next day an armistice was concluded. A convention followed, the terms of which were, that the British should evacuate the possessions on the Plata in two months, and that all prisoners taken on both sides should be restored. By this capitulation, Monte Video, which might have been safely maintained against any enemy, and which would have afforded a secure dépôt for our manufactures, was also lost.

But the events which were now passing on the continent of Europe were destined to change completely the aspect of affairs in South America. The unprincipled invasion of Spain by Napoleon in 1808 had placed that country in a situation extremely critical. Ferdinand VII., in concert with the emperor, had intrigued to wrest the sceptre from the feeble hands of his father; the French everywhere overran the Peninsula, and numerous petty juntas were formed. These began to extend their authority to the colonies, and despatched several mandates to the New World, demanding implicit obedience to the resolutions which they contained. As far as possible, the provinces of the Rio de la Plata conformed to their dictates, and sent money and supplies of various kinds to repel the attempts of the French, a nation peculiarly offensive to them.

Whilst the public mind at Buenos Ayres was thus kept in a state of excitement by the aggression of Napoleon, the transfer of the court of Lisbon to the Brazils inspired the princess regent of Portugal with the ambition of establishing herself in a similar manner at Buenos Ayres. Her father and her brother having at Bayonne renounced their right to the crown of Spain, she despatched emissaries to La Plata to assert her contingent claim, and to concert measures for her residence in the capital. Her proposals were received with enthusiasm, not only by the people, but also by the most influential persons of the country. But when her projects were on the point of being crowned with success, they were rendered abortive by the arrival, in May 1809, of the viceroy Cisneros, who, having touched at Monte Video in ascending the river Plata, there concerted measures with the governor-general, Elio, who, like himself, was a staunch supporter of the rights of Ferdinand. In the mean time Napoleon, having turned his attention to the colonies of Spain, had, like the princess already mentioned, sent an emissary to Buenos Ayres to gain over the inhabitants. Liniers, whom the course of events had brought prominently forward, is said to have secretly favoured the interests of France; but he was deposed from all authority, and banished to Cordova. In no instance was Napoleon successful in seducing the American colonies from

La Plata.

La Plata.

Spain, although it is perfectly evident that the doubtful nature of their allegiance, thus brought palpably before them, was well calculated to afford a plausible pretext for their adopting measures to secure their own individual independence, should circumstances hold out a well-grounded hope of success. These were not long in arriving.

Cisneros, the new viceroy, exerted himself to the utmost to fulfil the orders of the court of Madrid, and to close the ports of the Plata against British traders, who, in spite of reiterated prohibitions, continued to land their goods. An intelligent native of the name of Don Mariano Moreno addressed a pamphlet to the viceroy, demonstrating the necessity of re-modelling antiquated institutions, no longer compatible with national prosperity. The enlightened views of Moreno, though strongly opposed by the privileged merchants of Cadiz and Buenos Ayres, were generally favoured by his countrymen, and the necessity of a relaxation of the prohibitory system, as the only means of replenishing the exhausted treasury, at length compelled the reluctant acquiescence of Cisneros.

From this period the principal supporters of the Princess Carlota changed their views, and formed plans of ultimately setting up the standard of independence. After some political struggles, they succeeded in deposing the viceroy, and, on the 25th of May 1810, named a *junta gubernativa*, composed of nine members, with Don Cornelio de Saavedra as their president, and Dean Funes and Don Mariano Moreno as their secretaries.[1]

Moreno, the secretary, possessing a genius fitted for the times, became the life and soul of the new government. As the eyes of the people in the provinces were opened to the daring nature of the step which had been taken, the authority of the junta became more and more circumscribed, and was soon reduced to the limits of Buenos Ayres. Monte Video did not recognise it at all. As the port of this city contained a naval dépôt, there were there concentred a greater number of civil and military officers, who, being Spaniards, immediately took alarm, and decisive measures were adopted to prevent the heresy from spreading beyond the limits of Buenos Ayres, if not to crush it there. But the Creoles viewed the matter very differently. They assembled at the municipality, and unanimously resolved that it was expedient to join the party in the capital. But this wise resolution was rendered abortive by the precaution of the governor, Elio, and by the address and intrigue of an individual, Dr Obes by name, whose ambition was the original cause of the misfortunes which befell the Banda Oriental. He succeeded in drawing over many of his countrymen to his own views; and ultimately an answer was transmitted to Buenos Ayres, the purport of which was, that the Monte Videans could not give in their allegiance to an authority not appointed in a legitimate way by the nation. But Moreno was nothing dismayed by this intelligence, and his measures became more decisive as the emergency increased. He succeeded in expelling the viceroy and the oidores from the country; and had not the junta itself become infected by schism, such a man at the head of affairs would have soon brought matters to an issue. It became impossible for the junta to exist in its then disjointed state. Moreno and his party withdrew; and he having accepted a mission to England, unfortunately died on his passage.

The people of Buenos Ayres having so far succeeded in establishing their independence, considered themselves powerful enough to proselytize in the provinces. A division of patriots under Ocampo was sent against Cordova, where a formidable faction opposed to the new order of things had been organized by Liniers; and this leader was taken prisoner and shot, along with several other influential persons. Such severe measures, however, not harmonizing with the moderate views of Saavedra and the junta, Ocampo was recalled, and the chief command intrusted to Don Antonio de Balcarce. The history of La Plata is now for some years closely interwoven with that of Upper Peru. In September 1811 the junta gubernativa at Buenos Ayres was dissolved, and Saavedra the ex-president compelled to fly. An executive was thereupon vested in the hands of a triumvirate, Don Manuel Sarratea being its head. Monte Video still stoutly maintained the sinking cause of Spain; the effort was unavailing. Twice the soldiers of the fortress, in attacking the soldiers of Buenos Ayres, were driven back. In one of these the noted Artigas displayed his characteristic heroism, and at the head of his brave Gauchos performed prodigies of valour in the patriot cause. But he had long displayed symptoms of insubordination. About this period he withdrew from the command of Rondeau, and, in acting independently, evinced ever afterwards great dislike to the inhabitants of Buenos Ayres. In October 1812 another change was effected in the government, and in the January following a sovereign constituent assembly was convened at Buenos Ayres. It was not until now that the Spanish flag and cockade were abolished, and replaced by the bicolor. Now also the coinage bore the republican arms. The assembly elected an executive consisting of three individuals, and Don Carlos Alvear was chosen president of the assembly. But this form of government was as short-lived as any that had preceded it. On the 31st of December 1813 it was abolished, and Señor Posadas was elected supreme director of the republic, with a council of seven to act along with him.

Monte Video, which still held out for the mother country, was soon afterwards taken, when between 5000 and 6000 royalist troops laid down their arms, and an immense quantity of military stores was likewise given up. But the refractory Artigas, who had assumed the title of chief of the Banda Oriental, demanded possession of the place, which being refused, he in a short time took it by force, and retained possession of the fortress until a Brazilian army ejected him in the year 1817. The mutations and changes which the government of Buenos Ayres underwent we need not follow; and the civil dissensions by which the country was afflicted are equally endless and uninteresting. In 1816 a new congress met at Tucuman, which named Pueyrredon director of the republic; in July it declared the countries on the Plata independent, and, having transferred its sessions to Buenos Ayres, issued a declaration,[2] containing a list of twenty-eight articles. This remarkable document describes the cruelties which the united provinces of the Rio de la Plata, as well as other parts of America, had endured, whilst under the yoke of Spain, and the motives which led them to shake it off.

The republic now assumed the title of the United Provinces of South America, and on the 3d of December 1817 it proclaimed a *reglamento provisorio*, as preliminary to a constitution. The congress chosen in compliance with the *reglamento* was opened in February 1819, and on the 25th of May the new constitution was published; but it afterwards underwent many important changes. It was on the model of that of the United States, and secured personal freedom and equality, liberty of conscience and of the press, and the right of suffrage. The country, however, still continued in a disturbed state, and these troubles were increased by the intrigues of France and Austria to impose upon the natives of Buenos Ayres a Bourbon or an Austrian prince; but the latter were happily defeated by the good sense and patriotism of the people, notwithstanding the anarchy which had reduced them to the brink of destruction. To enumerate the factions which successively got the upper hand at Buenos Ayres, or to describe their various intrigues to maintain themselves in power, would be to draw a most disgusting picture of the reign of anarchy. Numerous successive governors seized upon office, and retained it but for a few weeks, and in some instances for a still shorter period. These rapid changes were generally preceded by sanguinary struggles, and followed by banishments and proscriptions; but in no instance was confiscation of property resorted to, so far had public opinion wrought an improvement. In October 1833 an attempt was made to effect a revolution in Buenos Ayres, and in June of the year following the government resigned spontaneously. The internal provinces were as usual the theatre of petty dissensions and skirmishes. In March 1835 the chamber elected General Don Rosas governor and captain-general of the province of Buenos Ayres for five years; giving him extraordinary powers, whilst he was at liberty to resign whenever he might judge fit, and only restricting him in one point, by obliging him to maintain and uphold the Catholic religion. The peace of the republic was disturbed throughout the year by petty insurrections, and by an attempt in the province of Tucuman to foment a revolution in favour of the Unitarians; but it was completely put down, and during the year 1836 the republic remained in a comparatively tranquil state. It is worthy of record, that on the 4th of December Spain acknowledged the independence of La Plata, and of all the other provinces in America which formerly belonged to her. Since then, up to the present time (1838), no event of any moment has occurred, with the exception of a declaration of war against Peru; but a peace was concluded between the two powers before any blood was shed on either side.

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[1] Memoirs of General Miller, vol. i. p. 60.

[2] *Manifestacion historica y politica de la Revolucion de la America*, Octr. 25.

Boundaries and extent.

La Plata is situated between 20° and 38° or 39° of south latitude, and between 55° 36′ and 71° of west longitude. Its extreme length is about 1400 miles, and in breadth it varies from 500 to 800. It is bounded on the north by Bolivia; on the east by Paraguay, Uruguay, and the Atlantic Ocean; on the south by Patagonia and the Atlantic Ocean; and all along its western limits, the lofty ranges of the Andes separate it from Chili. In the north-west, the eastern declivities of the Andes project a considerable way forwards, so that this district, which comprises the provinces of Salta, Tucuman, Santiago, Mendoza, San Juan, Rioja, and Catamarca, is a high and rugged table-land. All the rest of La Plata constitutes one continuous plain, perhaps the most extensive and uniform in the whole world. The geology of this country presents little variety, and almost nothing that is interesting. Rocks are seldom seen, except in the mountainous region. Some gypsum occurs in the vicinity of Buenos Ayres, and limestone is said to occur in several places. The stones used in paving the streets, or in building, are brought from the island of Martin Garcia, at the mouth of the Uruguay, or as ballast in vessels from Europe.

Rivers.

Of the rivers, the principal is that which gives name to the region. The country, however, is traversed by several other large streams, the general bearing of which is to the south-east. Passing over the Pilcomayo, the Bermijo or Rio Grande, and the Salado, which have been described in the articles Paraguay and Parana, the next in importance is the Saladillo. The course and extent of this river are very imperfectly known. It appears to rise in the mountainous parts of Cordova, and after traversing the province of Buenos Ayres, it falls into the sea at Rosas, in the bay of Samborombon. The Tercero, which also rises in the province of Cordova, and falls into the Parana, has been proved to be navigable for barges as high as the Pass of Fereira, about thirty leagues below the city of Cordova.

Considerable light has recently been thrown on the hydrography of the southern portion of the Argentine Republic, by the publication of a journal kept by La Cruz, a Chilian gentleman, who, in the year 1806, undertook the command of an expedition which had for its object the discovery of a more direct means of communication between the southern provinces of Chili and Buenos Ayres, than the old one by Mendoza. An abridged account of the hydrographical facts which have resulted from this expedition we shall give in the language of an able writer.

" As we retrace his (La Cruz's) route, proceeding from east to west (from the frontiers of Buenos Ayres towards the Andes), the first considerable body of water which we meet with is the Desaguadero of the Diamante, in the middle of the continent, fifteen leagues north of the lake in which it terminates, and which is many leagues farther south than has been hitherto supposed. We next find, at a very short distance, the Chadileubu, which rises in the cordillera of Melalgué, and flows into the Desaguadero. Proceeding some leagues farther, we come on the Cobuleubu, or Rio Colorado, making a bold circuit eastward through the Pampas, as it descends from the Andes near Maulé, before it turns southwards to the sea. As we approach the Cordillera, we arrive at the Cudileubu and the Neuquen, the latter receiving the Tocoman and Reinguileubu, all considerable rivers, the united waters of which, under the name of Mucum-leubu, flow southwards into the Rio Negro. The Neuquen and Cobuleubu both appeared to him to be navigable downwards from the place where he crossed them.

" Respecting the Limayleubu, which La Cruz frequently made the object of his inquiries, the accounts of the Indians were positive and distinct. All concurred in stating it to be the greatest river with which they were acquainted on the eastern side of the Andes; that it was nowhere fordable, and that it received the Neuquen, Cudileubu, and all the other rivers of the Eastern Andes northwards to the sources of the Rio Colorado. It issues, according to them, from a beautiful lake called Alomini, of great size; for the cacique Manguel had travelled a day and a half along its shores. It is situated between the Cordilleras Miguen and Quenuco, and has an island in the middle of it. The river Limayleubu is small at first, but is soon swelled by the accession of a great many streams, of which the last in order, as named by the Indians, is the Naguelguapi. This river springs, they said, not from a lake, but from a morass of the same name. Besides the lake Alomini, the Indian chiefs also knew a lake called Guechulauguen, situated farther south, and the waters of which flow into the Limayleubu."[1]

This account differs somewhat from those which were previously given by Falkner the Jesuit and others, and which have found their way into all geographies, and vitiated all maps, thus giving rise to extreme confusion. The conclusions to be deduced from the statements of La Cruz we give in the language of the writer just quoted.

" Thus it appears to us to be clearly established that the main branch of the Rio Negro rises in the lake Alomini, situated in the Cordilleras, east of Villarica; and that, issuing thence under the name of Limayleubu, and being joined by numerous streams, among others by the Naguelguapi, mentioned by Falkner, it soon becomes a great river, of considerable width, and nowhere fordable. It afterwards receives the Cariguenague, coming from the north, and lower down, the Mucumleubu, itself a great river; the numerous tributaries to which were crossed by La Cruz.

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[1] Edinburgh Review, No. cxxxi. p. 101–2.

The latter river is evidently the Sanguel, or Reed River of Falkner. These united waters proceed southwards a short way, till, meeting the southern branch of the Rio Negro, they turn eastward to the ocean."[1]

Lakes. Numerous rivers take their rise in the eastern declivities of the Andes, and, after irrigating considerable tracts of country, are either absorbed by the soil or flow into inland lakes. Amongst these may be mentioned the Rio Dolce, which originates in the lofty mountains of Tucuman, and, after watering the capital of the same name, passing near Santiago del Estero, capital of the province so named, and traversing Cordova, is lost in a salt lake situated in that province, and called " lagunas saladas de los Porongos." Lakes are distributed over the whole expanse of the Pampas, and some of them are of considerable size, one in Entre Rios being one hundred miles in length; but they cannot be said to correspond in grandeur to the other features of this region. The soil is almost everywhere impregnated with fossil salt; and the water of most of the lakes and pools is brackish and disagreeable to the taste. So plentifully is this saline matter distributed, that whole tracts of country are covered with its efflorescence. But a want of water is universally experienced; for, notwithstanding the number of lakes and inferior rivers, many of them disappear during the dry season. A growth of rushes overspreads their bottoms, serving as lairs for the pumas, who lie in wait for the cattle that, perishing of thirst, fly to the green stagnant water which lies on the marly surface, is as thick as refuse oil, and swarms with myriads of mosquitos.

Soil. The soil of this vast territory is a rich mould, perfectly free from stones, not one being seen on its surface for many hundred miles together. Though an uninteresting level, devoid of picturesque scenery, it is divided into regions different in climate and in produce. On leaving Buenos Ayres, and proceeding in a westerly direction, the first of these regions is covered for the space of 180 miles with clover and thistles, or artichokes; the second region, which extends for 450 miles, produces grass; and the third, which reaches the base of the cordillera, is a grove of low trees and shrubs. The first region varies in a striking manner with the seasons of the year. In winter the leaves of the thistles are large and luxuriant, and the whole surface of the country has the rough appearance of a turnip field. The clover in this season is extremely rich and strong, and amongst it the wild cattle graze at liberty. In spring the clover disappears, the leaves of the thistles droop along the ground, and the country has still the appearance of a rough crop of turnips. But in less than a month the whole region becomes a luxuriant wood of thistles in full bloom, and reaching ten or even eleven feet in height. Summer, however, is not over before another change takes place. The thistles suddenly lose their verdure and sap, their heads droop, the stems become black and dead, and being levelled by the pampero or hurricane, they are rapidly decomposed, when the clover rushes up, and all again becomes a sea of verdure. The second and third of these regions present nearly the same appearance throughout the year; for the trees and shrubs are evergreens, and the immense plain of grass only changes its colour from green to brown. Not a weed is to be found throughout its vast extent; and over its ever-verdant and luxuriant surface innumerable herds of cattle range at large. The region of wood is equally remarkable. The trees are not crowded; but in their growth such beautiful order is observed, that the traveller can gallop between them in every direction.[2]

Climate. The tropical climate which prevails in the northern districts disappears more and more towards the south, so that snow and ice are not unknown. Upon the east coast the air is humid; rain, thunder, and violent storms are not unfrequent; but in the western district the atmosphere is so free from vapour, that at mid-day the planet Venus is often distinguishable in the heavens, and the drought is so great that dead bodies are actually parched into mummies. The climate of the Pampas is subject to a great difference of temperature in winter and summer, although the gradual changes are very regular. The winter is about as cold as November is in England, and the ground at sunrise is invariably covered with white frost; but the ice is very thin. In summer the sun is oppressively hot; and not only is manual labour suspended during the middle of the day, but even the wild horses and cattle are exhausted by it. The only great irregularity in the climate is the pampero, or south-west wind, which sweeps these plains with a velocity and a violence which it is impossible to withstand. These periodical visitations, however, produce beneficial effects, the weather being particularly agreeable after they have exhausted their fury; and, taken as a whole, the Pampas may be said to enjoy as beautiful and as salubrious an atmosphere as the most healthy parts of Greece and Italy, and without being subject to malaria. With regard to humidity, the atmosphere is not uniform at places under the same latitude. In the provinces of Mendoza and San Luis, or in the regions of wood and grass, the air is very dry, and there is no deposition of dew at night. But in Buenos Ayres a considerable quantity of moisture prevails in the atmosphere, probably from the vicinity of the place to the ocean.

Productions. The productions are gold and silver, copper, tin, lead, and iron (of which large masses are often found), saltpetre, selenite (which is used instead of glass for windows and lanthorns), marine salt, barrero (a loam impregnated with salt, and greedily devoured by sheep and oxen); and there are also numerous mineral springs, besides the saline lakes already mentioned, from which salt can be procured. In some parts of La Plata there are wooded tracts consisting of palms, cedars, and other trees; but from the Rio de la Plata to the Straits of Magelhaens, as well as throughout the most part of the Pampas, we find neither tree nor shrub. Of fruits there are sugar, vines, and others; of grains, wheat and maize are especially cultivated; melons, pumpkins, beans, potatoes, and vegetables of all sorts, are raised; as also rice, manioc, and a shrub resembling aloe, from the fibres of which ropes and cordage are made; ricinus, earth almonds, flax, hemp, rhubarb, indigo, vanilla, ipecacuanha, tobacco, cotton; monkshood, with which the Indians poison their arrows; St John's wort, capaiva, and others.

Animals. This country has long been celebrated for the abundance of its cattle, oxen, horses, sheep, goats, asses, mules, and swine. The horses are both wild and tame, and the number of them, as well as that of the cattle, is immense. The inhabitants of the Pampas who superintend the herds are called *Gauchos*, an account of whom will be found in the article Buenos Ayres. Amongst the wild animals may be mentioned many species of large wild cats, the jaguar, cougar, chibi-guazo; puma, which may be said to represent the lion in the new world; different kinds of pole-cats, the zorillo, tajassu, tapir, armadillo, marten, wild dog, guanaco; chameleon, sometimes of an enormous size; monkey, deer, hare, rabbit, elk, rigua; many species of serpents, as the boa, rattlesnake, great water-serpent, viper, adder; crocodile, mosquito, wasp, ant, and so on. Amongst the birds of this country may be mentioned the white raven, the gold-coloured sparrow, the partridge, as large as a domestic fowl, the ostrich, pigeon, wild turkey, goose, and some others. There are seven kinds of bees, of which several produce honey that has a very considerable, and sometimes alarming effect, when taken in large quantities. Of fish there are sea-bream and gold-fish; crawfish, perch, shad; whales and seals, which yield train oil and fish-bone for exportation; sharks, eighteen thousand of their skins being annually exported; and turtles.

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[1] Edinburgh Review, No. cxxxi. p. 103.

[2] Rough Notes taken during some rapid journeys across the Pampas and among the Andes. By Captain F. B. Head

Inhabitants. The inhabitants present the same national diversities here as in the other states of South America. Their number has been variously estimated at from half a million to nearly three millions; a sufficient proof of the uncertainty which prevails regarding the exact amount of the population of La Plata. In the Weimar Almanack for 1838 they are stated at 2,024,995, viz. Creoles of Spanish descent, 600,000; Mestizoes, 600,000; Indians, " fideles," 800,000; negroes, 25,000. Of aboriginal Indians there are numerous nations; but, as will be seen, the whole do not comprise a population at all commensurate with the varieties of distinct tribes. The Indians of the Pampas are said not to exceed eight or ten thousand souls.

La Plata consists of the following provinces, most of which have a capital city of the same name: Buenos Ayres, Cordova, Entre Rios, Corrientes, Catamarca, Mendoza or Cuyo, Rioja, Salta, Santiago del Estero, Santa Fe, San Juan, San Luis, Tucuman, and Tarija. Missiones is sometimes reckoned a province of La Plata, but it now belongs to Paraguay. Buenos Ayres, the capital, having already been described, we shall pass on to the other provinces.

Cordova. Cordova is bounded on the north by Santiago, on the south by the Indian territory and Buenos Ayres, on the east by Santa Fe, and on the west by San Luis. It extends about 110 leagues from north to south, and about the same distance from east to west. This is a fine province, the soil being rich and fertile, and well irrigated. It is pretty thickly set with trees, possesses excellent pasturage, and abounds in fine clover. Cordova, the capital of the province, is picturesquely situated in a deep valley, beside a river surrounded by mountains, in lat. 31. 15. south, long. 62. 40. west. It was founded in 1573, and became a place of considerable importance in the time of the Jesuits. In 1804 and 1810 attempts were made to render the river Tercero, which passes near Cordova, navigable from this point to its junction with the Parana; but the commerce of the country was too limited, labour too dear, and overland carriage too easy and cheap, to render this an eligible speculation, so that the attempt was abandoned. The population of the whole province has been estimated at 315,000.

Entre Rios. Entre Rios is situated between the two great rivers Parana and Uruguay, and is bounded on the north by the province of Corrientes, and on the south by Buenos Ayres. It possesses several peculiar advantages, and is one of the most fertile and pleasing provinces in the whole republic. Embraced on all sides but one by the two great rivers just named, it is easily accessible by shipping; and being thus insulated, it is protected from the incursions of the Indians. It is copiously irrigated, and the soil is distinguished for its fertility. Wood is abundant, but small in size. The pastures are extensive; but the wild cattle, which formerly abounded, are much reduced in number. There are two small towns in the province, each of which is dignified with the name of city; one is Badaja, opposite to Santa Fe, on the Parana, the other is Villa del Arroyo de la China, on the Uruguay. Farther south, and nearer to Buenos Ayres, there are two other towns, called respectively Gualeguay and Gualeguaychu, but they are still smaller than the two former. The great natural advantages of Entre Rios must ultimately raise it into a place of considerable importance. At present the population is computed at 105,000.

Corrientes. Corrientes is situated to the north of Entre Rios, and forms a continuation of that province, being also situated between the rivers Parana and Uruguay. On the north it is bounded by the state of Paraguay. It has an average breadth of about two hundred miles, and its length may exceed that, though the boundary line between it and Entre Rios has not been laid down with accuracy. The territory of Corrientes is intersected by several rivers, some of which are navigable for a considerable distance. Besides the celebrated lake Ybera, there are in the province numerous sheets of water, by which it is rendered one of the most fertile countries on the face of the globe. Corrientes, the capital, is admirably situated on the banks of the Parana, near its junction with the Paraguay. It is a very ancient city, but the population is inconsiderable. That of the whole province is estimated at 140,000.

Santa Fe. Santa Fe is situated between the river Parana and Cordova, which constitute its boundaries on the east and the west. On the south it is bounded by Buenos Ayres, and on the north by Santiago del Ostero. This fertile country is irrigated by numerous rivers, some of which are of considerable size. The chief employment of the inhabitants consists in the breeding of vicumras and horses, the skins of which animals are conveyed to Buenos Ayres. Santa Fe, the capital, is situated on the western part of the Parana, at about eighty leagues from Buenos Ayres, and has risen to importance by becoming a dépôt for goods on the river. The inhabitants of the town amount to about 4000, and those of the province to about 52,500.

San Luis. San Luis is bounded on the east by the provinces of Buenos Ayres and Santa Fe, on the west by Mendoza, on the south by the territory of the Pampas Indians, and on the north by Cordova. This province is reckoned about a hundred leagues in extent from north to south, and from fifty to sixty in breadth from east to west. The soil is uniformly productive, and the climate is salubrious, but the inhabitants are very indolent, and agriculture is not pursued to any extent. San Luis, the capital, is a very ancient town, and the only place of any importance in the journey between Buenos Ayres and Mendoza. It is situated in a fertile valley at the foot of a range of hills, and the entrance to it is through long lanes, having dead mud-walls on either side. The population of the town has been estimated at 15,000, and that of the province at 103,000.

Mendoza. Mendoza or Cuyo is a well-irrigated and fertile plain, bounded on the east by San Luis, on the west by the cordillera of the Andes, on the north by San Juan, and on the south by the Indian territory. From north to south it extends about a hundred and fifty leagues, and from east to west rather more than a hundred leagues. The inhabitants of this province are very industrious, and they raise wheat and maize for exportation. Their chief occupation, however, is the cultivation of vines and clover grass. A considerable quantity of wine is made, in which article an extensive trade is carried on, and also in brandy and dried fruits. One of the most productive branches of commerce is the transport of maté to the various provinces of the republic. Mendoza, the capital of the province, is a large town, situated in an extensive and well-cultivated plain at the foot of the Andes, between 32° and 33° of south latitude. Its most remarkable feature is a fine *alameda*, or public promenade, of great length and beauty. The town covers a considerable space of ground, as there is generally a vineyard, orchard, and garden attached to every house. The population of the city is estimated at 16,000. There are several other towns of some note, such as San Carlos, to the south, in the valley of Uco; Coricouto, to the east; and another in the same direction, eleven leagues from the city, called Los Barriales. Over the whole country there are numerous establishments and farms for breeding cattle and prosecuting various agricultural operations. The population of the entire province may be estimated at 103,335.

San Juan. San Juan is situated to the north of Mendoza, extending about a hundred and twenty leagues from north to south, and about the same distance from west to east, terminating, like Mendoza, at the foot of the Andes. The country is remarkably fertile, producing wheat, maize, olives, and vines, in abundance. The produce of the olive plantations is much esteemed in Buenos Ayres; but the natives direct their attention chiefly to the cultivation of the vine, which grows luxuriantly, and to the making of wines and brandies, which they export in large quantities as far as Potosi, Buenos Ayres, Santa Fe, and a great portion of the eastern side of the Rio de la Plata. The city of San Juan, situated in latitude 31. 15. south, and longitude 68. 35. west, was founded as early as 1560, and is consequently one of the most ancient places in the republic. It is now considered as the town which most closely follows Buenos Ayres in the march of social reform. The mines of gold and silver which were said to enrich this province have never yet been discovered. The population of the city of San Juan is estimated at 19,000, that of the whole province at 103,330.

Rioja. Rioja is situated to the north of San Juan, and also at the foot of the Andes. It is about one hundred and forty leagues in length, by nearly the same in breadth. Like the other provinces in this region, it is a mountainous table-land; and it shares with Mendoza and San Juan in the growth of vines, wheat, and maize. Rioja, the capital, is a small and unimportant city, situated in latitude 28. 30. south, and longitude 68. 35. west, two hundred and ninety leagues from Buenos Ayres. It contains about 3000 inhabitants; and the population of the entire province is reckoned at 87,500 souls.

Catamarca. Catamarca is a tract of country extending about one hundred leagues in length and nearly as much in breadth. It is situated near the foot of the Andes, under the twenty-eighth degree of south latitude, and is bounded by Tucuman and Salta on the north and east, by the Andes on the west, and by Rioja on the south. It consists of a mountainous table-land, but is noted for an extensive and fruitful valley, called the Valley of Catamarca. The temperature of this district is of the most genial description, and the country produces cotton of a very superior quality. The city of Catamarca is situated about sixty leagues south-east of Tucuman, in latitude 27. 45. south, and longitude 66. 0. west. It was founded more than a century and a half ago, and stands in the beautiful valley which bears its name. It contains about five thousand inhabitants. The other towns in this province are unimportant. The population of the whole province is estimated at 105,000 souls.

Tucuman. Tucuman, one of the most important and fertile provinces in the republic, is situated in the twenty-seventh degree of south latitude, having Salta on the north, and Santiago on the south and south-west, and extending fifty-eight leagues from north to south, and about fifty leagues from east to west. The rice which is called *de castilla* grows here in abundance, and is of a very superior quality. The other productions are, wheat, maize, ground pistachio-nuts, and tobacco, of which thousands of bales are exported to Cordova, San Luis, San Juan, Mendoza, and other cities. Fruits of various sorts are abundant; and potatoes here attain an enormous size. To the west of the city is a delightful mountain, of great height, from which sixteen rivers descend to fertilize and beautify the surrounding territory. These streams unite and form the river Santiago del Estero. Along all the lower parts of this mountain are immense clusters of trees, and amongst them many of bitter oranges. The city is surrounded by these woody tracts, which occupy a space of fifteen leagues. The trees sometimes attain an extraordinary size, and the timber is of the best quality used in America. Tucuman, the capital of the province, is a straggling city, situated in 26. 50. of south latitude, and 64. 35. of west longitude. The houses in general are of an inferior description; but the place is memorable from its having taken a distinguished part in the revolutionary struggle. The inhabitants, who amount to ten or twelve thousand, are described as hospitable, honourable in their dealings, of a mild disposition, and much inclined to labour. The other towns are Monteros, Suares, Chiquiligasta, Rio Chico, Francas, and Burroyaco, each of which constitutes a large parish, at the same time that it contains minor parishes. The population of the whole province is estimated at 140,000 souls.

Salta. Salta is situated to the north of Tucuman, and is of considerable extent. Its western part belongs to the great range of the Cordilleras, and is rich in metals. Here are found gold and silver, copper, iron of various qualities, sulphur, alum, vitriol; and there are also indications of the existence of tin and quicksilver. Many branches of mountains, off-shoots from the colossal chain of the Andes, extend into the province, from which proceed pleasant and beautiful valleys, intersected by numerous streams which irrigate and fertilize the country. In one of the intervals between the low collateral branches of the Andes is situated the capital. To the eastward of the city the country becomes flat, and continues so to the borders of the Bermijo and Parana. The city of Salta, the capital of the province, is situated in lat. 24. 15. south, and long. 64. 0. west, on the great road leading from Buenos Ayres to Lima by the way of Potosi. It was founded in 1582, and has long been a place of some consideration in this thinly-peopled region. The population amounts to about 9000 souls. The other towns in the province are Caldeva, Rosania de la Frontera, Rosario de Serrillos, Chicoana, Atua, and a few small villages. The population of the whole province is estimated at 140,000 souls.

Santiago. Santiago del Estero is situated between Tucuman and Cordova, being south of the former and north of the latter. It is of great extent in all directions, and is one of the most fertile of these provinces. Agriculture is the chief occupation of the inhabitants of Santiago. Wheat produces eighty fold, and it requires little or no aid from art to raise this heavy crop. All kinds of grain may here be brought to perfection, yet the inhabitants are slow to avail themselves of the advantages presented by nature. The city of Santiago, situated on the road to Bolivia through Cordova, in 27. 55. south latitude, and 63. 20. west longitude, is thinly peopled, and of little importance. The river Santiago runs close past it in its course to the great lake by which its waters are absorbed. The population of the whole province is estimated at 210,000 souls. This province, along with those of Tucuman and Cordova, are all bounded on the east by that vast territory called Grand Chaco, extending hence to the river Parana. It is the native country of the Abipones, and once contained 2,000,000 of aboriginal inhabitants. The Spaniards formed several establishments here, but their cruelties drew down upon them the vengeance of the Indians, who effected their extirpation. The inhabitants of the Grand Chaco, although now very much reduced in number, still retain their independence.

Tarija. Tarija is the most northerly province in the Argentine Republic, and consequently borders upon Bolivia, to which it in reality belongs, although politically it forms one of the provinces of the Rio de la Plata. It consists of a succession of charming valleys, with a delightful climate and a fruitful soil. Corn, maize, the yerba-maté of Paraguay, the cocoa, flax, and every necessary of life, are produced here in the greatest abundance. No part of America indeed seems to be superior to this district of Tarija; and the reason why it is so little known is, that, possessing no mineral treasures, and being inhabited merely by an agricultural people, the Spanish authorities never deemed it worthy of the slightest attention. To the south-east of this province lies Jujuy, which, in the event of Tarija being permanently united with Bolivia, will be erected into a province of the Argentine Republic; indeed some recent writers reckon it such already. It is of much the same character as Tarija, having a very prolific soil, and producing abundance of similar productions. There are some mines of gold in this territory, but they have not been worked to advantage. The city of Jujuy lies on the road from Buenos Ayres to Upper Peru, and is a very old place. The whole district contains from 50,000 to 60,000 inhabitants.

Executive power.

Don Juan de Rosas was in 1835 appointed dictator of the republic for five years. There are four principal ministers, one for each of the foreign, home, finance, and war departments. The state religion is the Roman Catholic, which is under the direction of four bishops. The Jesuits, who nearly three fourths of a century ago were expelled from this and other parts of South America, have been allowed to return.

The commerce of the country, the state of education, and its moral aspect generally, will be found described in the article Buenos Ayres.

According to official accounts from Buenos Ayres, the finances stood thus on the 7th of April 1836: Income, 11,727,446 dollars; expenditure, 8,439,165 dollars; surplus, 3,288,281 dollars. On account of the public debt, 7,747,000 dollars fall to be deducted, thereby giving rise to a deficiency, which was covered by the sale of 1200 leagues of the states land. It appears, however, that these accounts are little to be depended upon; for, according to the budget for 1837, the income was 12,000,000 dollars, and the expenditure 18,315,124 dollars, thus making a deficit of more than 6,000,000 of dollars. To cover these deficiencies, and wipe out the accumulated debt, it is proposed to obtain a native loan of 17,000,000 dollars. Altogether, the accumulated debt of the Argentine Republic amounts to 42,000,000 dollars.

Constitution.

The constitution of this federal republic has not yet been completely organized. The head state, the seat of the congress or legislative assembly, is Buenos Ayres. The number of senators amounts to forty-eight, and that of deputies to eighty-eight. The states are all at liberty to manage their own affairs, each having a governor, with subordinate functionaries. In all of them the principle of democracy is recognised, but practically it is more acted upon in some states than in others. Where the governor has great influence, either from his wealth or from other circumstances, he is frequently found to evince a distaste for legislative control. Occasionally, indeed, they openly avow themselves absolute; and as Buenos Ayres can exercise but a feeble authority over those provinces which are situated far in the interior, they are not always called to a strict account of their stewardship.

In conclusion, it may be observed, that the union of the provinces forming this republic is far from being perfect. They exercise too much individual independence, and are too jealous of each other, and of the capital in particular, heartily to entertain common views for the general good. They are as yet but weakly cemented together, and a long period will elapse before they are fused into one homogeneous mass. This is no doubt in part owing to their being spread over a vast extent of country; but, when communication between distant parts becomes more easy and frequent, which it will be when the rivers are rendered properly navigable, so as to facilitate commerce, then a more complete amalgamation of the whole may confidently be anticipated. (R. R. R.)

PLATÆÆ, in *Ancient Geography*, the name of a strong town in Bœotia, which from its situation was exposed to the north wind. It was burned to the ground by Xerxes; and it was famous for the defeat of Mardonius the Persian general, as also for the signal victory of the Lacedæmonians and other Greeks under Pausanias the Lacedæmonian, and Aristides an Athenian general, in memory of which the Greeks erected a temple to Jupiter Eleutherius, and instituted games which they called Eleutheria. Platææ stood at the foot of Mount Cithæron, on the road to Athens and Megara, and on the confines of Attica and Megaris.

PLATFORM, in the military art, an elevation of earth, sometimes covered with planks of wood, upon which cannon are placed to fire on the enemy. On the ramparts there is always a platform, where the cannon are mounted. It is made by heaping up earth upon the rampart, or by an arrangement of madriers, rising insensibly, for the cannon to roll on, either in a casemate, or, on attack, in the outworks. All practitioners are agreed that no shot can be depended on unless the piece can be placed upon a solid platform; for if the platform shakes with the first impulse of the powder, the piece must likewise shake, which will alter its direction, and render the shot uncertain.

Platform, in *Architecture*, is a row of beams which support the timber-work of a roof, and lie on the top of a wall where the entablature ought to be raised.

This term is also used for a kind of terrace or broad smooth open walk at the top of a building, whence a fair prospect may be obtained of the adjacent country. Hence an edifice is said to be covered with a platform when it is flat on the top, and has no ridge. Most of the oriental buildings are covered in this manner, as were all those of the ancients.

PLATINA is a metallic substance, the name of which has an allusion to its colour. It is a diminutive of *plata*, and signifies little silver. From its great specific gravity, and other resemblances which it has to gold, it has been called *or blanc*, or white gold; from its refractory nature, *diabolus metallorum*; and from some doubts entertained of its character as a metal, *juan blanco*, white jack, white rogue, or white mock metal. It has also received the appellation of the *eighth metal*; and, probably from some district which affords it, has been called *platina del Pinto*.

PLATING is the art of covering baser metals with a thin plate of silver, either for use or for ornament. It is said to have been invented by a spur-maker, not for show, but for real utility. Till then the more elegant spurs in common use were made of solid silver, and, from the flexibility of that metal, they were liable to be bent into inconvenient forms by the slightest accident. To remedy this defect, a workman at Birmingham contrived to make the branches of a pair of spurs hollow, and to fill that hollow with a slender rod of steel or iron. Finding this a great improvement, and being desirous to add cheapness to utility, he continued to make the hollow larger, and of course the iron thicker and thicker, till at last he discovered the means of coating an iron spur with silver in such a manner as to make it equally elegant with those which were made wholly of that metal. The invention was quickly applied to other purposes; and to numberless utensils which were formerly made of brass or iron are now given the strength of these metals, and the elegance of silver, for a small additional expense.

The silver plate is generally made to adhere to the baser metal by means of solder, which is of two kinds; the soft and the hard, or the tin and silver solders. The former of these consists of tin alone, the latter generally of three parts of silver and one of brass. When a buckle, for instance, is to be plated by means of the soft solder, the ring, before it is bent, is first tinned, and then the silver-plate is gently hammered upon it, the hammer employed being always covered with a piece of cloth. The silver now forms, as it were, a mould to the ring, and whatever of it is not intended to be used is cut off. This mould is fastened to the ring of the buckle by two or three cramps of small iron wire; after which the buckle, with the plated side undermost, is laid upon a plate of iron sufficiently hot to melt the tin, but not the silver. The buckle is then covered with powdered resin, or anointed with turpentine; and, lest there should be a deficiency of tin, a small portion of rolled tin is likewise melted on it. The buckle is now taken off with a tongs, and commonly laid on a bed of sand, where the plate and the ring, whilst the solder is yet in a state of fusion, are more closely compressed by a smart stroke with a block of wood. The buckle is afterwards bent and finished. Sometimes the melted tin is poured into the silver mould, which has been previously rubbed over with some flux. The buckle ring is then put amongst the melted tin, and the plating finished. This is called by the workmen *filling up*.

But when the hard solder is employed, the process is in many respects different. Before the plate is fitted to the iron or other metal, it is rubbed over with a solution of borax. Stripes of silver are placed along the joinings of the plate, and instead of two or three cramps, as in the former case, the whole is wrapped round with small wire; the solder and joinings are again rubbed with the borax, and the whole is put into a charcoal fire till the solder be in fusion. When taken out, the wire is instantly removed, the plate is cleaned by the application of some acid, and afterwards made smooth by the strokes of a hammer.

Metal plating is when a bar of silver and another of copper are taken of at least one equal side. The equal sides are made smooth, and the two bars fastened together by wire wrapped round them. These bars are then sweated in a charcoal fire, and after sweating, they adhere as closely together as if they were soldered. After this they are flattened into a plate between two rollers, when the copper appears on one side and the silver on the other. This sort of plate is named *plated metal*.

French plating is when silver-leaf is burnished on a piece of metal in a certain degree of heat. When silver is dissolved in aquafortis, and precipitated upon another metal, the process is called *silvering*.

PLATO.

The birth of Plato is nearly coincident with that great epoch of Grecian history, the commencement of the Peloponnesian war. In the first year of that war, the Athenians, having ejected the unhappy people of Ægina, apportioned the island amongst colonists from themselves.[1] Amongst these Athenian occupants were Aristo, and Perictione. or Potona, as she is also called, the father and mother of Plato. Their residence, however, in the island was not permanent nor even long, as the intrusive colony was in its turn ejected by the Lacedæmonians, on which occasion his parents returned to Athens.[2] It was during this interval, and in the year 429 B. C., that the philosopher was born.[3]

From these circumstances, it has been commonly supposed that Plato was born in Ægina. They are not, however, sufficient to establish such a conclusion. For a colonization of the kind here described did not necessarily imply residence on the part of those persons to whom the lands were allotted.[4] Nor is the fact of the recovery of the island by the Lacedæmonians from the hands of the Athenians, mentioned by the contemporary historian. Ægina was still in the occupation of the Athenians in the fifth year of the Peloponnesian war;[5] and in the eighth year of the war we find that the poor exiles, who had meanwhile obtained a refuge at Thyrea, were there cruelly exterminated by the Athenians.[6] On the whole, it seems more probable, from the constant designation of Plato as "the Athenian," without any other addition, though this alone, it must be allowed, is not decisive of the fact, that Athens itself may claim the honour of having been his birthplace.

It is remarkable that his proper name was not that which his fame has immortalized, but Aristocles, after his paternal grandfather.[7] The name of Plato is said to have been given to him by the person who was his master in the exercises of the gymnasium, as characteristic of his athletic frame in his youth.[8] In this way, being familiarly applied to him, it gradually prevailed, to the entire disuse of his family name.

The philosopher was connected by descent with the ancient worthies of Athens; on his mother's side with Solon, and on his father's with the patriot king Codrus.[9] And thus, according to the notions of nobility prevalent amongst the Greeks,[10] he could trace up the honours of his parentage to a divine founder, in the person of the god Neptune.

A circumstance is related of his infancy, which, though obviously fabulous, cannot properly be omitted in his biography, as a pleasing and appropriate tribute of the imaginative genius of the Greeks to their poet-philosopher. Whilst he was sleeping when a babe, on Mount Hymettus, in a bower of myrtles, during the performance of a sacrifice by his parents to the muses and nymphs, bees, it is said, lighted on him and dropped honey on his lips, thus giving an evident augury of that peculiar sweetness of style by which his eloquence would be distinguished.[11]

For the same reason, a similar fancy, which has thrown a poetical ornament over the account of his first devotion to philosophy, must not be passed over in silence. Socrates, it is related, was apprized beforehand, in a dream, of the first visit of the gifted pupil, who was destined to carry philosophy forth on the wings of his genius to its boldest flights. Socrates was telling his dream to some persons around him, how he seemed to see a young swan coming from an altar in the grove of Academus, and first nestling in his bosom, then soaring up on high, and singing sweetly as it rose in the air, when Aristo presented himself, leading his son Plato, whom he committed to the instruction of the sage. Socrates, it is added, struck by the coincidence, immediately recognized the fulfilment of his dream, and welcomed Plato as the young swan from the altar, represented to him in the vision.

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[1] Thucyd. ii. 27.

[2] Diog. Laert. in *Vit. Plat*

[3] Diog. Laert in *Vit. Plat.*

[4] Thucyd. iii. 50.

[5] Thucyd. iii. 72.

[6] Ibid. iv. 56, 57.

[7] Aristocles was also a Spartan name, being the name of the brother of the king Pleistoanax. Thucyd. v. 17.

[8] As derived from πλατυς, *broad*. Laertius gives this explanation, which Seneca also adopts (*Epist.* lviii. 27), but says others interpreted the name as denoting a broad forehead; others, as characteristic of his style of eloquence.

[9] His family also is shewn to have been of rank, from its connection with some of "the Thirty," called "the Thirty Tyrants," established at Athens by the Lacedæmonians. See Plat. *Ep.* vii.

[10] See Herodot. *Euterp.* 143.

[11] Cicero, *De Divin.* i. 36.

The accounts of his early education, to which we should naturally have looked with great interest, are extremely meagre. We only know by general notices that he passed through the usual course of education adopted amongst the higher classes of the Greeks. That education was directed to the cultivation at once of the powers of the mind and of the body, under the two great divisions of literature and gymnastics. The youth was delivered to the charge of the grammarian, the teacher of music, and the trainer. From the grammarian he learned the art of reading and writing his own language, and a knowledge of its authors, especially its poets; from the teacher of music, skill in performing on the lyre and the flute, together with the principles of the science of music; from the trainer he acquired strength and expertness in the several exercises of wrestling, and boxing, and running, by which it was intended not only to mature the powers of the body, but to qualify the youth for attaining eminence at the public games. These were the schoolmasters of the accomplished Athenian, and with these he was occupied until he had reached about his twentieth year. Accordingly, the names have been transmitted to us of those who discharged these offices for Plato; of Dionysius, as the grammarian under whom he learned the elements of that command over his own language, and its literary resources, which his matured eloquence so richly displayed; of Draco of Athens, and Metellus of Agrigentum, as his masters in music; and of Aristo the Argive, as his master in gymnastics. It is added that he also studied painting; but the name has not been given of any individual who acted as his preceptor in the art.

In evidence of his great proficiency in these early studies, it has been stated, that he gave specimens of his genius in every department of poetical composition; that in epic poetry he laboured after the highest excellence, and only abandoned the attempt on comparing his efforts with the poems of Homer, and despairing of reaching so high a standard; that in dramatic poetry, he had prepared a tetralogy, the four plays usually required of an author in order to competing for the prize at the festival of Bacchus, but changed his purpose only the day before the exhibition, in consequence of impressions received from Socrates. And even in gymnastics excellence has been claimed for him; since it has been asserted that he actually entered the lists at the Isthmian games.

Whatever credit we may give to these particulars, there can be no doubt, that so inquisitive a mind as that of Plato, and so resolute a spirit in the prosecution of its undertakings, received the full benefit of this preliminary culture; and that he was thus amply prepared for entering on the severer discipline of those pursuits which engaged him when he became a hearer of Socrates.

This preliminary education, in fact, was very imperfect as a discipline of the mind. It gave the youth a forwardness and fluency of knowledge, so that he was fain to fancy himself, when he had scarcely attained manhood, equal to undertake affairs of state, and to serve the highest offices of the government. But it did not form his mind or character. He had yet to learn the nature of man; to study the principles of ethics and politics. This task of instruction devolved on the sophist or the philosopher (as the same person was at first indifferently called), into whose hands the Greek youth was now delivered.

Plato, accordingly, at the age of twenty years, began to be a regular attendant on the lessons of Socrates. The reputation of Socrates as a teacher in this higher walk of education, now eclipsed that of all other professors of philosophy. He had at once exposed the incompetence of the sophists who preceded him, and superseded them in their office. Plato would be conducted to him by his father, as the account states he was, very much in the way which is depicted under caricature by the comic poet,[1] as to the most distinguished master of the day, to be qualified for taking on him those public duties to which every citizen of Athens might be called; to enable him to distinguish himself in counsel and argument, and obtain influence and importance in society. From the numbers that resorted to Socrates, as well as to the sophists before him, it is plain that, to obtain instruction in philosophy for its own sake, or to become philosophers themselves, was not the object with which he was sought by the generality. Here and there the spark fell on a kindred genius, and lighted up a flame of philosophy in the breast of a disciple. Thus from the school of Socrates came the founders of several other schools; and, on the whole, a greater impulse was given by his teaching to the study of philosophy than had ever been felt before in Greece. Still, as Socrates himself did not profess to teach his hearers wisdom, so neither did they in general come to him as learners of wisdom, or as actuated by the pure love of wisdom, but to acquire practical information which their previous studies had not given them. We may imagine such a disciple as Plato first presenting himself amongst the multitude of hearers; how he would be struck by the first observation of the extraordinary manner of Socrates, especially at finding the very person to whom he came to be taught professing that "he knew nothing;" and that he was only wiser than other men on this account, that, whilst others knew not and presumed they knew, he neither knew nor presumed that he knew. The interest of such a mind as Plato's could not but be powerfully called forth by so strange an avowal on the part of a man whom he had been led to look up to as the wisest of men. To him it must naturally have prompted the questions, what philosophy might be; what the nature and condition of man; what the criteria of truth and falsehood; and thus have firmly laid hold of those tendencies to speculation which we see fully developed in the mature fruits of his genius. Again and again he is present at the searching investigations carried on in the discussions of which Socrates is the leader; soon he is himself interrogated by Socrates; and we cannot doubt that he is thenceforward irrevocably become, not the disciple of Socrates only, but the disciple and votary of philosophy.

That Plato was thus won over to philosophy from an early period of his life, is evident from the statement of Aristotle respecting him, that "from his youth he had been conversant with Cratylus, and the opinions of Heraclitus,"[2] and from the indications in two at least of his dialogues (and these supposed to be the earliest in the date of their composition, as written indeed during the lifetime of Socrates), the *Phædrus* and the *Lysis*, of his early acquaintance with Pythagorean notions.

There seems, too, but little room to doubt that he had begun at the same time to study the doctrines of the Ionic school under Hermogenes, as well as those of Parmenides and Zeno. For what he puts into the mouth of Socrates in the *Phædo*[3] respecting Anaxagoras, is probably (as Socrates himself was known to have had a strong aversion to physical science) the expression of his own disappointment and dissatisfaction at the outset of his studies, in the conclusions of the school, of which Anaxagoras was then the chief authority. Of Parmenides, again, he more than once speaks in terms of enthusiasm, as of a name with which he had very early associations of reverence;[1] here, as in the instance of Anaxagoras, we are disposed to think, depicting, in the person of Socrates, a portion of the history of his own mind.

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[1] Aristoph. *Nubes.*

[2] Aristot. *Metaph.* i. 3.

[3] *Phæd.* pp. 220–225, ed. Bip.

Judging indeed from the tenor of his writings, we should conclude that his curiosity was excited, from a very early period, to explore the whole field of philosophy; and that, so far from resting on what he learned from Socrates himself, he applied the lessons of Socrates to the extending and perfecting those researches which he was carrying on at the same time, by means of books, or oral instruction from others.[2] Socrates was to him the interpreter, and commentator, and critic, of the various philosophical studies in which he was engaged. For this is the view which he has given us of Socrates in his Dialogues. Socrates there seldom or never appears as a didactic expounder of truth. He is presented as the critic of opinions and doctrines and systems, and the judge to whom everything is to be submitted for approval, or rejection, or modification, as the case may be.

Indeed, so exuberant and energetic a mind could not have been satisfied with being simply a learner in any school. It would eagerly seek the means of comparing system with system, and of examining into points of agreement or disagreement in the theories proposed. The doubts raised by Socrates, the hints thrown out by him, the conclusions to which he pointed, but which he yet left unconcluded, would to such a mind seem as so many points of departure for its own excursions. They naturally suggest that much more must be done than merely to take up what has been said by Socrates, in order to work out, or even rightly to conceive, what had fallen from his lips. For the conversations of Socrates were not framed to convey positive instruction, so much as to set the mind of the hearer a-thinking, and to provoke further inquiry. In the living pictures of them which Plato has drawn, they leave off just at the point where we expect the teacher would proceed to speak out more distinctly, and tell us precisely what his view of the subject is. If these pictures represent (as we may reasonably believe they do) the impressions received by Plato from the conversations of Socrates, what stimulants to inquiry must he have felt in the several particulars which he has so forcibly touched,—in the mingled lights and shadows of the scenes in which the great master occupies the foreground. Well therefore may we conceive that, at the time when he enjoyed the guidance, and control, and encouragement of Socrates, he was laying a broad foundation of erudition for that vast and richly-ornamented fabric of philosophy which the existing monuments of his genius exhibit.

From Socrates himself this demand of the inquisitive hearer could evidently not be supplied. Socrates was deficient in erudition properly so called. He had studied men rather than books. His wisdom consisted of deep and extensive observation accurately generalized, drawn from passing things, and capable accordingly of ready application to the same course of things; forcibly convincing his hearers by the point and propriety with which it met each occasion, and giving experimental proof of its soundness and truth. Erudition, accordingly, was to be sought elsewhere; and Plato therefore supplied this need from other sources, infusing it into, and blending it with his own speculations, whilst the Socratic spirit mellows the whole mass, and gives unity to the composition.

The death of Socrates, his tears over which Plato has recorded in that affectionate and interesting memorial of his master's truth and dignity, the Dialogue of the *Phædo*, naturally excited alarms for their own safety amongst those who were conspicuous disciples of the martyred sage. They saw, by the violent extremity to which the spirit of intolerance had proceeded, unchecked by any feeling of humanity or regard for truth, that the wisdom, and gentleness, and benevolence of an enlightened philosophy were no securities against the deadly hatred of bigotry. They found that the malignant tongue of priestcraft could stoop to employ any instrument, however mean, for the accomplishment of its purpose; that it could instigate the actor on the scene of civil affairs to do its work of sycophancy, whilst the prompter of the mischief, lurking in ambuscade, wore the mask of concern for the public good, and even arrogated the merit of sanctity, and truth, and tenderness. Persecution has ever been the same. Its essential features are vices of the human heart, not of any particular system of religion. We find it, accordingly, in several recorded instances in the heathen world, displaying itself very nearly as in the dark times of anti-Christian corruption. Athens itself had already furnished examples of its untiring and sure vengeance. In particular, the case of Anaxagoras had been a striking illustration. When not even the power and the eloquence of Pericles could save Anaxagoras from a prison, and expulsion from Athens, on account of his physical speculations; the very philosopher whose system of physics raised an insuperable barrier against atheism, by demonstrating the supremacy of mind; it was but too evident that there was a mysterious agency working in the heart of society, like secret fires in the depths of the earth, capable of awing and paralyzing every other power.

A more recent experience of the same truth, within the memory of the youngest disciple of Socrates, was in the dark proceedings consequent on the mutilation of the Hermæ, the rude images of Mercury erected in the vestibules of private houses as well as in the sacred places of Athens, and on the discovery of the profanation of the Eleusinian mysteries by the mock representation of them in private houses.[3] The secret information on which those proceedings were carried on; the indifference shewn at the period of alarm to everything else, even on an occasion of great public interest, but the vindication of the popular superstition; the effect which the charge of being implicated in these outrages had in checking the career of Alcibiades at the moment of his triumph over his political opponents; all shewed, that it was a vain hope to resist the secret arbiters of public opinion on questions of religion. Then came the fearful consummation of this vengeance in the death of Socrates by the poisoned cup; leaving no doubt in the minds of any, that they who would follow his example in boldly and honestly inquiring into current opinions, and declaring their convictions of the truth on matters affecting the conduct of men, must either prepare themselves for exile (which alone was a great punishment in the ancient world),[4] or drink the hemlock.

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[1] Μελισσον μεν και τους ἀλλους οἱ ἑν ἑστως λεγουσι το παν, αἰσχυνομενος μη φορτικῶς σκωπτωμεν, ἧττον αἰσχυνομαι, ἢ ἑνα ὀντα Παρμενιδην. Παρμενιδης δε μοι φαινεται το του Ὁμηρου, αἰδοιος τε μοι εἶναι ἁμα δεινος τε· συμπροσεμιξα γαρ δη τῷ ἀνδρι, πανυ νεος, πανυ πρεσβυτῃ· και μοι ἐφανη βαθος τι ἐχειν πανταπασι γενναῖον. (*Theætet.* pp. 137, 138. *Parmenid.* p. 72.)

[2] This evident early devotion of Plato to the pursuit of his whole life, argues the mere calumny of that statement which represents him to have at first sought his fortune by the profession of arms. The calumny is a current one, which has been applied to other philosophers. He has also been absurdly represented as present at the battles of Tanagra and Delium, when he was, in truth, a mere child.

[3] The performance of religious rites in private houses is forbidden in Plato's Dialogue on Laws, x. p. 117.

[4] Cicero says of exile, endeavouring to reconcile the feelings to it, "jam vero exilium, si rerum naturam, non *ignominiam nominis* quærimus, quantum demum a perpetua peregrinatione differt." (*Tuscul. Quæst.* v. 37.)

Socrates himself had the courage to take the latter part of the alternative. To him it was the natural termination of that energetic course which he had from the first adopted. He would have unsaid all his teaching; he would have practically recanted the strong language in which he had, through all his life, been discoursing of the worthlessness of the body and of the present life, and of the immortality and perfection of the soul. His philosophy kept him immured in his prison, and riveted the fetters on his limbs, far more than the condemnation of his judges or the hammer of the jailor. For, as he says of himself in the words in which Plato has naturally expressed his sentiments in the prison, his "sinews and bones would long ago have been at Megara or in Bœotia," had he not thought it "best," and firmly fixed his resolution, to abide the issue there.[1]

But this was not the case with the hearers of Socrates. They were not, like him, placed in a commanding post, from which they could not retreat without being stigmatized as deserters of their profession, and betrayers of the truth. They might with honour and propriety consult for their safety. Whilst, therefore, as is probable, the bulk of those who had attended on the teaching of Socrates simply withdrew from public notice, and retired to their homes at Athens or elsewhere, the principal disciples of the school, —those who were most known as followers and admirers of Socrates,—left Athens, and sought an asylum for themselves and for philosophy at Megara.

Amongst those whom Socrates drew around him were several individuals of mature age, already trained in some sect of philosophy, and eminent in their own walk of science, yet desirous of availing themselves of the far-famed wisdom of the sage of Athens. Of this class was the philosopher Euclid, from whom the Megaric school derives its existence and celebrity.[2] As a disciple he belonged to the Eleatic school, and, trained by Zeno, the great master of dialectic before him, had made that science his especial study. He had shewn a singular zeal in attending on the lessons of Socrates; for he continued to go to Athens for that purpose, even when the obnoxious decree of exclusion against Megareans, on pain of death, had been passed by the Athenians; setting out at night-fall on a journey of more than twenty miles from Megara to Athens, and assuming the disguise of female attire that he might pass unnoticed.[3] His conduct on the occasion of the dispersion of the school of Socrates corresponded with this zeal. He received the members of the school with open arms, and gave them a home with him at Megara. There, for a time at least, they gathered themselves, in shelter from the storm which had driven them from Athens. But the school, in fact, was broken up. It had subsisted and been held together by the personal influence of Socrates himself, and with him its principle of vitality, as a body, was gone. He had not laboured to establish a sect or a theory; and he left therefore no particular rallying point, or symbol of union, around which a party might be formed. He was himself the symbol of union to his disciples; bringing together around him the professors and disciples of every different sect. There was yet to arise out of his society one who, richly imbued with his doctrine and method, should rekindle the extinct school with his own spirit, and bid it live again in its genuine offspring; and that individual was Plato. But the times were not yet ripe for this.

In the mean time Plato was destined to spend several years in journeying from place to place, at a distance from the past and the future scene of his philosophical labours. These were doubtless years of great importance to him, for the perfect formation of the peculiar character of his philosophy. In the course of them, we find him visiting Megara, Cyrene, the Greek settlements on the coast of Italy, Sicily, Egypt, "exploring (as Cicero says of him in oratorical language) the remotest lands,"[4] after the manner of Solon and Pythagoras, and other wise men before him, who had enlarged their minds by contemplations pursued in foreign travel. Thus did he singularly combine in his studies the more ancient with the Socratic mode of philosophizing. The method of Socrates was exclusively domestic. He studied mankind within a small compass (the circle of Athens itself), only with a more accurate and searching eye than any one had ever done before him; and therefore drew sound general conclusions from his observations within that range of view. He evidently judged it better thus to restrict the attention, and require men to investigate closely what lay before them, than to encourage them to indulge the prevailing habit of more diffusive and vague observation. This is told us in other words by Plato himself, where he introduces Socrates as a stranger even to the beautiful scenery in the immediate neighbourhood of Athens, and as one who appeared never to have been out of the walls of the city; and as owning that, in his fondness for study, he was content to learn of the men in the city, who could teach him what the fields and the trees could not.[5] But this method, good as a foundation, and necessary as a corrective of desultory and superficial habits of thought and study, was not sufficient for the requirements of Plato's mind. He observes in one of his works that there is much to be gained from contemplation rightly directed in foreign travel both by land and sea; that we are not only to look to our own country for examples, but seek in the world at large for specimens of the highest order of men, which, though rare, might, from time to time, be found under every form of government; and that no perfect civilization can be attained without this means of observation and improvement.[6] He describes, in fact, the course which he had himself pursued, and the benefit which he had found resulting from it.

Having sojourned for a time at Megara, together with the other disciples of Socrates, and probably there, with the assistance of Euclid, increased his acquaintance with the writings of Parmenides and Zeno, as well as studied more intimately the dialectic of their school, he appears to have proceeded to Cyrene. Cyrene was the home, not only of Aristippus, to whose school it afterwards gave its name; but of the venerable Theodorus, the most eminent geometrician of his day. Theodorus had been occasionally a resident at Athens, and an attendant on the teaching of Socrates, whilst he was himself resorted to by the Athenian youth for instruction in the science of geometry.[7] Plato no doubt had been amongst those who had thus availed himself of the presence of Theodorus at Athens. His predilection for mathematical studies is conspicuous throughout his writings. His skill in geometry, in particular, requires no other evidence than the interesting fact of his ready solution, in that infant state of the science, of the oracular problem which required the doubling of the cubic altar at Delos.[8] He has described Theodorus as present at Athens at the time when the prosecution was instituted against Socrates.[1] He now went to Cyrene, probably with the view of following up that course of geometrical study which had been so abruptly terminated; whilst he regained also the society of a friend for whom he evidently felt respect and admiration.[2]

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[1] See *Phædo*, p. 224; also *Crito*.

[2] Euclid the mathematician flourished about a century after him.

[3] Thucyd. i. 139; Aul Gell. *Noct. Att.* vi. 10.

[4] Ultimas terras lustrasse Pythagoram, Democritum, Platonem, accepimus: ubi enim quid esset quod disci posset, eo veniendum judicaverunt. (*Tusc. Qu.* iv. 19.)

[5] *Phædr.* p. 287; *Crito.*

[6] *De Legib.* xii. p. 196, 197.

[7] Plat. *Theætet.* p. 51, 52.

[8] Plutarch. *De Socrat. Genio*, p. 288, tom. 8, Reiske. The inscription said to have been over the portal of the Academia, "Let no one enter who is not a geometrician," seems to belong rather to Pythagoras, or perhaps was imitated from the Pythagoreans.

The course of his travels conducted him to the Greek settlements on the coast of Italy and Sicily, where the colleges of the Pythagoreans were established. It may readily be imagined with what eager curiosity Plato undertook this voyage, what delight he promised himself in seeing the place itself where Pythagoras had taught, and in personal conference with the living successors of the mystic sage, and in obtaining a greater insight into the doctrines of a school which had such charms for him. He had much to observe also in the peculiar discipline by which the Pythagoreans were formed into a distinct fraternity amongst themselves. Greece Proper had nothing to exhibit like this. For though the different sects of philosophy were distinguished there by the names of founders and places, they were not held together by any rules of discipline. But the Pythagoreans at Tarentum, Crotona, and elsewhere in Magna Græcia, had incorporated themselves into synedria, or colleges; each individual giving his property in common, and regarding the bond of connection with his brethren of the sect as closer than the ties of kindred.[3] Associations of this kind must have appeared, at the first, as anomalies even to the philosophical Athenian, accustomed as he was to regard the free intercourse of social life as indispensable to his very existence.

It has been said that Plato was admitted to the secret discipline of the Pythagoreans. Probably he was only received by them with great cordiality, and had access to writings and information respecting their doctrines, which would have been denied to one, who came less recommended to them by the sincere enthusiasm of philosophy, and approximation to their views. There are no traces certainly in his writings, or elsewhere, of his having been a professed Pythagorean; although he undoubtedly was greatly captivated by the Pythagorean doctrines, and has introduced them largely into his own speculations.

Archytas, the greatest name of the Pythagorean school after that of Pythagoras himself, was then flourishing at Tarentum. It must have been an interesting occasion, when there were assembled together at Tarentum, as Cicero relates,[4] Pontius the Samnite, the father of that Pontius who defeated the Roman consul at the Fauces Caudinæ; Archytas the Pythagorean, discoursing against pleasure; and Plato the Athenian. The very place where they met,—a point of contact between the old empires of the world, and the rising power destined to break them in pieces,—in itself adds to the interest. Then the characters of the two philosophers who thus met, further arrest our attention:—Archytas, the representative of the old traditionary theological systems now moulded into a scheme of philosophy and a discipline of life; and Plato, the accomplished artist, who was soon to take up the scheme of philosophy where the Pythagoreans left it, and consecrate it by the inspirations of his own genius to an eternal empire on the throne of literature:—Archytas, nurtured in the reserve and mysticism of the Pythagorean discipline; Plato, formed to busy and importunate discussion by the ever-colloquial Socrates,—two philosophers so contrasted with each other in many respects, and yet so concordant in their love of ancient wisdom and indefatigable research after truth.

From the Pythagoreans Plato proceeded to Egypt to converse with the priests of that ancient land, from which Greece had derived her original civilization and science. Since the settlement of the Greek colony in Egypt by Psammetichus,[5] there had existed a regular channel of intercourse between Greece and Egypt, and accurate means of information to the Greeks respecting Egypt. The history of Herodotus must in itself have awakened the curiosity of those who had any taste for such inquiries, to know still more of a people from whom Greece had already learned so much, and from whom evidently so much was to be learned; and must have stimulated them to avail themselves of the existing facilities of gratifying that taste. To Plato, indeed, if we take the testimony of Herodotus, that the Greeks, though they had endeavoured to appropriate the discovery, derived the doctrine of the immortality of the soul from the Egyptians (who were the first, he thinks, to teach the doctrine, accompanied with that of transmigration),[6] a visit to Egypt must have been most attractive. Herodotus has given us an engaging view of the impression which such a visit produced on his mind. What an animated picture might the still more philosophical mind of Plato have presented, of the result of his conversation with the priests of Egypt. Though we may not credit the account of his having had the mysterious wisdom of the Hermetic Columns unfolded to him by the priests, and of his being instructed in magic,[7] on this occasion; we have intimations of the treasures which he collected in Egypt scattered through his writings, and, so far, some evidence that this visit was not without its influence on the character of his philosophy.

Indeed it has been further asserted, that, whilst in Egypt, he had access to an existing Greek version of the Old Testament, and that to this circumstance we must attribute that purer and more elevated theology which his works exhibit, in comparison with those of other heathen philosophers. A strange oversight in chronology has also attributed to him a personal intercourse with the prophet Jeremiah.[8] These statements are obviously mere suppositions, by which Christians, over-zealous for Plato's philosophy, vindicated their admiration of it, whilst they asserted also the originality and supremacy of Scripture truth. At the same time, it is indisputable that Judaism diffused much religious and moral truth beyond its own pale; and that not only Plato, but the Egyptian priests, his instructors, unconsciously derived much from the inspired sources, in collecting, under the form of fable, or allegory, or maxim, portions of truth which the sacred oracles had scattered around them in their transmission.[9]

Having traversed Egypt, where he is said to have assumed the disguise of an olive-merchant, in order to journey more securely in a country not naturally tolerant of strangers, he purposed penetrating into Persia and India. But the disturbed state of those parts of Asia prevented his fulfilling his intentions. He returned accordingly to Magna Græcia, once more to enjoy the society of the Pythagoreans. At length, having spent several years in these travels, he turned his steps homeward. We have no means of ascertaining the exact time which these travels occupied, or at what period of his life precisely he undertook the office of teacher of philosophy at Athens. From the epistle addressed to the friends of Dion, it appears that he was scarcely forty years of age when he first went to Syracuse;[1] so that probably not more than about ten years were taken up in his wanderings.

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[1] *Theætet.* ad fin.

[2] See *Theætet.* throughout.

[3] See Plato, *Rep.* x. p. 293; Polyb. ii. 39; Aul. Gell. i. 9; Origen. *C. Cels.* ii. p. 67, iii. p. 142, ed Spenc.; Jamblich. *Pyth. Vit.* c. 17, p. 154.

[4] *De Senect.* c. 12. Cicero says Plato was at Tarentum in the consulship of L. Camillus and Appius Claudius. There appears some inaccuracy in the tradition, but we may believe its substantial truth.

[5] About B. C. 650. Herodot. *Euterp.* 154.

[6] Herodot. *Euterp.* 123.

[7] Pliny says that Plato went to Egypt for the purpose of learning magic. *Hist. Nat.* xxxi. c. 1.

[8] Quapropter in illa peregrinatione sua, Plato, nec Hieremiam videre potuit tanto ante defunctum, nec easdem scripturas legere, quæ nondum fuerant in Græcam linguam translatæ. (Augustin. *De Civ. Dei*, viii. 11.) Clement of Alexandria, however, asserts that there existed a version of the Law prior to that of the Septuagint. *Strom.* i.; Euseb. *Præp. Evan.* ix. 6.

[9] Hence it was said by Numenius the Pythagorean, τι γαρ ἐστι Πλατων, η Μωσῆς Αττικιζων, "What is Plato, but Moses in Attic Greek."

The visit to Sicily here referred to, had for its object to explore the crater of Mount Ætna, and therefore properly belongs to that part of his history which we have just been tracing. But it had also very important bearings upon the future fortunes, both of himself and many others; so important, indeed, that Plutarch, following out a remark which occurs in the supposed epistles of Plato, attributes it to a providential arrangement, in order to the restoration of liberty to the Syracusans.[2] For it was at this time that he became acquainted with the elder Dionysius, tyrant of Syracuse, and Dion, whose sister Dionysius had married. He reclaimed Dion, who was then quite a youth, from a life of vicious indulgence, to habits of sobriety, and inspired him with an ardent love of philosophy. Thus began an intimate friendship between the philosopher and Dion, which subsisted unimpaired until the tragical death of the latter.

Through the influence of Dion, the tyrant Dionysius, who was himself a literary man and a patron of literature, was induced to receive Plato into the circle of his court. The result, however, whether it was owing to the jealousy of other philosophers who were then at the court of Syracuse, or to an excess of freedom of speech in Plato, and an ebullition of temper and disappointed literary vanity upon the part of Dionysius, was unfortunate. Dionysius was affronted at some words that passed at an interview with him, and was only prevented by the interposition of Dion from slaying the philosopher at the moment of exasperation. But still he did not remit his displeasure; for on suffering him to depart, he instructed the Lacedæmonian ambassador, Pollis, in whose vessel he was to be conveyed from Sicily, either to slay him on the voyage or to sell him as a slave; observing sarcastically, "that being a just man, he would be equally happy though reduced to slavery." Pollis is said to have so far lent himself to this cruel treachery, that he actually caused the philosopher to be sold as a slave, by landing him at Ægina at a time when a decree was in force there, sentencing to death every Athenian who should set foot in the island. From this shameful indignity, however, Plato was immediately relieved by the generous kindness of Anniceris, a philosopher of Cyrene, who happened to be at Ægina at the time, and paid the twenty minæ, the price of his redemption. And such, it is added, was the noble concern which Anniceris felt for him, that he could not be prevailed on to receive back the money from the friends of Plato at Athens, but refused it, saying "that they were not the only persons interested in the welfare of Plato."[3]

The story is related with circumstantial particularity, and so far bears the aspect of truth. Still it has been questioned, as inconsistent with the character of Dionysius, who, though despotic in the power which he possessed, and often cruel in his use of it, was a man of education and courtesy, and the patron of literary men. And the treachery of Pollis, as thus exhibited, has been regarded as altogether unlikely in the high-minded Spartan. Nor again do we find any allusion in the writings of the philosopher himself to so affecting an incident in his life. The story may be thought still more improbable, if the account be true that Dionysius presented him with a considerable sum of money, with which he was enabled, during his residence in Sicily, to purchase a treasure inestimable to him, the books of Philolaus the Pythagorean. These arguments, however, may be pressed too far. Individuals possessed of absolute power have often been found capable of deeds from which their own feelings, apart from that great temptation, would have shrunk: and sudden and most unreasonable and absurd outbreaks of violence, inconsistent with their general behaviour, are characteristics of such power. And as for the Lacedæmonians, we know that at the height of their civilization they were guilty of the acts of barbarians. Their extreme cruelty to the poor debased Helots is well known;[4] and in the Peloponnesian war they slaughtered indiscriminately all whom they met with at sea, even neutrals, and persons inoffensively engaged in the business of commerce.[5] Further, there are repeated instances of Greeks selling as slaves the free inhabitants of captured cities in their wars with each other.[6] There is no reason, at any rate, to question the general truth of the story, whatever may be thought of the particulars. There can be little doubt that the visit of Plato at Syracuse ended unsatisfactorily; that offence arose between the tyrant and himself; that he was treated with great indignity, and that he returned to Athens in disgust.[7]

From this time we may contemplate him as pursuing, with little interruption, the course of philosophical labour for which his whole previous life had prepared him. The term "Academy" is now familiar to every one as synonymous with a place of learning. How strongly does this mark the celebrity of a school, which has thus immortalized in vernacular language the grove of the hero Academus or Hecademus, the ground on which Plato walked, and, as he walked, imparted to the throng around him the riches of his genius, and taste, and learning! Here, in the most beautiful suburb of Athens, the Ceramicus, Plato possessed a small patrimony, a garden, where he fixed his abode, in the immediate vicinity of the grove, his daily resort. Here, amongst the tall plane-trees which shaded the walks, were assembled, year after year, the master-spirits of the age, whether in pursuit of knowledge for its own sake, or for counsel in the direction of public or private life,—the philosopher, the statesman, and the man of the world,—to converse with the Athenian sage, and imbibe the wisdom which fell from his lips. What an interesting assemblage must that have been which comprized in it, amongst other influential persons, and young men who afterwards rose to importance in their respective states, Demosthenes, Hyperides, Aristotle, Speusippus, Xenocrates, Polemo, Dion! At once you might see in the throng the young and the gay by the side of the old and the sedate; the stranger from some distant town of Asia Minor, or Thrace, or Magna Græcia, and the citizen of Athens; the tyrant of some little state learning theories of government and laws from the philosopher of the republic; and the haughty Lacedæmonian paying deference to the superior wisdom of an individual of a country which his own had humbled in arms.[8] Nor was the audience exclusively of the male sex. The wives and daughters of Athenian citizens, indeed, were not in that assembly; for custom excluded these. But the accomplished courtezan, whom the unnatural exclusion of the chaste matron from social intercourse had raised to importance in Grecian society, was there, seeking the improvement of her mind by joining in the discussions and listening to the instructions of the philosopher, and thus qualifying herself for that part which she had to sustain as an intimate with the men of the highest rank and most intellectual cultivation in Greece. The celebrated Aspasia had been at once the intimate of Pericles, and a hearer of Socrates; and Plato himself pays her the compliment of saying, that both Pericles and Socrates had taken lessons in rhetoric from her, as a most accomplished mistress of the art; to whom, indeed, Pericles had been chiefly indebted for his eloquence.[1] So now in Plato's own school of the Academia were found, amongst others of the same class, the beautiful Mantinean Lasthenea, and Axiothea of Phlius.

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[1] B. C. 389. *Ep.* vii. p. 93, Bipont ed.

[2] Plutarch in *Dion*, tom. v. p. 262, Reiske.

[3] Laert. in *Vit. Plat.*

[4] Thucyd. iv. 80.

[5] *Ibid.*

[6] *Ibid.*

[7] The conduct of Dionysius towards Philoxenus, the dithyrambic poet, for freely giving his opinion on the bad poetry of Dionysius, was very similar. See Diodorus Siculus, xv. 6, who also, in xv. 7, confirms the account of this treatment of Plato.

[8] In the Dialogue "on Laws," it is the Athenian stranger who instructs the Lacedæmonian and Cretan in the theory of legislation. Here we have probably a representation of what actually was seen in the Academia itself. Socrates is away; Plato speaks; Cretans and Lacedæmonians, among others, are the auditors.

Socrates attracted persons around him from all parts of the Grecian world, by the charm of his engaging conversation, and thus became in himself a great object of interest.[2] Plato made Athens itself also, even more than his own person, an object of interest to the civilized world of his day; converting it, from being only the centre of political intrigue and agitation to the cities of Greece, into a common university and common home for all. Compare what was said of Athens about half a century before, "that it was the nature of Athenians neither to keep quiet themselves, nor to suffer other people to do so,"[3] and its well-known character at that time of a "tyrant state,"[4] with the respect which Plato had won for it, when it became, not through the versatility of its citizens, and its inexhaustible resources, but by a truer title, through the lessons of virtue and wisdom, which it freely imparted to all, pre-eminently the School of Greece;[5]—and what an exalted opinion does the change now operated give us of the influence of Plato!

Isocrates had, at the same time, his school of rhetoric overflowing with pupils. Aristippus, also trained in the school of Socrates, was inculcating his scheme of ethics, which maintained the theory of pleasure as the chief good. But esteemed as Isocrates was for the gentleness of his life, and his skill as a master of rhetoric; and acceptable as the doctrines of Aristippus must naturally have been to a corrupt society; neither of these great names sufficed to obscure the greater name of Plato, or could rival the pretensions of the Academia to be the great school of philosophy, and literature, and civilization.

A mind so intensely occupied as that of Plato, would scarcely find leisure for taking part in the political affairs of his country. The profession of philosophy was not as yet indeed become entirely distinct; but the teaching of Socrates had greatly tended to render it so. The rigorous method of interrogation which called forth the latent difficulties on other subjects, could not but produce great distrust in those who laid themselves fully open to it, as to their own ability to manage the complex matters of public concern, as well as impress them with despair of success in that walk of exertion. Socrates himself avoided as far as possible all interference in the politics of Athens. Plato strictly followed his example. Accordingly, we find, in several places of his writings, a contrast drawn between the philosopher and the man of public life; and an indirect apology for himself, as one who kept aloof from the public assemblies and the courts.[6] He betrays indeed strong disgust, not unmixed with contemptuous feeling, at the state of misrule into which the democracy of Athens had degenerated in his day, and he was evidently glad to avail himself of the plea of philosophy to absent himself from scenes so uncongenial to his taste. Doubtless, independently of any political bias, he was glad to escape from the sycophancy and tumult of the popular assemblies at Athens, and to enjoy the calm shades of his beloved retreat. This was the sphere of action for which nature and his whole previous life had peculiarly fitted him. Here he could effectually diffuse the salutary influence of his philosophy, in counteracting, in some measure at least, the selfishness of the world. Here he could maintain an undisputed supremacy over minds, which (such was the impatience of all authority in those times) no mere external power could have so entirely subjected to the direction of an individual.

Through the influence, however, of his Pythagorean friends, with whom he appears to have held constant intercourse, Plato was prevailed upon, at the age of sixty-five years, to quit the retirement of his garden for a time, and pay a second visit to Sicily.[7] It was the policy indeed of the Pythagoreans, like that of the Jesuits in modern times, to keep up an active intercourse with society, whilst in their internal system they cultivated philosophy with the ardour of exclusive devotees. Socrates wished to govern the conduct of men by an appeal to their reason; convincing them of their errors and follies, and leading them to seek the means of informing themselves aright. The Pythagoreans, like the Jesuits, aspired to carry out their views by a moral hold over men in society; by taking part accordingly in the management of states, and by a secret influence over those in power. The accession of the younger Dionysius to the throne of Syracuse, and the opening presented for producing an effect on him through Plato's influence with Dion, the next in power to the tyrant, were opportunities which would not be lost by their watchful zeal. Such seems, if we may proceed on the authority of the Epistles, to have been the occasion of this invitation of Plato to Syracuse. We see, at the same time, that there was a struggle of factions at Syracuse at this period. The party opposed to Dion, in order to counteract his influence, obtained the recall of Philistus, a man distinguished alike as a statesman, a commander, and an historian,[8] and a strenuous supporter of the existing government, but then in banishment through the ingratitude and caprice of the elder Dionysius. The result was, that though the reception of Plato at Syracuse was most flattering, for he was welcomed with the royal pomp of a decorated chariot, and the celebration of a public sacrifice, his mission was ultimately fruitless.

At first everything seemed prosperous. The change wrought in the manners of the court is described as marvellous. Philosophy became the fashion; and the very palace was filled with the dust stirred up by the number of geometricians. Even the expulsion of Dion, which soon followed, through the successful intrigues of his enemies, did not at once estrange Dionysius from the philosopher. He would not indeed allow Plato to leave Sicily with Dion; but, using a gentle constraint over him, detained him within the precincts of the citadel; shewing him at the same time all respect, and hoping at last, as it seems, to bring him over to his interest. At length the attention of Dionysius was called to preparations for war; and Plato, released from his embarrassing situation, was enabled to return to Athens.

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[1] Plat. *Menex.* p. 277.

[2] During the representation of "the Clouds," he stood up in a conspicuous part of the theatre to gratify the curiosity of the audience, many of them strangers visiting Athens at the festival, to see the philosopher who had attracted so much notice as to be personated on the stage. Ælian. *Var. Hist.* ii. 13.

[3] Thucyd. i. 70.

[4] *Ibid.* i. 124.

[5] *Ibid.* ii. 41.

[6] *Phædo*, p. 145; *Theæt.* p. 115, et seq.; *Gorg.* p. 82, et seq.; *Repub.* vi. p. 79; *Epist.* vii.

[7] Diogenes Laertius says, he went to Sicily on this occasion, in order to found a city according to the principles of his Republic, but that Dionysius failed in his promise of land and men for the purpose. But others, he adds, stated that the object of his visit was the liberation of the island from tyranny. In *Vit. Plat.*

[8] Cicero speaks of Philistus as a writer in the following manner: Philistum doctum hominem et diligentem. (*De Divin.* i. 20.) Catonem cum Philisto et Thucydide comparares? quos enim ne e Græcis quisquam imitari potest. (*De Clar. Orat.*)

He was not, however, deterred from once more making the trial, how far an impression could be made on the mind of Dionysius, and the restoration of Dion to his country effected; and, as on the former occasion, so now, he was chiefly induced to undertake the enterprise, by the earnest intercession of his Pythagorean friends. Dion himself was living at Athens, waiting the opportunity of returning to his country; and his relatives at Syracuse sent letters to Plato, urging him to use his exertions in behalf of Dion. Even Dionysius himself wrote a letter to him, entreating him to come, and promising satisfaction at the same time in regard to Dion. He also sent a trireme for him, with Archidemus, a disciple of Archytas, and others with whom the philosopher was acquainted, to render the voyage more agreeable to him.[1] For a while Plato persisted in declining the invitation, pleading his advanced age, for he was now sixty-eight years old;[2] but at length he gave way to these united solicitations. Dionysius, indeed, like his father, was fond of drawing around him men of eminence for literature and philosophy. At this time, amongst others of the same class at his court, were the philosophers Diogenes, Æschines, Aristippus, and some Pythagoreans. Plato might have not unreasonably hoped, therefore, that a mind delighting in such society, or at least ambitious of the reputation of being a patron of literature, might yet be influenced to sound philosophy. He was, besides, desirous of making an attempt to produce a reconciliation between Dionysius and Dion. Thus did he pass the Straits of Sicily a third time, to be a third time disappointed in the object of his voyage. Though he was welcomed, as before, with great splendour and demonstrations of respect, not only were his endeavours for the restoration of Dion unsuccessful, but he incensed the tyrant by venturing to intercede in behalf of Heraclides, a member of the liberal party at Syracuse, who was under suspicion of having tampered with the mercenaries. Still Dionysius was desirous of retaining the friendship of the philosopher. Plato was removed, indeed, from the garden in which he lived, under the pretence of a sacrifice about to be performed there by women, and placed in the quarter of the mercenaries. Such a situation was most unpleasant to him; as he could not but feel himself in danger amongst that lawless class, who naturally disliked him, as an enemy of the power which gave them employment and pay.[3] But this indignity was probably more the effect of the hostility of the opposite party against Dion, than an act of the weak tyrant himself. Plato, in his perplexity, applied to Archytas and the Pythagoreans at Tarentum, to extricate him from these difficult circumstances. At their instance, accordingly, Dionysius consented to the departure of Plato, and dismissed him with kindness, furnishing him with supplies for his voyage.

Thus did Plato once more return to Athens, heartily disgusted with the untoward result of his visits to Sicily.[4] Though the friend of Dion, the head of one great party at Syracuse, he had acted in Sicily consistently with his conduct at Athens, in not taking any active part in political affairs. Even Dionysius himself seems, throughout his conduct towards him, to have been jealous rather of his personal regard for Dion, than suspicious of any exertion on his part in the cause of Dion against him, and to have sought to detain him at Syracuse, not out of fear or ill will, but for the honour of the presence of the philosopher at his court. This is further evinced by the subsequent conduct of Plato. For, in the expedition which Dion planned and executed against Dionysius, he took no part; making answer to the invitation to join in it, "that if invited to assist in doing any good, he would readily concur; but as for doing evil to any one, they must invite others, not him."[5]

The remaining years of his life were gently worn away amidst the labours of the Academia. These labours were unintermitted to the very close of a long life; for he died, according to Cicero's account, in the act of writing; his death happening on the day in which he completed his eighty-first year. "Such," adds Cicero, "was the placid and gentle old age of a life spent in quietness, and purity, and elegance."[6] Another account, however, of his death states that he died during his presence at a marriage-feast.[7] And another account besides (evidently the invention of some enemy to his fame), attributes his death to a loathsome disease.[8] On his first residence in the garden of the Academia, his health had been impaired by a lingering fever, in consequence of the marshiness of the ground. He was urged to remove his residence to the Lyceum, the grove afterwards frequented by the school of Aristotle; but such was his attachment to the place, that he preferred it, he said, even to the proverbial salubrity of Mount Athos; and he continued struggling against the disorder for eighteen months, until at length his constitution successfully resisted it.[9] Adopting habits of strict temperance, he thus preserved his health during the remainder of his life, amidst the harassings of foreign travel, and the undermining assiduities of days and nights of study.

Plato was never married. He had two brothers, Glauco and Adimantus, and a sister, Potona, whose son, Speusippus, he appears to have regarded with peculiar affection and interest, as the destined successor to his school of philosophy. He inherited a very small patrimony, and he died poor, leaving but three minæ of silver, two pieces of land, and four slaves, and a few articles of gold and silver to the young Adimantus, the son, as it would seem, of his brother of that name.[10]

In person he is described as graceful in his youth, and, if the etymology of his name be correct, as remarkable for the manly frame of his body.[11] One circumstance, however, is mentioned, which detracts in some measure from his bodily accomplishments; the imperfection of his voice, which has been characterized as wanting in strength of tone.[12]

In regard to moral qualities, he was distinguished by the gravity, and modesty, and gentleness of his demeanour. He had never been observed from his youth to indulge in excessive laughter.[13] Several anecdotes are told of his self-command under provocation; as, for example, his declining to inflict the due punishment on a slave when he found himself under the excitement of anger.[14] A pleasing instance is given of his amiableness and modesty, at a time when his fame was at its height. Some strangers, into whose company he had been thrown at Olympia, coming afterwards to Athens, were received by him there with the greatest courtesy. All the while, however, they were ignorant who their host was. They merely knew that his name was Plato. On their requesting him to conduct them to the Academia, and show them his namesake, the associate of Socrates, they were astonished to find, by his smile and avowal of himself, that they had experienced so much unpretending kindness from the great philosopher himself.[1] Again, being asked by some one if there would be any saying recorded of him, he answered with the like modesty, "One must first obtain a name, and then there will be several."[2]

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[1] Plat. *Epist.* vii. p. 124.

[2] B. C. 361.

[3] Plutarch. in *Dion.*

[4] Μεμισηκως την περι Σικελιαν πλανην και ἀτυχιαν. (Plato, *Ep.* vii. 149, Bip. ed.)

[5] *Ep.* p. 149.

[6] Diog. Laert. in *Vit.* after Hermippus.

[7] *De Senect.* c. 5.

[8] Μυρωνιανος δ' ἐν Ὁμοιοις φησι, Φιλωνα παροιμιας μνημονευειν περι των Πλατωνος φθειρων, ὡς ὁυτως ἀυτου τελευτησαντος. (Diog. Laert. in *Vit.*)

[9] Ælian.

[10] Diog. Laert. in *Vit.*; Aul. Gell. *Noc. Att.* iii. 18.

[11] Erat quidem corpus validum ac forte sortitus, et illi nomen latitudo pectoris fecerat. (Seneca, *Epist.* 58.)

[12] ἰσχνοφωνος. Diog. Laert. in *Vit.*

[13] Diog. Laert. in *Vit.* after Heraclides.

[14] Diog. Laert. in *Vit.* Seneca *De Ira.* The anecdotes themselves can hardly be regarded as original. Similar stories are told of others, as of Archytas. Ex quo illud laudatur Archytæ; qui cum villico factus esset iratior, "Quo te modo, inquit, accepissem, nisi iratus essem?" (Cicero, *Tusc. Qu.* iv. 36.)

The gravity of his manner was by some interpreted as severity and gloom. The comic poet Amphis complained of him, that "he knew nothing but to look sad, and solemnly raise the brow." Aristippus charged him with arrogance. It is no wonder, indeed, that, in contrast with the coarse freedom of Diogenes, and the excessive affability of Aristippus, he should appear haughty and reserved. But that this character did not really belong to him, we may judge from the social humour which mingles even with the sarcastic touches of his Dialogues, and from the anxiety which he shewed to correct such a disposition as a fault in Dion. His favourite pupil Speusippus was distinguished by the opposite quality of a lively temper; and to his especial direction we find Plato sending Dion, that he might learn, by the conversation and example of Speusippus, a more conciliatory and agreeable mode of address.

The instance given of his vanity in putting himself forward at the death of Socrates, as competent to retrieve the great loss in his own person alone, bears evident marks of a calumny. It may be so far true, as it represents a desire upon his part to console his brother disciples under their common affliction. But as an evidence of an assumption of superiority over them at such a moment, it accords little with that feeling of dismay for themselves, under which he, in common with the rest, fled to Megara as an asylum; or with his indisputable affection for the person of Socrates, and veneration for his wisdom and talents.

Again, the strictness of Plato's philosophical profession, amidst the general dissoluteness of manners at Athens, was construed by some who had an envious eye on his reputation, as only an affected austerity. It was complained of him, that his life did not answer to the high requisitions of his moral teaching.[3] Two of his brother disciples in the school of Socrates, Antisthenes and Aristippus, imputed to him the grossest licentiousness. The former taking offence at Plato for objecting to a treatise, which he proposed to read, on the Impossibility of Contradiction, vented his spleen in a most abusive dialogue, which he entitled Satho, intending at once by that term a satirical play on the name, and a stigma on the character, of the philosopher. These calumnies are in some measure supported by the tenor of certain epigrams attributed to Plato, and by passages of his Dialogues, which display a license of impure allusion, shocking to the feelings of the reader, in these days at least. His calumniators then found occasion for their scandal, in observing amongst those by whom he was surrounded, the young and the handsome. But though we may see much to reprobate in such passages, and painful as the impression is which they leave on the mind, as evidences of the deep corruption of human nature, we are not warranted in regarding them as conclusive of corresponding immorality of conduct in a writer of his age and country. They shew, indeed, that the writer has not escaped the contagion of the vicious atmosphere which he breathed, and they are of course a great drawback in our estimate of the purity of his sentiments and character. But we ought to set off against them the high tone of religious and moral feeling which is the general characteristic of his philosophy; the beacon which it holds up to warn men of the debasing allurements of pleasure, and of the misery consequent on the indulgence of passion; and its glowing exhortation to seek for true happiness, not in externals, or by aiming at a mere human standard of virtue, but by internal purification, and by imitation of the perfections of the Deity.

Much has been said on the absence of any reference to Xenophon in the Dialogues of Plato. Xenophon, in his *Memorabilia*, has spoken of Plato, and alluded to the affection with which Plato was regarded by Socrates.[4] But Plato has not availed himself of any opportunity of paying the like compliment to Xenophon. This silence cannot, perhaps, be entirely accounted for, without supposing that there was a feeling of literary jealousy on the part of Plato. But there are some considerations which may partly account for Xenophon's not appearing as an interlocutor in the Dialogues. Xenophon, though a man of philosophical mind, evidently attended the teaching of Socrates, not to learn the art of disputation, or for the indulgence of a speculative curiosity. When he philosophized, it was as a man of the world, acquainting himself with human nature, with the manners and opinions of men, in order to his own conduct in life. He was not one of those eager and flippant sciolists, whom Plato takes delight in submitting as apt experiments to the interrogatories of Socrates. Nor was he, again, a devotee of science, like the wise Theætetus, the interesting person who gives occasion to the dialogue of that name, and whom in some points he resembled. He would not therefore naturally be selected by Plato, in order to the carrying on of discussions intended for the development of his philosophy. It is remarkable, that Plato has only in two places even alluded to himself; in the *Phædo*, to explain his absence from the death-scene in the prison;[5] and in the *Apologia*, as amongst those present at the trial of Socrates, and capable of giving evidence as to the nature of those instructions which Socrates addressed to the young.[6]

Such was the character of this eminent man. His distinguished career exposed him to the shafts of envy and detraction; and the high aspirings of his mind were clogged and weighed down by that corrupt heathenism with which he was surrounded. Still his reputation for wisdom and virtue stands above all these attacks and circumstances of disparagement. The more we converse with him in his writings, the more we are charmed by the deep feeling of natural piety which pervades his philosophy as its master-thought, and by the sound practical wisdom which shines forth from them as the real character of the man, reclaiming and subduing the wild aberrations of his speculative fancy.

His remains were buried in the place which he had ennobled whilst living. Nor were they unattended by the

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[1] Ælian, *Var. Hist.* iv. 9.

[2] Diog. Laert. in *Vit.* p. 23, Bip.

[3] "Aliter, inquit, loqueris; aliter vivis." Hoc, malignissima capita, et optimo cuique inimicissima, Platoni objectum est, objectum Epicuro, objectum Zenoni. Omnes enim isti dicebant, non quemadmodum ipsi viverent, sed quemadmodum vivendum esset. (Seneca *De Vit. Beat.* c. 18.)

[4] Xenoph. *Mem.* iii. 6.

[5] Πλατων δε, οἰμαι, ἠσθενει. (*Phædo*, § 6.) This circumstance was perhaps thrown in for graphic effect. His own sorrow is too intense to be depicted; therefore he is concealed from the view: his name is introduced, but merely to state that he was not present.

[6] *Apol.* p. 78, Bip. ed.

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customary tributes of honour and affection. Aristotle, who had been his constant disciple during the last twenty years preceding his death, displayed his veneration for his preceptor by consecrating an altar to him. A festival, called after him Platonea, was instituted in honour of him, and celebrated annually by his disciples. A statue, dedicated to the Muses, was afterwards erected in the Academia by Mithridates the Persian. He had not, indeed, been dead but a very few years, when the great celebrity of his name called forth from his nephew and successor, Speusippus, an express work in his praise. Seneca further tells us of a singular mark of honour which was paid to him on the very day of his decease. There were some Magi, he relates, at Athens at the time, who, struck by the singular circumstance of his having exactly completed the perfect number of nine times nine years, performed a sacrifice to him, esteeming him on that account to have been more than man.[1] The story is evidently the invention of his later admirers. It is referred to here, as a testimony of the enthusiastic admiration with which his name has been ever attended. To the same feeling must be ascribed the fiction of the discovery of his body in the time of Constantine the Great, with a golden tablet on the breast, recording his prediction of the birth of Christ, and his own belief in the Saviour.[2]

PLATO'S WRITINGS AND PHILOSOPHY.

The writings of Plato obtained an early popularity. Already, during his lifetime, copies of them appear to have been circulated. An iambic line, λογοισιν Ἑρμοδωρος ἐμπορευεται, proverbially applied, long after the time of Plato, to those who made a traffic of the writings of others,[3] shews that there was an immediate demand for them in Greece. The Hermodorus here referred to, was one of his hearers, who is said to have sold the writings of the philosopher in Sicily for his own profit. The fact of their early circulation is further evidenced, if it be true, as has been stated, that complaints were made by some of the persons whose names appear in the Dialogues, and even by Socrates himself, of the manner in which they had been represented in them by Plato.[4] It is very probable, also, that during the long time in which he was publicly teaching at Athens, and, doubtless, recurring frequently to the same topics of discussion, considerable portions of what he delivered orally, were treasured up in the memory of some who heard them, and afterwards written down, and thus published to the world without having received the finishing touches of the author's hand. The practice, indeed, of thus carrying off the oral lessons of the philosopher is alluded to by Plato himself in passages of his writings, as in the *Phædo*, and *Theætetus*, and *Parmenides;* where the dialogue is related by some one remembering what has passed in conversation on a former occasion. This circumstance may, at once, account for the comparative inferiority of some of the Dialogues in point of execution, and for the fact that some have been passed under his name which are not really his; whilst we have, at the same time, a very considerable collection of writings authenticated by testimonies descending from his own times.

It is by no means necessary for our purpose here (which is to obtain a just general view of the character of the philosopher and his writings), to enter into the criticisms by which doubts have been thrown on particular Dialogues, and on different Dialogues by different critics, out of the number commonly included amongst the genuine works of Plato. We may only remark, that these doubts do not rest on external testimony, but are drawn from considerations of the internal character of particular writings, which have been judged inferior to the rest in matter and execution. Nor is it necessary that we should discuss the various theories proposed for connecting the several Dialogues, and tracing in them the gradual formation and development of the philosophical system of the author. This inquiry certainly has its interest; and could we arrive at any clear results in the prosecution of it, it would be valuable, for the light which it would throw on the interpretation of the philosophy of Plato. But though we can discover a connection between several of the Dialogues, like that of a series of discussions on the same subject, it is not possible to decide on the order in which the points discussed presented themselves to the philosopher's mind, or which we are to regard as the more mature expression of his doctrines. This inquiry further demands a decision of the agitated question concerning the double teaching practised in the ancient schools, known by the technical division into esoteric and exoteric, or mystic and popular; the former addressed to the mature disciple, the latter to the novice or general hearer. There are undoubtedly marks of a recognition of this distinction throughout the writings of Plato;[5] and it is also probably referred to by Aristotle, when he speaks of the "unwritten doctrines" of Plato.[6] But we cannot practically employ it in determining the relative value of particular discussions or statements in his writings, without involving ourselves in a maze of theoretic disquisition, and ending at last, perhaps, in absolute scepticism respecting his doctrines.

But there is a particular class of writings attributed to him, which would possess a peculiar interest for us, if we could establish their genuineness; respecting which, however, the severe verdict of modern criticism compels us to hesitate in pronouncing on their genuineness. We mean what are commonly published in the editions of his works as the Epistles of Plato. By some the question has been regarded as settled beyond controversy, against their reception.[7] The style of their composition has been judged to be quite below the character of Plato's mind. The apologetic tone of the chief part of them has also been considered as evidence of their having proceeded from friends or disciples of Plato, vindicating his character from misrepresentations in regard to his intercourse with the court of Syracuse. But though we may allow weight to these considerations, they are not sufficient peremptorily to decide the question against the Epistles; particularly as we have in their favour the authority, not only of Plutarch, who founds much of the narrative in his Life of Dion upon them, but of Cicero, referring to them and quoting them expressly as writings of Plato.[8]

Perhaps no philosophical writer has ever received so early and ample a recompense of his labours, not only in the reception and circulation of his writings, but in the still more glorious tribute of the spread of his philosophy, as Plato has received. We have mentioned the ordinary marks of admiration which accompanied him during his life and after his death. A more enduring monument was reserved for him in the foundation of the school of Alexandria, not many years after his voice had ceased to be

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[1] Senec. *Ep.* lviii. 28.

[2] Brucker, *Hist. Crit. Phil.* tom. i. p. 654.

[3] Dic mihi, placetne tibi, primum, edere injussu meo? Hoc ne Hermodorus quidem faciebat, is qui Platonis libros solitus est divulgare; ex quo λογοισιν Ἑρμοδωρος. (Cicer. *Ep. ad Att.* xiii. 21.)

[4] Athenæus, xi. 113. Axiothea is said to have been induced to attend on the teaching of Plato, from having read the Republic.

[5] See particularly *Conviv.* p. 245.

[6] Aristot. *Phys.* iv. 2.

[7] Mitford, *Hist. of Greece*, vol. vi.; Ritter, *Hist. of Anc. Phil.*

[8] Est præclara Epistola Platonis ad Dionis propinquos; in qua scriptum est his fere verbis: "Quo cum venissem, vita illa beata quæ ferebatur," &c. *Tusc. Qu.* v. 35; also *De Offic.* i. 7; and *De Fin.* ii. 14.

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heard in the groves of the Academia. There, as in a fitting temple, on the confines of the Eastern and Western Worlds, was enshrined the philosophy which had moulded into one the philosophical systems of the East and the West. And though, in the course of things, the infusion of Eastern Philosophy predominated at Alexandria, it was still under the venerated name of Plato that the new system was taught. The disciples of the Alexandrine school were proud to call themselves Platonists, and to regard themselves as interpreters of the doctrines of Plato, whilst they altered and disfigured those doctrines. Here, then, was erected the proper monument to his fame. Meanwhile, in the Academia, teachers in regular succession transmitted their inheritance of his name, and by the charm of that, prolonged a feeble existence. For the spirit which had formed and animated the school had fled with him; and the Middle and New Academics only attested, by their lingering decay, the strength of the foundation on which they had been built. How great the influence of Plato was on the philosophy of the Romans, needs not to be told to those who are even slightly acquainted with the philosophical writings of Cicero. And even when Christianity threw into the shade all systems of man's wisdom, the only philosophy which maintained its credit at the first, was that of Plato. Christian teachers were found, not unwilling to own that there was great accordance between his doctrines and the revealed truth. Whilst, on the one hand, there were disciples of the philosopher who claimed for him all that was excellent in the Christian scheme, there were Christians who asserted, that he had learned his superior wisdom from the elder Scriptures. All this shews the hold which his name still retained over the minds of men at this period. The great father of the Western Church, St Augustin, avows himself a warm admirer of Plato. He concedes the approximation of the Platonists to the Christian doctrines; affirming that all other philosophers must yield to those who had speculated so justly as they had respecting the Chief Good.[1] Afterwards, indeed, we find Aristotle supplanting Plato in favour with the Christian controversialist. The struggle had been for some time between their respective advocates, which of them should obtain the lead in the Christian schools. But Plato, on the whole, had the mastery, though the result of the struggle was an eclectic system, in which the principal differences of the two philosophers were studiously reconciled. In fact, we may consider Platonism as in the ascendency in the Christian schools, until the period of Scholasticism, that is, until the twelfth and the following centuries, when the discipline of argumentation was at its height in the Church, and with it the study of Aristotle's philosophy. Even then the theories of Plato maintained their ground. The speculations pursued by members of the Church continued to be for the most part Platonic in their principles, though they were conducted and modified by the dialectical method of Aristotle.

What, then, was the character of this philosophy, it will naturally be asked, which both rendered it so attractive to those amongst whom it arose, and also secured for it such an immortality?

It is a very remarkable circumstance that, as far as we know, Plato should have escaped all censure at Athens on account of his philosophy, when other philosophers, who, like him, became centres of popular attraction, were the objects of extreme persecution. It is the more remarkable, as not only his master experienced such persecution, but his immediate disciple, Aristotle, was forced to fly from Athens to escape the storm with which he was threatened. Coming between these two, and enjoying, at the height of his popularity, an influence perhaps surpassing that of either, he yet was suffered to wear out his life unmolested, amidst the tranquil labours of his school.

The only evidence to the contrary of this is an unauthenticated anecdote, told by Laertius, of Plato's having accompanied Chabrias to the citadel of Athens, and shewn his zeal in support of that general, under the capital charge brought against him. Upon this occasion, it is said, Crobylus, the sycophant, meeting him, observed, "Are you coming to plead for another, as ignorant that the hemlock of Socrates awaits you too?" to which he replied, "When I served my country in the field I underwent dangers, and now in the cause of duty I undergo them for a friend."[2]

But though we may refuse to believe this story, it is quite evident, that the condition of philosophy at Athens was not without its obloquy and danger even in its most flourishing times under Plato. We may gather from many passages of the writings of Plato, that the cause of philosophy still needed defence, and that great caution was required on the part of those who publicly professed the study of it. A re-action indeed had taken place in favour of philosophers, in consequence of the severity with which Socrates had been treated; and the assailants of Socrates suffered retribution from the popular feeling. Still there was in the mass of the Athenian people a strong antipathy to philosophy, from their ignorance of its real nature. They had been taught to regard philosophers as idle and mischievous drivellers, ever prosing about nature and the phenomena of the heavens, and as contemners of the gods.[3] They had seen also how some of those to whom Athens owed her greatest calamities, had been amongst the students of philosophy. Alcibiades, for example, had been a hearer of Socrates; one of singular natural endowments, in the formation of whose mind Socrates had taken especial pains, and who might therefore be regarded as the test of what philosophy could effect. The people had loved him as their spoiled child, in spite of all his follies; but they had felt also the mischief and misery of his wild career of ambition; and they threw the blame on his instructors, and the system in which he had been trained. Again, a great prejudice had been excited in the public mind against philosophy in general, from the many low and mercenary professors of it with which Greece abounded; minute philosophers, patronized by the public for their temporary services in teaching the arts of public life, but who produced ignominy and disgust to the true profession by their unworthy monopoly of its name. Add to this, that popular opinion had been corrupted by the false teaching, which had been so long and extensively at work throughout Greece. Erroneous principles of judgment and conduct had taken root in the public mind; or, to describe the case more correctly, all principles were unsettled, and the state of the public mind was a state of inward anarchy and insubordination. A philosopher, therefore, seriously devoted to his profession, and pursuing it with a single eye to the advancement of truth, was necessarily regarded with suspicion and dislike. For it is a natural propensity of the mind to adhere to what is established, whether it be good or evil, simply because the transition is easy, and no effort of thought is required, no trouble of self-examination imposed, no censure of self exacted; and what is inveterate in their own minds passes with men for the oldness of truth and nature. A reformer, therefore, is always an object of aversion; and no reform is successfully accomplished, until it has worked its way by subduing the prejudices which it has to encounter at the outset. Not only was the opposition to sound philosophy produced in the minds of the vulgar by this distemper of public opinion; but even the better part of society, the more educated and reflecting members of the community, were infected by it. The majority of these would be deterred from taking up a profession exposing them to so much dislike and risk. Some of them, too, with a view of standing well with the mass of those amongst whom they lived, and promoting their own interest, would avail themselves of the popular clamour against philosophy, cry down the pursuit of it as innovation and danger, and make it their business to exaggerate, instead of counteracting, vulgar prejudices on the subject.

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[1] Augustin. *De Civit. Dei*, viii. Chapter after chapter is taken up in Eusebius' *Præparatio Evangelica*, in shewing the agreement of Plato with the Scriptures.

[2] Diog. Laert. *in Vita Plat.* 18.

[3] 'Ουδ' ἂν κωμωδοποιος ἐιη, ὡς ἀδολεσχω, κ. τ. λ. *Phædo*, p. 159; *Apol.* p. 44; *Polit.* p. 92, *et alib.*

These obstructions to the teaching of philosophy are pointedly referred to by Plato, as existing in his time, and demanding his attention, in order to the success of that mission of reform which he had undertaken. He treats the vulgar prejudice against philosophy as not altogether unreasonable,[1] in consequence of the perverse opinions which had been popularly inculcated; and endeavours to disarm the public hostility, by alleging the causes of the disrepute into which philosophy had unjustly fallen. Alluding, as it seems, particularly to the instance of Alcibiades, he points out, that it is not philosophy which corrupts the young, but the passions of the young and noble spirit which pervert the means of good to the greatest mischief. None but those of the highest order of talent and natural gifts are fully susceptible of its influence; but then these are the very cases, he observes, which are also capable of the most mischief, through their greater susceptibility of the seductions of the world. There cannot but be objections against philosophy, he further observes, as long as the mass of mankind is, as it is found, incapable of appreciating real essential good for its own sake; and as long as those of superior nature, who should be its devoted friends, and examples of its influence, are drawn away from it in pursuit of popular opinion. He endeavours, accordingly, to evince that there is no just ground for alarm, at least in those days, at the power of philosophy. It was now deserted and helpless, fallen amongst those who were not its own people. If disgrace now attached to philosophy, it must be imputed to the unworthy alliance into which it had been forced. The mean artisan, who has made his fortune, now quits his prison, and decks himself out, and aspires to the hand of the daughter of his master in her poverty and destitution.[2] It was no wonder, therefore, that such spurious fruits, of so unsuitable alliance, were then seen in the world, and that the few who clung to the true profession were like strangers in the world, living away from public affairs, as unwilling to join in the general iniquity, and unable to resist it effectually by their single strength.[3]

If Plato thought it necessary thus to apologize for the pursuit of philosophy, it is clear that there was yet reason to apprehend an outbreak of violence against its professors. In fact, however, he appears not only to have escaped all such outrage, but, whilst he propagated, by his oral teaching and his writings, a system of doctrines directly contrary to the impure morality and superstition established around him, to have enjoyed an esteem beyond that which any other teacher on the same ground ever obtained.

The explanation of this is in a great measure to be sought in the circumstances under which his philosophy was formed and matured, and to which it was peculiarly adapted.

What Themistocles admitted truly of himself when he answered, that he should not have achieved his glorious deeds if Athens had not been his country, was as truly applied by Plato to himself, when he enumerated amongst his causes of gratitude to the Gods, that he was born an Athenian.[4] For his philosophy was eminently Athenian. Viewed at least as we have it in his writings, it was the expression, by a master-mind, itself imbued with the spirit of the age, but rising above that spirit by its intrinsic superiority, of those tendencies of thought and action, which had been working in Greece, and especially at Athens, the centre of Grecian civilization.

The Peloponnesian war terminated with leaving Athens humbled before the confederacy, which the hatred and jealousy of her power had leagued against her. But the loss of her ascendency in Greece was not the worst evil brought on Athens by the result of that war. The machinery of faction, by which the war had been principally carried on, produced the most mischievous effects on the character and happiness of the Greeks at large; aggravating the symptoms of evil already existing in the constitutions of the several states, and, not least, in that of Athens. Not only did the insolence of the Athenian democracy gain strength in the result, and rise beyond all bounds, but the excesses in which party spirit had indulged, drew into prominence the selfishness and ferociousness of a demoralized people. Then might be clearly seen the levity and licentiousness of men, who, living amidst constant hazards, had learnt to regard nothing beyond the enjoyment of the passing hour; the cunning and cruelty engendered by mutual distrust; and the wanton contempt of all law and religion, prompted by the sight of the calamities which the tempests of social life scatter indiscriminately on the good and the evil. On this stock of corruption, speculative irreligion, and speculative immorality, had also grown up as its natural offshoots. Men were found hardening themselves against the reproaches of conscience and the fear of retribution, by arguing against the fundamental truths of religion and morals. In religion, it was contended that there were no Gods; or that if the existence of a divine power were conceded, there was no Providence over human affairs; or, lastly, that if there were a Providence, the wrath of the offended Deity was placable by the prayers and sacrifices of the offender. In morals, the question was debated, whether all was not mere matter of institution, and the device of the weak against the stronger power; and whether right might not change with the opinions of men.

This state of things had produced and fostered a spurious race of philosophers, familiarly known by the name of the Sophists; a name, not at first implying that disrespect, by which it afterwards characterized the pretensions of those to whom it was given. For the Sophists evidently were not the primary corruptors of the public mind in Greece, but themselves the offspring of that moral chaos, which resulted from the internal disorders of the country, and which they sustained, as its own children paying the recompense of their nurture to their genuine parent. They were an evidence of the corruption having reached the higher classes of society; for their instructions were sought by those who could pay for them, and who desired to qualify themselves for office and power in the state. Going about from place to place, and domesticating themselves wherever they could obtain a reception, they undertook to render all that flocked to them adepts in the arts of government, and even in virtue. The pretension would have been absurd and extravagant, but for the prevailing looseness of opinion on moral subjects.[5] But when right was understood as nothing more than what happened to be instituted and in fashion, there was an opening to every unprincipled teacher to adapt his moral lessons to the varied requirements of each distinct society.[1]

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[1] 'Ω μακαρεις, ἡν δ' ἐγω, μη πανυ ὁυτω των πολλῶν κατηγορει, ἀλλ' ὁιαν τοι δοξαν ἑξουσιν, ἐν ἀυτοις μη φιλονεικων, ἀλλα παραμυθουμενος, και ἀπολυομενος την της φιλομαθειας διαβολην, ἐνδεικνυε ὁυς λεγεις τους φιλοσοφους, κ. τ. λ. (*Rep.* vi. p. 101.)

[2] Δοκεις οὖν τι, ἦν δ' ἐγω, διαφερειν ἀυτους ἰδειν ἀργυριον κτησαμενου χαλκεως, φαλακρου και σμικρου, νεωστι μεν ἐκ δεσμων λελυμενου, ἐν βαλανειῳ δε λελουμενου, νεουργον ἱματιον ἐχοντος, ὡς νυμφιου παρεσκευασμενου, δια πενιαν και ἐρημιαν του δεσποτου την θυγατερα μελλοντος γαμειν. (*Rep* vi. p. 9 ,)

[3] *Ibid.* p. 95.

[4] Lactant. *Div. Inst.* iii.

[5] *Rep* vi. p. 85.

At no place were these universal teachers more cordially received than at Athens. The anxiety with which an expected visit from any one of greater note among them was expected at Athens, and the zeal with which the young hastened to see and hear the wise man on his arrival, are depicted in lively colours by Plato. At Athens, evidently, if anywhere, the Sophist felt himself at his proper home. There was his readiest market. Herodotus may justly have been surprised at the success of so vulgar a deception at Athens, the seat of literature, as that practised by Pisistratus, when he exhibited to the people a woman of great stature, arrayed in full armour, and pompously borne in a chariot into the city, as the goddess Minerva, reinstating him in her own citadel.[2] It would have been still stranger if these impersonations of Athenian wisdom had not succeeded in imposing on the understanding of Athenians. For their minds were in that fluctuating state, which disposed them to receive every various form. They were subject to chance-impressions from the last teacher. Their general cultivation of mind, and taste for literature, prepared them for listening with pleasure to exhibitions of rhetorical and dialectical skill, such as the Sophists gave. And from admiration of the skill thus displayed, the transition was natural to consider that, as the only wisdom, which was capable of maintaining both sides of a question with equal plausibility, and that, the only virtue, which could shift and accommodate itself to every expedient with equal satisfaction.

Yet the Athenian was not entirely the creature of those circumstances, which had so considerably modified his character. He yet retained some traces of that high feeling so beautifully touched by his own tragic poet, when that poet speaks of "the pious Athens," and appeals to the ancient associations of religion which consecrated the land. Religion indeed had acquired the name of superstition, or the fear of supernatural powers, δεισιδαιμονια; but even this marks that there were some who cherished, though in that degenerate form, a veneration for the truths of the Divine Being, and the Divine agency in the world. Nor was the Athenian ever insensible to his pride of birth, and rank among those of the Grecian name.[3] He dwelt on the recollections of a remote antiquity of origin, as distinguishing him among the members of the Greek family. He claimed to be the offspring of the Attic soil, αὐτοχϑων, whilst others were descended from successive immigrations of strangers. Amidst his fickleness, and susceptibility of every passing impulse, he yet felt himself strongly influenced by his veneration for the past, and loved to connect himself with the ancient glories of his country. In the Athenian character, accordingly, may be observed the union of extremes; devoutness of deep inward feeling, accompanied with superficial irreligion and profane dissoluteness of morals; a mercurial temperament, ever eager for change, floating like a light cloud over a deep-rooted reverence of antiquity, and the tradition of ancestral wisdom and virtue.

Now, on accurately studying the writings of Plato, we find them, both, a reflexion of this state of the public mind at Athens, and a corrective of it. Full of imagination and of severe subtile thought, they are formed to attract and fix the attention of the literary Athenian. Bringing the Sophist on the scene, and giving sketches of the social life of Athens, and making conversation the vehicle of his instructions, Plato in a manner transferred to his own teaching, what was every day witnessed at Athens in the professorial exhibitions of the Sophists themselves. His philosophy, a counterpart, in its way, to the drama of the comic poet, instructed the people, at once, through their wisdom and their folly. As Aristophanes spoke to them under the mask of folly, and gave utterance to lessons of severe wisdom under that mask; so Plato, on the other hand, put on the mask of the sage, and in grave irony ridiculed and exposed the light-hearted folly of his countrymen. Both were wiser than they seemed to the outward observation; as was indeed the volatile Athenian, to whom they addressed their counsel. Both presupposed that delicacy of perception and quick tact in their fellow-citizens, which would be flattered by such indirect modes of address, and would, at the same time, appreciate the jest of the one, and the irony of the other. Both speak with the freedom of the democratic spirit. But the counsel of Aristophanes is that of the privileged jester of the sovereign-people amidst festal scenes and the enthusiasm of mirth; whilst Plato appeals to the Athenian at the moment of quiet, serious reflection on the surrounding folly, and treats him as a contemplative spectator, rather than himself an actor in it.

Before the time of Plato, there were no philosophical writings which answered the requisitions of the Athenian mind. There were poems of the early philosophers. There were didactic writings of the later Pythagoreans, and even dialogues discussing speculative questions. Anaxagoras, too, whose name was well known at Athens, had published a treatise of philosophy.[4] But none of these, if they were even accessible to the Athenian, were calculated to attract his attention. The philosophical poems differed nothing from prose but in the metre, and were exceedingly dry and uninviting to the general reader. The books of Pythagoreans were very few, at least at this time, and hardly known to any but the devoted student of philosophy.[5] Nor would the dialogues of Zeno or Euclid, concerned about mere logical subtilties, or the physical discussions of Anaxagoras, possess any charm for the lively Athenian. Even afterwards, the instructive writings of Aristotle did not obtain that reception which could save them from a temporary oblivion. But the dialogues of Plato supplied exactly what was yet wanting in this department of Athenian literature. They were the proper development of the philosophical element in the genius of the people. The shrewd practical talent of the Athenians had been strikingly exhibited in the successful achievements of their great generals and statesmen, and in the lead of Athens itself amongst the states of Greece at the close of the Persian war. Their taste in arts, and poetry, and general literature, had put forth splendid fruits in the works of Athenian artists, Athenian masters of the drama, and of history. But their genius for abstract speculation as yet had nothing which it could claim as strictly its own. Socrates indeed laid the basis for such a work. During the half century preceding the appearance of Plato as the leader of a school of philosophy, Socrates had been engaged as a missionary of philosophy, awakening the curiosity of men; turning their thoughts to reflection on themselves, as creatures endued with moral and intellectual faculties; and inspiring them with longings after some information on questions relating to their own nature, and a taste for discussions addressed to the resolution of such questions. Plato succeeded him, and carried the philosophical spirit, now fully called into action, to its result. His works accordingly display this spirit at its maturity; exemplifying at the

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[1] See *Meno*, pp. 371–380; *Theæt.* p. 127; *Soph.* pp. 232–234.

[2] Herodot. *Clio*, 60.

[3] *Ibid.* vi. 59; Αϑηναιος ὢν Λαμψακηνῳ, shews in a few words the Athenian estimation of themselves.

[4] Laertius says that Anaxagoras was the first to publish such a treatise. In *Vit. Anax.* viii.

[5] It must be of the more modern Pythagoreans that Dionysius of Halicarnassus speaks, when he recommends the reading of them, not only for their matter, but for their style. *De Vett. Scr. Cens.* iv.

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same time that peculiar combination of qualities which formed the Athenian character. Thus are they at once serious and lively, abstract and imaginative; full of deep thought and feeling intermingled with gaiety and humour; instinctive with the awe of religion and ancient wisdom, whilst they present also an image of Athenian versatility, and frivolity, and love of change. They convey indeed a strong rebuke of the vices of the times. They draw, in no softened colouring, outlines of the evil and misery resulting from the profligacy of existing governments, and the excesses of individual cupidity; the two great causes assigned by Plato for the prevailing evil of his times. But these lessons were calculated rather to interest the hearer or reader by their faithful representation of manners, than to alienate him, as we might at first think, by the justness of the censure. Athenians would give their attention to such descriptions, as they did to the invectives of their orators,[1] acknowledging the general truth of the representation; and each, at the same time, taking no offence at what he applied to others, and to every one rather than to himself. Philosophy too, taught, as by Plato, colloquially, was such as peculiarly to suit the taste of the Athenian, whose life was in the agora, or the ecclesia, or the courts of law; and who regarded the interchange of words as no unimportant ingredient in everything that he had to do.[2] Such conversation, too, as that of Plato's Dialogues, elegant conversation, steeped in the well-spring of Grecian literature, and expressed in language such as Jove, it was said, might use, and adorned with the charms of an exquisite musical rhythm, could not but be attractive to Athenian ears. We may see, accordingly, in these circumstances, at once, an occasion for the existence of such writings as those of Plato, and a reason of the peculiar mould in which they were cast, as well as of the success which attended them.

Not only, however, was the general character of his philosophy, as viewed in connection with the writings which convey it, derived from such influences; but the internal structure of it was the natural result of the peculiar education of such a mind as his, under the circumstances to which we have referred. His philosophy was essentially dialectical or colloquial; an examination and discussion of systems, and doctrines, and opinions. According to his notion, the true philosopher is the dialectician; the investigator, who has fought his way, step by step, through every argument capable of being adduced in support of a particular opinion, refuting those that are unsound, until at length he has found rest in some position that cannot be shaken.[3] Hence he is the disciple of no particular system of philosophy, whilst he brings all systems under his survey, and compels all to pay a tribute to his stock of truth, by discussing them, and rejecting in them what will not abide the test of examination. We have seen that he was engaged in studying the doctrines of Heraclitus, and of the Pythagoreans, and of the other schools, whilst he was also a hearer of Socrates. He had thus begun in early life to analyse different systems by the searching method of Socrates; and his mature philosophy was only the same proceeding more deeply imbibed in his own mind, more extensively carried on, and more vigorously applied. So far, indeed, does the colloquial spirit predominate over his philosophy, so entirely dialectical is it in its whole internal character, that it leaves on the mind of the reader more an impression of a series of discussions, in order to the determination of the questions considered, than the conviction of any thing positively determined. Hence it is that Cicero, speaking of Plato's writings, says, that "in them nothing is affirmed; and much is discoursed on both sides; everything is inquired into; nothing certain is said."[4] So also Sextus Empiricus raises the question, in what respect the philosophy of Plato differs from that of the Sceptics.[5] And again his doctrines have been characterized as brilliant clouds, which we seem at the point of grasping, when they vanish from our hands. This effect is doubtless partly to be ascribed to the disguise of his irony; to the artist-design which presides over his whole instruction. But it is also the proper effect of that dialectical philosophy which is worked out in the Dialogues. Whilst he is a consummate artist throughout, he is also illustrating the lessons which he had learnt from Socrates, by bringing false opinions to the test of discussion, and leaving truth, for the most part, to be collected from refutation of error, rather than positively enunciating it, or exactly defining it.

For when we come to examine his philosophy more closely, we find, that it begins and ends, like the lessons of Socrates, with a confession of the ignorance of man. Socrates had led him to perceive how much was taken for granted in the popular opinions and systems of philosophy; how even those who had a reputation for wisdom and talents took up principles which they had never examined, and which they could not satisfactorily account for, or defend, when pressed in argument. Imbibing, accordingly, the spirit of the Socratic method, he did not endeavour to *teach*, in the proper sense of the term, so much as to explore and test the minds of men; to ascertain, how far they really understood the doctrines and opinions which they professed. The fundamental error of the Sophists was, that they assumed all current opinions to be true. They did not think it necessary to examine this preliminary; whether the opinions on which they built their fabric of knowledge were true or false. It was enough for them, that certain opinions were *actually* held; and to these, as given principles, they directed their whole system of teaching. Their teaching, accordingly, was entirely προς δοξαν, relative to opinion; and it must, consequently, stand, or fall, as existing opinions could be maintained or impugned. Now, with Plato, as with Socrates, the investigation of this preliminary point (that is, whether existing opinions are true or no), is everything. The presumption that they are true, is what he will by no means admit. He demands a positive evidence of them. And as the presumption of their truth is a bar to all inquiry concerning them, he commences with the opposite presumption of their falsehood, or at least a confession on the part of the inquirer, that as yet,—until he has investigated,—he does not *know* the *truth* of his opinions.

For the same reason, he avoids all dogmatism in his conclusions. Those might aspire to communicate the knowledge of new truth to the mind, who, as the Sophists did, assumed that knowledge was entirely subjective; or who held that any opinion which could be produced in the mind, was simply true, was really known, because it was there. But as Plato denied the truth of Opinion, if it had no other evidence, but that of its mere presence in the mind; so, neither would he concede that any process of the mind in itself, or any argumentative and persuasive instructions, could produce, *by their own force*, a conviction of truth in the mind. In other words, he required the student of philosophy, not only to begin, but to end, with a confession of the ignorance of man.

We have an apt illustration of this in the dialogue entitled the *First Alcibiades*. There Socrates is introduced, questioning Alcibiades concerning his plans of life, and shewing how entirely he had presumed on his knowledge of matters with which he was unacquainted; and that until he could be brought to feel and confess his ignorance, there was no possibility of his being able to direct himself or others aright.

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[1] Thucyd. iii 38; Demosth. *passim*.

[2] 'Ου τους λογους τοις ἐργοις βλαβην ἡγουμενοι, ἀλλα μη προδιδαχθῆναι μαλλον λογῳ προτερον, ἢ ἐπι ἁ δεῖ ἐργῳ ἐλθεῖν, κ. τ. λ. (Thucyd. ii. 40; also iii. 42.)

[3] 'Ωσπερ ἐν μαχῃ δια παντων ἐλεγχων διεξιων, κ. τ. λ. (*Rep.* vii. p. 167.)

[4] Cic. *Acad. Quæst.* i. 12.

[5] Sex. Emp. *Pyr. Hyp.* i. 33; Diog. Laert. in *Vit. Plat.* 33.

In the *Meno*, the same is illustrated by the comparison of the effect of the searching questions of Socrates, on the mind of the person submitted to them, to that of the torpedo. Meno says, he had thousands of times, and to many a person, and with much credit to himself, as he thought, spoken on the subject of virtue; but on conversing with Socrates, he was quite at a loss now to say even what virtue was.

To the same purport is the general application by Socrates in the *Apologia*, of the oracle which pronounced him the wisest of men. The oracle, he observes, had only used his name by way of example, as if it had said, "He, O men! is the wisest of you, whoever, like Socrates, is convinced, that he is in truth worthless in respect of wisdom."[1]

The method of Plato, accordingly, is the reverse of didactic. The Sophists could employ a didactic method; because they assumed principles as true, from which they might proceed to argue and persuade. But this was precluded to Plato, assuming, as he did, that all opinions demanded a previous examination. It was necessary for him to extort a confession of ignorance, to make men sensible of the difficulties belonging to a subject. It only remained, therefore, for him to proceed by Interrogation. In a colloquial philosophy, Interrogation is what experiment is in physical inquiry. It is the mode of discovering what the real state of a person's mind is, in regard to the opinions which he professes. The whole art of Socrates consisted in putting questions to the person with whom he conversed, so that an answer bearing on the point in debate might be elicited; that the grounds on which a given opinion was held might fully appear; and the person's own answers might open his mind to see it in its proper light. This method Plato has followed out in the interrogatory of his Dialogues. Under such a method of philosophy, the answerer is brought to teach himself. The lesson thus given by the philosopher, consists wholly in the questions which he puts. He preserves, from first to last; the simple character of the inquirer; and he *pronounces* only so far as he approves or rejects the answer given.

The popular opponents of this method called it a method of producing doubt; and regarded it as dangerous to the principles of the young. Plato carefully obviates such a misrepresentation of his proceeding, and guards his method from being confounded with that of the Sophists. The Sophists taught the art of exciting doubts on every subject; a mere effort of gladiatorial skill. They professed to make men apt to cavil and dispute on any given subject.[2] All principles, according to them, were equally stable; all were equally open to be impugned. They, therefore, did not care how they unsettled the minds of men, if their skill could only find materials on which to exercise itself. In Plato's hands, however, the awakening of doubt has for its object, to remove the unstable ground on which opinions may happen to be rested, and to lead to more settled convictions. With him it is exalted into a regular discipline of the mind. With the Sophists, it was perverted to strengthen that universal scepticism in which their whole teaching was based. So strictly does Plato confine the application of his method to the single purpose of investigating the truth, that he strongly objects to the use of it as a mere exercise of ingenuity; lest the young, led on by the pleasure of refuting and perplexing others, should think, at last, that there were no real distinctions of right and wrong.

Plato seems the more anxious to distinguish his method of inquiry from that of the Sophists, as his method did in some measure resemble theirs. It was inquisitive on every subject, as theirs was. It did superficially appear to be nothing but questioning, and doubting, and cavilling. It did appeal to the reason of every man, and oblige him to see how he could defend his opinions. And on this very ground Socrates had been attacked: for he was accused of corrupting the young, by making them "doubt," ἀπορειν ποιουντα.[3] Plato fully admits that this practice, as pursued by the Sophists, was dangerous to the principles of the young. In fact, he observes it would be even better to suffer them to remain under the guidance of some principles which, though not true, served as restraints on their passions, than to remove everything from their minds, and leave no check whatever to licentious indulgence. By a beautiful illustration, he compares the effect produced by the sophistical method, to the case of a child brought up amidst wealth, and luxury, and high connections, and the society of flatterers, but in ignorance as to his real parentage. Suppose, he observes, such a person to come to know that those, whom he has hitherto believed to be his parents, are not so, and at the same time not to know who his real parents are. It is clear, that whilst in his state of ignorance concerning his supposed parents, he would respect and attend to them more than to his flatterers; but on finding out his mistake, unless he were of a superior character, such as is rarely met with, he would attend to his flatterers more than to those whom he once supposed to be his parents. So would it be, then, he shews, with one who should find out that the popular principles of morals in which he had been trained, were not the truth, without arriving, at the same time, at the real truth. He would no longer be controlled by those moral principles of which he had discovered the falsehood; but having nothing to substitute in their place, he would give way afterwards, without reserve, to the seductions of pleasures, the flatterers, whose blandishments he had before in some measure resisted.[4] In opposition to such a system of cavilling, Plato holds an even course between the scepticism which merely doubts about everything, and the dogmatism which pronounces on everything without examination.

The method by which he accomplishes his object, carried out to the fulness of a regular system and discipline of the mind, is, what he calls by a term conveying to a Greek ear its colloquial origin and application, DIALECTIC. As contrasted with the spurious method of the Sophists, or the method of contradicting on every subject, and involving the mind in endless perplexity, it was the true art of Discussion. As contrasted with the mere wisdom of opinion, δοξοσοφια, which the Sophists inculcated, it was philosophy, real science, or knowledge of the truth. The method of his philosophy, and his philosophy itself, thus run up into one, and coincide under the common name of Dialectic.[5]

To trace the manner in which this coincidence was effected, will lead us to a perception of the true character of Plato's philosophy, as a system mediating between the dogmatism of the sciolist on the one hand, and the scepticism of the disputant on the other.

The hypothesis, we observe, on which he founded the whole of his proceeding, was the fallaciousness of Opinion; the Sophists, on the contrary, assuming the truth of Opinion

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[1] ‛Ωσπερ ἀν ειποι ὁτι ‛Ουτος ὑμῶν, ὦ ἀνθρωποι, σοφωτατος ἐστιν, ὁστις, ὡσπερ Σωκρατης, ἐγνωκεν, ὁτι ὀυδενος ἀξιος ἐστι, τῃ ἀληθεια, προς σοφιαν. (*Apolog. Soc.* p. 53.)

[2] *Rep.* vii. p. 177.

[3] *Apolog.* p. 54; *Gorg* p. 162; *Meno.* p. 347: *Polit.*; *Conv.*

[4] *Rep.* vii. pp. 174–178.

[5] ’Αλλα μην το γε διαλεκτικον οὐκ ἀλλῳ δωσεις, ὡς ἐγωμαι, πλην τῳ καθαρῶς τε και δικαιως φιλοσοφουντι. (*Soph.* p. 275.) ‛Ο μεν γαρ συνοπτικος διαλεκτικος· ὁ δε μη, ὀυ. (*Rep.* vii. p. 173.)

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universally. Whilst to the Sophists every opinion served as a ground of argument, and for them there was no need to look beyond the *apparent;* it was necessary for Plato, to seek for some Criterion of Truth out of the region of mere Opinion. Commencing with denying the sufficiency of what metaphysicians call subjective truth, or the assumption that whatever is perceived by the mind is true, because it is so perceived; he had to search after objective truth, truth independent of the mind of man, and exempt from the contingencies and variations of human judgment, as a foundation of his system of knowledge.

The hypothesis, accordingly, of the fallaciousness of Opinion from which his Method set out, involved a corresponding hypothesis in philosophy of the fallaciousness of the senses. It is the joint application of these two fundamental principles that combines his Method and his Philosophy in one master-science of DIALECTIC. Opinion, according to him, is the kind of knowledge derived from the information of the senses, and is therefore no proper knowledge at all, but mere belief or persuasion, πιστις; whereas true knowledge is founded on that which is purely apprehended by the intellect, without any intervention whatever of the senses. Dialectic, as it is philosophy, is conversant about that which IS, or which has BEING, as contrasted with presentations to the senses, which have only the semblance of Being; as it is a method, it investigates the reason, or account of the Being of everything;—the account of everything as it IS, and not as it APPEARS; not being satisfied, like its sophistical counterpart, with opinions of which no account can be given, but bringing all to the test of exact argument and definition.

In order, therefore, to give his Method a firm basis, and his philosophy a distinct object, it was required, that he should establish a sound theory of Being, or, in other words, a sure Criterion of Truth. Such, then, was his celebrated Theory of IDEAS.

There are four distinct views embraced in this theory as it is developed by Plato; four phases, as it were, under which it is presented.

I. The first, and most strictly Platonic view of it, according to what we have already stated, is in its connection with logical science. None of the great philosophers before Plato; none, that is, of those who had speculated on the universe at large, as Thales, Pythagoras, Heraclitus, Parmenides, Anaxagoras, were conversant with logical science. Zeno the Eleatic, and Euclid of Megara, were known indeed as dialecticians. But the kind of logical science which they professed, was a rude and imperfect art, consisting chiefly in the knowledge and use of particular fallacies, and not founded in any deep study of the nature of thought and reasoning. They were, besides, mere dialecticians, rather than philosophers in the most extended sense of the term. Plato's mind, however, while it was engaged in logical studies, was also no less intent on the investigation of the first principles of all things. And, as has been often observed in other cases, the favourite study of his mind gave its complexion to his theory of first principles, or doctrine of Ideas.

The term "Idea" does not indeed convey to the understanding of a modern any notion of a connection of the theory with logical science. In our acceptation, it belongs exclusively to metaphysics. But in Plato's view there was no separation of the two branches of logic and metaphysics. Both were closely united in the one science to which he gave the name of Dialectic, and which was accordingly at once a science of the internal reason,—that is, of the processes of the mind in its silent speculation on things; and of the external reason,—that is, of the processes of the mind in communicating its speculations to others in words. The terms, therefore, belonging to the one process, are indiscriminately applied to the other. Thus, to "give a reason" of the being of a thing, διδοναι λογον τῆς οὐσιας, was equivalent to a scientific view of it; and the word λογος denoted at once the terms of language by which that reason was expressed, and the reason itself as it existed in the mind. Thus, too, the word ἰδεαι, or ideas, was only a little varied from the logical term εἰδη, or species, which indeed is sometimes substituted for it in the phraseology of Plato. The simplicity, accordingly, and invariableness, and universality, which belong to terms denoting the agreement of a variety of objects in certain characteristics, were transferred to supposed counterparts in the mind itself, or to the notions represented by the terms which are the name of the species. Hence the idea, or *eidos,* was conceived to be, not simply a result of a process of the mind, but something *in* the mind, and as having a being independent of the mind itself. As the species expressed in words was universal, so its counterpart in the mind was the universal nature in which the individuals to which it referred, participated. In that, the mind, perplexed by the variety and anomaly of individual objects, found an invariable sameness. In the contemplation of it, the mind no longer wavered and doubted, but obtained a fixedness of view. The idea, or species, therefore, was to be explored and reached in order to a just theory of everything, and was in itself that theory.

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Further, as there is a relative classification of objects by means of words; some standing for characteristics common to a greater number of objects, whilst others stand for characteristics of only some out of that number; this property of words was in like manner conceived to have its counterpart in the mind. A graduated series of species was supposed to exist, first in the mind, and then independent of the mind, by means of which, as by steps, the mind might rise to the highest species, the ultimate idea itself, in which all others were comprehended. And hence there was no real perfect science but that which penetrated to this ultimate nature or being; and all other ideas, or theories, were truly scientific only as they participated in this.

This notion of "participation" of the ideas, was a still further application of logical language to the business of philosophy in general. For, as the several particulars belonging to a species all possess those characteristics which constitute their species, as well as those which connect them with a higher species or genus of which they are the species, their logical description is made up of an enumeration of those characteristics, together with the name of the higher class or genus under which the whole species is included. The higher class is an ingredient in the specification of a lower; or, conversely, a lower class participates in a higher. So Plato considered everything in the universe, as being what it is, by a "participation" of the Ideas; and consequently, that to explore its nature we must ascertain the idea which thus constitutes it. The Pythagoreans before him spoke of things as existing by "assimilation" to the essential being. Plato's logical views occasioned this change of phraseology; for he varied only the term, as Aristotle observes, whilst he followed the Pythagoreans as masters in the fundamental conception of his theory.[1] Aristotle, indeed, whilst he assigns the logical studies of Plato as the occasion of the form of the ideal theory, more particularly accounts for the theory, from Plato's observation of the importance of definitions in the ethical discussions of Socrates. Plato found how effectual an instrument Definition had been in the hands of Socrates in silencing the impertinencies of false opinion on moral subjects. As it had brought moral questions to an issue, so it might be applied, he thought, generally, as a stay to the extravagancies of opinion on all subjects whatever. Accordingly he had only to generalize the principle of definitions, and the result was the theory of

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[1] Aristot. *Metaph.* i. 6.

Ideas, or the universal science of reasons, and ultimate criterion of all truth.

To understand, however, rightly how Plato was led by logical considerations to his theory of Ideas, we should observe more particularly what his view was of the nature of logic. We should greatly misapprehend him if we supposed that he had that notion of the science which has prevailed since the systematic exposition of it by Aristotle. As it was conceived by Plato, it answered strictly to its original name of dialectic, rather than to that of logic; being the art of discussion, or the art of drawing forth the truth from the mind by questioning, rather than the art of deducing consequences from given principles. It was a higher, more comprehensive science, than the art of Deduction. For it was conversant about the discovery and establishment of principles; whereas the logical science which is employed about Deduction, assumes the principles in order to speculate about their consequences. It left the latter inquiry to be pursued by subsequent research, whilst the more ambitious flight of those who first speculated on the nature of Discourse was directed to the discovery of truth. In Plato's hands it was an energetic reform of the quibbling shallow logic, which was as yet known and practised in the schools. This logic had no concern for truth, but only for victory and display. It consisted in a skill of wielding certain sophisms, known by familiar names in the schools, and founded on the equivocations of words. An appearance of truth being all that it aimed at, it did not exact of the student any consideration of the nature of things. It was enough that he could give the word reason, the mere logos, the symbol or counter. He was not taught to go beyond this legerdemain of language, or to search out the reason of the being of things, and correct the paralogisms involved in the use of words, by reference to the realities represented by them. This sophistical method affected indeed to be a didactic art; to instruct and furnish the mind with principles applicable to every subject of discussion. It considered, forsooth, language as an universal science of nature already constructed; and, proceeding on this supposition, professed to enable the student to apply the wisdom already embodied in language, to the purpose of appearing wise himself, and imparting to others the same apparent wisdom. But going no further than this, it ended in mere δοξα, mere opinion. It produced, that is, in the result, only a wavering state of mind, subject to be changed by every new impression of opposite arguments, and imparted no steady knowledge.

It was a great reform, then, which Plato undertook, in following up the example proposed in the conversations of Socrates, and instituting a proper science of Dialectic, a science of the reason of the being of things. It was a change from an empirical system, a vain art of words, to a scientific method or investigation of the reasons themselves, on which an instructive use of words must be founded.

For, we must observe, it was still a science of words which he teaches as the true logic or dialectic. It had throughout a reference to discussion. Still it was a real science as compared with the verbal and technical logic of his predecessors. Though it was a science of words, it had for its object the determination of such words as should fully correspond to their intention as symbols, in characterizing the proper being of the thing denoted. These reasons of the being of things, the λογοι της ουσιας, were the Ideas.

His logical method, accordingly, was an analytical, inductive method. Setting out on the assumption of the erroneousness of opinion as such, it examines hypothesis after hypothesis on each subject proposed for discussion, rejecting and excluding, as it proceeds, everything irrelevant. The scrutiny instituted consists in searching for the grounds of contradiction with regard to each opinion, and shewing that opposite views on point after point in the matter discussed, are at least as tenable as the assumptions contained in the given opinion or hypothesis. Hence it consists almost entirely of refutation, or what both he and Aristotle denominate *elenchus*, a process of reasoning by which the contradictory of a given conclusion is inferred.

A method of this kind was calculated fully to put to the test every unsound opinion. It collected everything that could be said either for or against a given opinion. It made the maintainer of it state on what grounds he maintained it, what consequences followed from it; and either forced him to self-contradiction in his defence of it, or obliged him to modify it according to the requisitions of the argument. And the result was, that whatever stood its ground after this complete sifting of the question, might be regarded as stable truth. When refutation had done its utmost, and all the points of difficulty and objection had been fully brought out, the dialectical process had accomplished its purpose; and the affirmative which remained after this discussion might be regarded as setting forth the truth of the question under consideration. For everything connected with it, and yet not founded in the truth of things, was then removed. And the result therefore might be accepted as a simple truth of being, an object which the eye of the intellect might steadily contemplate.

The process throughout corresponds with the process of investigation in modern philosophy. Only we must conceive the dialectical investigation of Plato as nothing more than an admirable scheme for clearing a question of everything foreign to it; whilst the latter draws out the true law of nature from the promiscuous assemblage of phenomena under which it is presented to observation, and concealed until analysis has done its work on the mass. The nomenclature of the two methods varies accordingly. Argument is the instrument of the former; experiment that of the latter. Refutation is the primary business of the former; rejection and exclusion of irrelevant phenomena that of the latter. Definitions of words, as they are signs of the being of things, are the result of the former; whilst the latter developes laws of nature.

Both processes are carried on by Interrogation. But whereas the analysis which investigates a law of nature proceeds by interrogation of nature, the analysis of Plato's dialectic proceeds by interrogation of the mind, in order to discover the true being or idea of the thing discussed. Therefore it was that Socrates called his art, in his own playful manner, μαιευμα, a kind of midwifery;[1] a delivering of the mind of the notions with which it was pregnant. Thus the dialectic of Plato, being entirely directed to observation on the mind, and not to external nature, takes the state of knowledge as it exists in the mind for the ground of its proceeding. It deals with things; that is, as they exist in the forms of thought; going, as Plato says, "from species to species, until it arrives at the principle of all things,"[2] and following throughout the steps by which the mind advances in obtaining an exact view of any object of its contemplation. It is, in fact, the true thought spoken out. The process of thinking by which it is attained, is the dialectical process of interrogation. The decision of the mind when its conviction is settled, is the dialectical conclusion.[3]

The chief logical instrument employed in this method is division. The being able to divide according to genera, and not to consider the same species as different, nor a different one as the same, is stated to belong especially to dialectical science.[4] In searching out the true definition of the being of a thing, this portion of the internal process of the mind would naturally strike the attention. General ideas being founded on general resemblances of objects, the first step towards a more distinct idea of an object is to see that the generalization is complete; that it neither excludes nor includes any objects which it ought not to exclude or include. The true idea of any object would be that which characterized every object belonging to the idea, and none other. The analysis accordingly pursued by Plato is conversant about Division, using the induction of particulars in subordination to this.[1] We find, indeed, a constant use of Induction by Plato, after the manner of Socrates. But it is always in reference to the main purpose of determining, not a general fact, but the dominant Idea in every object of thought.

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[1] *Theætet.*

[2] *Rep.* vi. p. 124.

[3] *Theætet.* p. 151.

[4] *Soph.* p. 274.

At the same time, we may observe, the Dialectic of Plato is truly a method of investigation, though it does not penetrate to the depth of the modern analysis. It employed deductive reasonings; but these were not essential parts of its method; since the whole was a process of ascent to the theory of the Ideas.

Afterwards, indeed, Dialectic approximated to what is now commonly understood by Logic. The transition was first to the consideration of it as a method of drawing out the probable conclusions deducible from given premises. This was natural. For in Plato's method every opinion was admitted as an hypothesis to be examined, in order to rejecting the falsehood and eliciting the truth that might be contained in it; and so far his Dialectic might be regarded as a speculation on probabilities. This transition prepared the way for a further one, when Dialectic became strictly the science of Deduction. Attention would be drawn more and more to the use of words as instruments of reasoning, when Dialectic was once exalted into the rank of a science.

The progress seems to be this. The science being cultivated primarily with a view to discussion, the importance of language in order to reasoning could not fail, from the first direction of the mind in this channel, to strike the philosophical observer. The phenomena of sophistical argument would suggest the necessity of inquiry into words as they are employed in reasoning. Philosophers, accordingly, would be led to examine into the nature of words considered as signs and representatives of thought. Thus they would proceed to arrange words into classes, according to their import in this respect. Thus would be obtained that great division of words into those that denote an individual alone, and those that stand both for many and for one, or into singular and common;—the fundamental principle of logic properly so called, or of logic as the science is now considered. The use of Division and Definition would soon appear. These processes, indeed, would be naturally discovered in the very prosecution of discussions addressed to the refutation of false opinions and popular fallacies. The early dialectics, accordingly, abounded in the use of them.[2] Afterwards, as the analytical power of language came to be more particularly observed, the connections of words in propositions and arguments would attract speculation. The possibility of exhibiting any given proposition or argument under abstract formulæ, in which unmeaning symbols were substituted for the terms themselves of the proposition or argument, would at length be discovered. Thus in the result would be erected a formal science of logic, in which language would be considered as an artificial system of signs, and the validity of arguments would be explored, independently of the subject-matter about which they happen to be conversant.

When Plato, however, drew his Theory of Ideas from the logical speculations in which his mind was engaged, there was no such system as that now found in treatises of logic. There are the materials in the writings of Plato for constructing a method of dialectic, such as the science presented itself to his view; but that method remains, even to this day, to be fully explored and stated. It is clear that he had such a system, and that his writings proceed on regular method; though he has nowhere accurately sketched it, and perhaps never even proposed it to himself in the form of a system. His thoughts were engaged in this, as in other subjects, in giving the great outlines of his philosophy. It was enough for him to have seized the bearings of logical truth on all truth; and to this general view of the science he has made everything secondary and subservient.

II. The next aspect under which the Theory of Ideas should be considered, is that in which it sums up and measures the infinites of the sensible world. In this point of view it more immediately represented its Pythagorean prototype, than under its logical aspect. It is in reference to this intention of the theory that Aristotle objects, that whilst it professes to give the account of things, it introduces an additional number of objects in the Ideas themselves; an absurdity, he observes, like that of attempting to facilitate a calculation by adding to the numbers to be calculated.[3] It was, accordingly, an endeavour to reckon up the individuals of the universe, and exhibit their sum in one statement. As Plato's logical speculations gave their colour to his whole philosophy, so the devotion of the Pythagoreans to mathematics led them to form a mathematical theory of the universe. The universal nature of number gave them the ground for this application of their peculiar studies. For all things are in number; and there is nothing from which the notion of number may not be abstracted. That number, then, which alone measures all other numbers,—Unity,—would be regarded as the common measure of all things. And thus the philosophy of the universe would be reduced to a system of calculation; and the infinity of existing things summed up in definite proportions of numbers. The Greek word *logos*, whilst it combined in it the notions of "word" and "reason," also further combined that of "ratio," and reasoning and calculating were expressed by the one term λογιζεσθαι. This marks the connected trains of thought by which the arithmetical theory of the Pythagoreans was formed. The effects of this combination of thought are seen, not only in the fundamental conception of the theory, but in our ordinary phraseology on the subject of reasoning even at this day; as, for example, in our use of the word "Term,"—that is, "limit," or "boundary,"—for words, not only in their logical signification, but even in their familiar use.[4]

It appears to have struck the mind of Plato that the theory of the Pythagoreans was not sufficiently comprehensive, or even ultimate, as an account of the Being of things. The simplicity of Number did not adequately explain the great variety of natures found in the universe; and though the science of Arithmetic held almost the highest place in his scale of knowledge, on account of its abstract nature, and its leading to the consideration of Being, apart from the changeable objects of sense; he still viewed it as practically implicated with the physical sciences, and, as such, therefore, not strictly and exclusively conversant about Being. In like manner, the science of Geometry, though purer than the physical sciences, as being conversant only about abstract magnitudes, is excluded from the highest place. Geometry, no less than Arithmetic, might seem to be simply an intellectual contemplation; since, though it employs visible figures in its demonstrations, the demonstrations do not refer to these, but to the abstract notions which the diagrams represent. Yet Geometry, as it assumes its principles, and its truths consequently depend on assumptions which in themselves demand evidence, cannot, he observes, rank as perfect intelligence.

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[1] Πολυ δε μαλιστα και πρῶτον την μεθοδον ταυτην τιμᾶν, τοῦ κατ᾽ εἰδη δυνατον εἶναι διαιρειν. (*Polit.* p. 66.)

[2] Τουτων δη ἐγωγε αὐτος τε ἐραστης, ὦ Φαιδρε, τῶν διαιρεσεων και συναγωγων, ἱν᾽ οἷοστε ῷ λεγειν τε και φρονεῖν· ἐαν τε τινα ἄλλον ἡγησωμαι δυνατον εἰς ἑν και ἐπι πολλα πεφυκοτα ὁρᾶν, τοῦτον διωκω, κατοπισθε μετ᾽ ἰχνιον ὥστε θεοῖο· και μεντοι και τους δυναμενους αὐτο δρᾶν, εἰ μεν ὀρθως ἡ μη προσαγορευω, θεος οἶδε· καλῶ δε οὖν μεχρι τουδε διαλεκτικους. (*Phædr.* pp. 362, 363.) Plato appears to have been the author of a work "On Divisions," not now extant.

[3] Ὥσπερ εἰ τις ἀριθμῆσαι βουλομενος, ἐλαττονων μεν ὀντων, οἰοιτο μη δυνησεσθαι, πλειω δε ποιησας ἀριθμοιη. (Aristot. *Metaph.* i. 7.)

[4] Hobbes uses the mathematical phraseology throughout. Reasoning, with him, is "reckoning," and words are "counters." (*Leviathan*, i. 4, *et alib.*

Perfect intelligence, *νοησις*, implies an absolute stay to the thought; something beyond which no further inquiry can be made, which may be seen as it were by the mind's eye immediately in itself. And such an object only is furnished by the Idea. Though, accordingly, Plato thus carried his theory beyond that of the Pythagoreans, we find him still cherishing the Pythagorean doctrine of Number, by assigning to it the second place in his scale of knowledge, and only barely distinguishing it, in regard to scientific value, from his own Theory of Ideas.[1]

When we come indeed to look more closely into his theory, the mathematical approximation will distinctly appear. The ideas are the finite, applied to the infinite of the sensible world, and thus producing measure and proportion in the universe.[2] The physical sciences, as, for example, astronomy and music, are not truly scientific, because, addressing themselves to what is passing before the senses in the world, they do not consider the immoveable beings themselves, which are only imperfectly represented in the observed physical movements. The astronomer computes the actual velocities of the heavenly bodies; the musician counts the intervals of sounds. But neither of these is intent on the real beings, the Ideas themselves of velocity and of harmony. We can discern in such language as this, a mathematical basis of thought. Perpetual variations, as contemplated in their inconstancy, admit of no calculation. To estimate them, we must find the limit to which they continually approximate, and we thus, as it were, reduce to fixed order the apparent disorder and irregularity, and see the variable in its ultimate form of invariableness. This notion is not fully developed by Plato. But it is conveyed in his doctrine of a twofold class of sciences, under the same names; a popular astronomy, for example, and an higher astronomy; a popular music, and an higher music; the latter of which are sciences of the invariable and the finite, and run up into his Theory of Ideas.[3]

III. The third phasis of the Theory is that in which it is a philosophy of Being, in opposition to the mere knowledge of sensible phenomena. According to the school of Heraclitus, the sensible world was ever flowing, ever in a state of becoming or incipiency; being a mere development of successive phenomena, displacing each other without cessation. As duration is no positive existence as a whole, but is made up of an infinite number of moments, each of which is gone as the succeeding moment appears; so was it asserted generally in the doctrine of that school, that every object in the universe was a mere collection of successive phenomena. Of nothing could it be affirmed that it IS. The very sensations, no less than the objects of them, were in constant production; being the momentary, ever-varying results of the concourse of agent and patient. Colour, for example, as the object, and sight of the colour in the eye as the sensation, are momentary relations simultaneously produced by something that acts in the coloured object at the moment, on something that receives the impression in the eye.[4] This doctrine resolved all knowledge into sensation, and (which was equivalent to this) made "man the measure of all things," according to the celebrated enunciation of Protagoras.

Plato saw, that if these views were admitted as an account of the universe, his whole dialectic must fall to the ground. It would be nothing but miserable trifling to try to call forth those reasons of things which he conceived to be in the mind, if knowledge were of this fluctuating character.[5] There could not, in fact, be then any such reasons. There was nothing stable, nothing that remained in the mind, to serve as the standing criterion of true and false opinions. There would be no distinguishing whether all that passed in life were not a dream, or whether the occurrences in dreams were not rather the realities.[6] Some sure criterion was therefore wanted, to which the phenomena of sensation might be referred. The theory of Ideas, as a theory of Being, furnished this.

Plato admitted, accordingly, the perpetual flux of sensations and their objects, as taught by Heraclitus, whilst he refuted the sophistical extravagancies into which the doctrine had been carried. Granting, therefore, that there was no test of truth or falsehood in the sensations themselves, he points out, that the ground of fallaciousness is in the judgments formed by the mind concerning the impressions of the senses. The soul is endued with a common power of perception, to which the reports of the different senses are referred, and by means of which the mind is enabled to compare past and present sensations of the same kind, as also different sensations with one another. It is in the conclusions then formed on these comparisons that we are to seek for knowledge; or in the purely mental processes, abandoning altogether the mere informations of sense.[7]

He was led, accordingly, to examine these processes of the mind, in order to discover the grounds of truth and knowledge. He observed, that when the mind compares two sensations, and decides on their similarity or difference, there is always some ground on which that judgment is made. When, for instance, it decides on the equality of two things, there is a standard to which they are referred, the general notion of equality itself, which serves as a middle term for testing the equality of the two things compared. In like manner, there is always, whenever a comparison is made by the mind, some general principle, which is the medium of the comparison. And this is a principle not in any way produced by the sensations; for it is evidently prior to them, and independent of them; being appealed to by the mind as a criterion of them. This general principle, then, is in every instance the Idea; and not being formed by the sensations, it is not subject to their variableness. It remains unmoved, and the same, amidst the flow of the sensations, or of the objects of the sensations;—the standing criterion of all the judgments of the mind to which it applies.[8]

Hence we may see the peculiar meaning of the term "Idea" in Plato's philosophy. It consists in its contrast with the objects of sensation. The latter never attain to any definite perfect form—to any clear outline, as it were, to

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[1] *Rep.* vi. *ad fin.* The importance assigned to arithmetic in the early philosophy, is shewn in that line of Æschylus: Και μην ἀριθμον ἔξοχον σοφισματων, ἐξευρον αὐτοις. (Prom. 459.)

[2] *Phileb.* pp. 234–240.

[3] Ὡς εἰσι δυο ἀριθμητικαι, και ταυταις ἀλλαι δυο τοιαῦται ξυνεπομεναι συχναι, την διδυμοτητα ἐχουσαι ταυτην, ὀνοματος ἑνος κεκοινωνημεναι. (*Phileb.* p. 303; also *Rep.* vi.)

[4] *Theætet.*

[5] *Ibid.* p. 90.

[6] *Ibid.* p. 82.

[7] *Ibid.* pp. 139–144.

[8] *Phædo*, pp. 170, 230–236; *Rep.* vii. pp. 145–147; *Theætet.*

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the eye. They flow and have vanished before they could attain to such form; since, in the very succeeding one another, they not only pass away, but undergo alteration. But the standard to which they are referred in the mind, is a positive defined shade, or form, or species, simple and uniform, analogous to an object of sight of which we can clearly trace the whole outline by the eye.[1] For the like reason, the term *exemplar*, παραδειγμα, is also applied to denote the Idea. As the one perfect standard to which all the reports of the senses are referred, it appears in the light of a pattern, to which they would be conformed, but for that incessant mutability which necessarily belongs to them. This, however, was rather the Pythagorean view of general principles than the Platonic, though Plato himself not unfrequently recurs to it.

Plato, at the same time, in thus constituting Ideas the sole absolute criteria of real existence, did not intend to deny all reality whatever to conclusions drawn from our sensible experience, such as those of the physical sciences. But he means, in the first place, to shew the delusive character of all informations of sense which are not corrected by the internal reason of the mind. In the next place, his design is to point out the inferior knowledge which every other kind of evidence conveys, but that which is drawn from the intuitive perceptions of the mind. The mere informations of sense, he teaches, are only a knowledge of semblances or idols, εἰκασια, conjecture founded on mere images of the truth. He describes this kind of knowledge by an admirable illustration from a supposed case of men placed in a long cavern, with their bodies so chained from infancy, that they can only look before them, whilst the light of a fire from behind casts on the side opposite to them, the shadows of vessels, and statues of stone and wood, carried along a track leading upwards from the cavern by persons who are themselves concealed by a wall, like the exhibitors of puppets. As men so circumstanced would see nothing of themselves, and of each other, or of the things thus carried along, but the shadows, they would mistake the shadows for the realities; they would speak of the shadows as if these were the things; and if any voice was heard from the persons carrying along the figures, they would think the sounds proceeded from the passing shadow.[2] Just like this, he declares, is the influence of education in the lower world of sense on the minds of men. They must be carried up from this cavern, in which they see everything only by an artificial light, to the light of the sun itself, to the region of Ideas, where alone objects are seen as they are in themselves.

As to the knowledge conveyed by the physical sciences, neither is this properly science. It amounts only, as he states it, to belief or opinion. These are less intellectual than the mathematical sciences, because they are conversant about human opinions and desires, or about the production and composition of things, or about the means of sustaining things produced and compounded.[3] They are therefore as unstable as the things about which they are. But they are still not devoid of evidence, so far as they collect the real informations of the senses, and do not learn from mere shadows. This is implied in his calling such knowledge belief, and distinguishing it from conjecture; though he is rigid in preserving the exclusive prerogative of Truth to the knowledge of the Ideas.

The evidence of Experience was necessarily slighted in such a philosophy, and condemned as insufficient for the discovery of truth. For what is Experience but the memory of several similar previous informations of sense, combined into one general conclusion? And though Aristotle allows that such a general conclusion, in which the mind acquiesces, might be regarded as scientific,[4] this could not be admitted by a philosopher who placed the objects of sensation out of the pale of Being. It was not enough for Plato's system to answer in favour of the scientific value of Experience, that though this and that particular instance of an information of sense had no immoveable truth in it, yet, from the observation of a number of similar instances, a general uniformity might be inferred, and an immoveable general principle established. He would grant that generalization was a corrective of experience. For this he did when he granted some importance to the arts in education, and for the purposes of life. But truth with him must be *universal*, not simply general: it must be that which is always the same, not simply that which is for the most part. And the highest degree of the evidence of experience, even that which amounts to what is called moral certainty, falls short of this absolute universality. It might be urged, for example, that though what was sweet to one person and at one time, might be bitter to another person and at another time; and though what seemed the same sensation of sweet, was not in fact the same at two successive moments, but a reproduction; still it was possible, by combining recollections of many similar instances, to form a general notion which should adequately characterize that sensation. Still Plato would say, this was only belief or opinion, and not science. The object of science must be such as cannot be otherwise: it must be absolutely one and the same permanent being: you must altogether quit the stream of the world of sense, and land on the rock of unchangeable eternal Being.

Thus Rhetoric is strongly reprobated by Plato, on the very ground on which it is systematically taught by Aristotle, of its being nothing more than an instrument of persuasion, or an art speculating on the means of persuasion. Much of his invective indeed derives its point from its application to the servile rhetoricians of his day. Still we find him condemning Rhetoric on the abstract ground of its having no higher view than persuasion. In the modern view of the subject, as in Aristotle's, Rhetoric is a real science, so far as it is framed on just conclusions respecting those modes of speaking, or writing, which excite interest and produce conviction. With Plato it is mere quackery; and for this reason, that it is founded on experience of what persuades, being only an ἐμπειρια or τριβη, a knack acquired by experience and converse with the world; an accomplishment, learned by practice, without any real knowledge, in flattering the passions of men. He in fact regarded Experience as corresponding with what we call empiricism; contrasting it with the conclusions of abstract reason, as we contrast an illiterate and unscientific use of experience with that of the philosopher.[5]

Looking to that sort of experience on which the popular teaching of the Sophists was founded, Plato, we should say, was fully justified in his condemnation of the experimental method of his day. It was in truth mere quackery. It was content with shadows and images of the truth, and entirely directed to *producing* a desired effect, without caring for the absolute truth;—a shallow philosophy of sensation, not founded in the nature of things. He had thus to contend against a system, which distorted that criterion of truth, which man has in himself, by the right use of his reason conjointly with his experience, to the undermining of all truth and reality. This empirical system was the crying evil of those times.

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[1] Hanc illi ideam appellabant, jam a Platone ita nominatam; nos recte speciem possumus dicere. (Cicer. *Acad. Qu.* i. 8.) Formæ sunt, quas Græci ἰδεας vocant, &c. (Cicer. *Topic.* 7.)

[2] *Rep.* vii. *ad init.*

[3] *Ibid.* p. 165.

[4] Ἐκ δ' ἐμπειριας ἡ ἐκ παντος ἠρεμησαντος του καθολου ἐν τῇ ψυχῇ, τοῦ ἑνος παρα τα πολλα, ὁ ἀν ἐν ἁπασιν ἐν ἐνῃ ἐκεινοις το αὐτο, τεχνῆς ἀρχη και ἐπιστημης· ἐαν μεν περι γενεσιν τεχνης· ἐὰν δε περι το ὀν, ἐπιστημης. (Aristot. *Analyt.* part ii. c. *ult.*)

[5] Gorgias, p. 117, *et seq.*; *Phædr.*

It had infected politics, and education, and private intercourse, as well as philosophy. In opposition to it, he had to take up an antithetical position; to call in question the existing acceptation and use of the human criterion of truth; to limit it within its proper bounds, and guard against its perversion. Accordingly the whole stress of his philosophy is on this point. It is a perpetual polemic against the sophistical principle, that "man is the measure of all things."[1] This amply accounts for his disparaging so much as he does, the scientific value of Experience, and insisting on the necessity of the existence of higher principles than those of Experience, in order that the mind may duly receive and appreciate the information of sense. He taught men, at any rate, to perceive that the popular notion of that evidence of truth which man has in his own nature was false and deceptive, and that in all judgments and reasonings there is also something more than is merely of man.

IV. The fourth leading point of view under which the Theory of Ideas remains to be considered, is its aspect as it is a theory of the Cause of the universe. Under this aspect it is identified with the speculation into the Chief Good. Here it is an account at once of the first principle of motion, and of the end to which all things tend as their perfection and ultimate good. According to Plato, there was no other cause worthy of the name, or which really accounted for the phenomena of the universe, but "The Good," or, as it is technically called, the Final Cause. The early speculations of philosophers had been chiefly directed to the material phenomena of the universe, and had attempted to account for them in a rude manner, by referring them to some one or more of the material elements. Some indeed had introduced also moral influences into their theory. The Pythagoreans combined with their speculation of the mysterious Unity, the notion of Love as the one-making principle. The Ionic school, however, appears to have led the opinion of philosophers in regard to the cause of the universe at the time of Plato. And though Anaxagoras asserted the ascendancy of mind, he had lost sight of his great theory in the explanations from material causes, to which he descended in the completion of his system. Socrates began a strenuous opposition to the physical philosophers. Plato carried on that opposition, and, blending the familiar ethics of Socrates with the moral and theological mysticism of the Pythagoreans, established the Final Cause or theory of "the Good," as supreme over the domain of science.

Anaxagoras had certainly prepared the way for the theory. Plato took up his doctrine of a Divine Intelligence, and gave it that development which, as it had been taught by Anaxagoras himself, it yet waited to receive. It was but a vain theory of a Supreme Mind (sublime and important as the simple enunciation of the great truth was), which did not also exhibit the Supreme Mind as operating in the universe by design, and as diffusing the energy of its intelligence and goodness, as well as of its power, throughout its operations.

The Supreme Mind, therefore, according to Plato, must be conceived, as exemplifying the attributes of its own nature in the works which have proceeded from it. If it be granted that there is a Supreme Mind, that must be the true measure of all things in the universe. All things must have been framed according to the scheme which such a mind would contemplate in their production. As intelligence, it cannot be regarded but as working for some object, ἑνεκα του; for by this is intelligence distinguished from unintelligent force; and the only object to the supreme intelligence is the most perfect nature, which is itself. The pattern of its own perfections, therefore, must have been present to it, and in its design, in the construction of the universe. In other words, the Deity himself is not only the author of all things, but he has designed to exemplify in them his own attributes. The principle, accordingly, by which all true philosophy must hold, and which it must carry out into its speculations, is, that "God is the measure of all things."[2] And hence, whenever the proper being of any thing is to be explored, it must be studied in that light in which it is seen as a work of the Supreme Mind, designed after the pattern of the divine perfections. In such a contemplation, the theory of the Best is the view by which philosophy must be guided; for, in ancient philosophy, an object of intelligent aim, and good, are equivalent terms. The object at which the most perfect intelligence aims, must be, therefore, that which is best; and in tracing out, accordingly, the workings of the Divine Mind in the world, we must look for "the best" in everything. That notion of everything by which it is "best," is both its real nature, and the cause of its being produced.

But why is not everything, as it is actually seen, a work of "the best?" why is not good visibly impressed on everything as it stands forth to the view? why must we, in short, resort to the Idea of good, in order to ascertain its nature, instead of taking it simply as it appears?

The antagonist force of unreason in the nature of that which has body, and is apprehended by the senses, occasions all the imperfection and evil in the world, as the world actually exists. It subsisted already in the mass of disorder and confusion which the Divine intelligence, by its operation, had brought into order and regularity of motion; and it still subsists, though reduced into subordination to intelligence. It is overruled so as to minister to the designs of mind, but still impedes by its contrariety of nature the development of good in the world. And thus Plato says that it is impossible for evils to perish out of the world, for that there must ever exist a contrariety to good.[3] Evil pre-existed, and evil accordingly must be displaced by the presence of good; as contraries are displaced by contraries; and as all generation, or production, is carried on by a process from contrary to contrary. Thus, though evil retires before good in the world of generated things, evil still manifests itself in the very act of its retiring before good; and a perpetual opposition of good and evil remains. What we see, accordingly, in the world, is not the perfect accomplishment of good, but effort and tendency after good in all things. The effects of a struggle between reason and unreason are manifested, on the one hand, in the evanescent imperfect nature of all sensible things; and, on the other hand, in their constant renewing, or in that undying vigour with which they flow on, and are reproduced, and aim at a perfection beyond themselves.[4]

Though, therefore, the Divine Artificer has designed everything in the world for the best, they are not actually the best as they are presented to our senses. They are the best that such things can be, but they do not attain to the Idea of good, according to which they have been made. Time, for example, only imperfectly represents the divine eternity, which is its true Idea. In eternity there is no distinction of past, present, and future. But the bodily nature will not admit of this co-instantaneous development of the divine Idea. Existence is here broken up into successive moments; and these successive moments, marked by the periodic motions of the heavenly bodies, introduce the distinctions of number into the simple idea of duration.[5] Again, the velocities of the heavenly bodies, which are observed by the astronomer, must be conceived as very in-

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[1] Παντων χρηματων μετρον ἀνθρωπος. (*Theætet.*; *De Leg.* iv.)

[2] *De Leg.* iv.

[3] Ἀπολεσθαι τα κακα, ἀδυνατον· ὑπεναντιον γαρ, κ. τ. λ. (*De Leg.* iv.)

[4] *Timæus*; *Polit.* p. 30.

[5] *Timæus.*

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adequate representatives of the "real velocities performed in the true number and true figures,"[1] which are the Ideas after which they have been established. Or, again, it is clear that the ideas of the good, and the just, and the honourable, and the beautiful, as they are seen in the world around us, are only imperfectly developed. Our thoughts are distracted by the contemplation of them in the world, by the multiplicity of forms under which they are apprehended by men, and it seems to the superficial glance as if there were no one perfect standard of each. At the same time, we are able to trace evident signs of such a standard, when we look thoughtfully at the course of things. We cannot doubt, on such examination, that these principles exist, and are working their way, and that the universe has been constructed after the pattern of them. But all that the most attentive study will disclose to us as actually observed, is *tendency* towards these principles—a "becoming" or incipiency of being.[2] We do not see their full effect, or what would be their effect, if the world were such as to give them free scope and exercise, and if the impressions of sense did not diversify and obscure the presentations of them to our minds. Must we not say, then, that if we formed our notions of these principles from the visible world, and the impressions of sense, that we must estimate them improperly? And must we not rather elevate our minds to the Ideas themselves, after which the universe has been constituted in its present order, and take our measures of them from the Divine Being, whose goodness, and truth, and beauty, they represent?

Thus did the Theory of Ideas serve as a moral explanation of the course of nature, and meet the demand of philosophy, by removing the perplexity of the mind on the contemplation of the apparent disorder of the world, and giving a firm stay to the thought in this direction. This apparent disorder has been the constant appeal of the atheist and the sceptic in all ages. And in Plato's time there was need, we find from several passages of his writings, of an answer on the part of philosophy to speculative objections on this ground. The Theory of Ideas supplied this answer. By the theory of a perfect model of good, imperfectly wrought out in the visible universe, the existence of evil was accounted for in some degree, and the eye of thought was enabled to see a chain of goodness, and beauty, and order, binding together the most untoward appearances of the moral world. As the Pythagoreans enchained these disjointed portions of the moral fabric, by supposing a fundamental Unity pervading the whole, and reducing the multiple and the unlimited to definite proportion—a sort of key-note, modulating the apparent discords of nature[3]—so Plato made the one moral good the all-pervading moderator of the system of the universe. The abstract notions, the genera, and the species, and the definitions, which dialectical science brought out by the aid of language, presented the materials for extending the moral view to other notions besides those strictly moral; and thus a theological and moral complexion was spread over the whole region of philosophy.

Ideas of evil were evidently excluded. "The good" could not be the cause of all things, but only of those that were well constituted; of evils it was causeless.[4] Evil, as we have seen, had no exemplar or pattern in the nature of the Author of the universe. It was a condition of that bodily nature on which the good was actively displayed. Evil arose from the nature of the "diverse"[5] inherent in body; that nature in body by which it was contradistinguished from the "sameness" belonging to the Ideas.

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In considering the Theory of Ideas under the different aspects which it presents, we have in fact taken a summary view of the whole of Plato's philosophy. This theory is the cardinal principle of the whole. The speculations on particular branches of philosophy are all included in this one theory, which binds them together and explains them. For when the mind had once risen to the contemplation of the Ideas, it needed no further helps from observation or study of nature to understand all knowledge. The mind was then in possession of the only true principles of knowledge; and to enter into the consideration of material and sensible phenomena, was only to return to the darkness and the dreams from which the eye of the intellect had been purified,—to quit the light of the sun for the cavern of shadows.

Accordingly, all his writings are devoted to the establishment of this theory. Proceeding on that notion of the importance of the theory which he inculcates, he bends every thought to this one point. No one science is set forth by him in detail; no one subject obtains with him a full and explicit consideration. All is resolved into its most abstract and general view, that the mind may be led to see the common principles of all truth; so intent is he throughout on his theory of Ideas, whatever may be his immediate subject of discussion. He assumes hypotheses, and examines them, and refutes them, in the way of argument, without pronouncing on either side of a particular question, as if indifferent about the establishment of any mere opinion, and desirous only of clearing his way for the perception of his theory.

But to place that theory in its full light, we should advert to the theories of Knowledge and of the Soul, which are intimately connected with it. These theories contain his account of the origin of the Ideas.

Knowledge, according to Plato, is Reminiscence, ’Αναμνησις, a recovery of forgotten truth, which had been possessed by the soul in a former state of existence. His dialectic professed to do nothing more than to lead the mind, by apt interrogation, to perceive the Truth for itself. It abandoned the attempt to communicate the Truth by didactic propositions. It only removed falsehood, and left the truth to its own course, to suggest itself to the mind, now disabused of its error and prejudice. It appealed to principles as certain criteria of truth, and yet confessed its inability to state those principles, and place them distinctly before the mind of the learner. They were simply referred to, as existing in every mind, whatever might be the peculiar opinions of the individual to whom the questions of the dialectician were addressed. How, then, could those principles have been acquired? No time in the present life could be pointed out when they first appeared in the mind. They are prior to the sensations, for the sensations are referred to them; and the sensations we have had from our birth. These standard principles, then, must have been acquired in a previous state of existence, and what is commonly called learning, is, in fact, Reminiscence; and to know, is, properly speaking, to remember.[6]

In proof of this account of the origin of the Ideas, Plato introduces Socrates making an experiment on the mind of an uneducated person. Socrates is represented putting a series of questions to a slave of Meno, and at length eliciting from the youth, after repeated correction of his errors, a right enunciation of a geometrical truth. Socrates then points triumphantly to the instance, and bids Meno observe how he had *taught* the youth nothing, but simply *interrogated* him as to his opinions, and the youth had himself recalled for himself the knowledge thus evidently existing in his mind.[1]

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[1] *Repub.* vii. p. 158; also *Philebus*, p. 303.

[2] Παντα τα ἐν ταῖς αἰσθησεσιν ἐκεινου τε ὀρεγεται τοῦθ᾽ ὁ ἐστιν ἰσον και αἰτου ἐνδεεστερα ἐστιν (*Phæd.* 170); προθυμεῖται μεν παντα τα τοιαῦτα εἶναι οἷον ἐκεινο ἐστι δε αὐτοῦ φαυλοτερα (*Ibid.* 171). He goes on to say this applies to all subjects as well.

[3] Δεσμῶν δ᾽ ὁ καλλιστος, ὁς ἀν ἀυτον και τα ξυνδουμενα ὁτιμαλιστα ἐν ποιῆ, τοῦτο δε πεφυκεν ἀναλογια καλλιστα ἀποτελεῖν· ὁποταν γαρ ἀριθμῶν τριῶν, κ. τ. λ. (*Timæus*, p. 307.) The Pythagoreans were fond of describing moral ideas by terms drawn from mathematics and music. The good man, for example, was τετραγωνος ἀνευ ψογου; and the words πλημμελῶς, ἐμμελῶς, and the like, known from their philosophy, are familiarly used in a moral sense.

[4] ’Ουκ ἀρα παντων γε ἀιτιον το ἀγαθον, ἀλλα τῶν μεν ευ ἐχοντων ἀιτιον, τῶν δε κακῶν ἀναιτιον· (*Rep.* ii)

[5] Θατερου φυσις. (*Tim.* p. 315.)

[6] *Phædo*, pp. 166–174.

Again, in illustration of the same, Plato refers to instances of association. Often, on the sensation of a particular object, we are reminded of something else not present to us. On seeing a lyre, or a dress, which one whom we love has used, a thought occurs of the person to whom it belonged. So also, on seeing pictures of objects, persons and objects will be suggested to the mind, unlike as well as like to the objects in the picture. Or one of two friends, being presented to our view, we are reminded of the other who is absent.[2]

Now the instances here referred to, both those of association, and those of the self-teaching of the mind by the excitement of its reflection, are highly interesting and important in the history of the origin of ideas. But they do not prove the point for which Plato adduces them. The case of the slave interrogated by Socrates certainly shews, that there are principles in the understanding, which are not derived from external information, but which only wait to be developed by occasions apt to call them forth. And as to the instances of association, we can only say, it is an ultimate fact of our mental constitution, that particular objects serve to bring others before our thoughts. All such instances are illustrations of the fact, that the mind is not passive in its admission of truth, receiving knowledge simply as something infused in it from without; but that its knowledge is in great measure owing to its exertion of its faculties, and its bringing to bear on the instruction given its own intuitive convictions;—that consequently the excellence of all teaching consists, not so much in the positive mass of instruction conveyed, as in stirring up the mind to learn from itself.

The stress of Plato's argument in favour of the theory of Reminiscence, and of the previous existence of the Soul as a consequence of it, is laid, we find, on the ground of the priority of the ideas compared with the several particular sensations which are referred to them as criteria. But the priority which he here claims for the Ideas, is not, in fact, a precedence in the order of time, but of logic. In the process of reasoning, general principles are prior to, and more known than, the particulars which fall under them; because in possessing them we possess the particulars, and the particulars, as yet unknown, are known by deduction from them as already known. Thus we familiarly speak of a conclusion as *following* from the premises. Now, Plato appears to have transferred a priority of this kind to the Ideas, and then to have concluded their priority ABSOLUTELY, as principles existing in the mind independently of the occasions on which they are called forth. But to establish a theory of Reminiscence, it was further required to be shewn, that the ideas are prior in the order of *time*,—that we possess them antecedently to, and independently of, all experience. The instance which he has given of the way in which a mathematical conclusion is reached by the simple leading of the mind in the right track, is an instance of what has in modern philosophy been more properly called "Suggestion,"—not of Reminiscence. So far from being an instance of Reminiscence, it shews, on the contrary, that the general principles of the mind are developed *subsequently* to the particular occasions which suggest them. It shews, further, that these principles are in some way dependent on such occasions for their development, though not dependent on them for their truth and reality; for the mind accepts them as true, and as the criteria of all other truth, at the moment when they are presented to it. This, then, is what is really illustrated in Plato's instance in the *Meno*. Geometrical science is the best illustration of it, though it is seen also in all our judgments and reasonings; because the remote conclusions to which we are brought by the chain of demonstration in that science, from a few very simple definitions, present the fact most strikingly. Those conclusions are clearly far beyond the compass of the definitions themselves. They are strictly deduced from them, however, and with an irresistible cogency of argument. The wonder is accounted for, by the fact to which Plato has called our attention. The demonstration of the problem appeals in every step to the intuitive convictions of the mind. Ideas are suggested by which the statements at each point of the proof are tested; and we sanction the conclusion, because the process by which we arrive at it, has been approved throughout by clear principles of our own minds.

But though the theory of Reminiscence has not been satisfactorily made out by Plato, he has the merit of having distinctly noticed and marked, in speculating on the origin of the Ideas, a class of notions of which no previous account, as it seems, had been given. The philosophy of sensation had before his time chiefly engaged the attention of thinking men, whether of those of the Eleatic school, who made everything stationary, or of the Ionic, who made everything flow.[3] It had been carried into the extreme of refinement by the Sophists, its devotees, when Plato commenced his antagonist system. He found that this philosophy was too narrow a basis for the structure of science, and that it could not stand alone. He saw that it left altogether unexplored the perceptions of the mind itself, such, for example, as the notions of equality, identity, time, causation, right, &c.; and that these notions were, in truth, more important for the establishment of science, than those which had previously chiefly attracted the attention of philosophers. He applied himself accordingly to examine and characterize these principles. The main thing to be accomplished in such an inquiry, was to distinguish them accurately from the informations of sense; to shew that they were not included in, or in any way derived out of, the informations of sense, but developed by the workings of mind. This fact he has recorded in his theory of Reminiscence,—a term expressing the point of contrast in his method, to that of the empirical philosophers before him exclusively founded on sensation.

The truth and importance, accordingly, of Plato's Theory of Ideas, appear in this; that by that theory he laid a stable foundation of science, in the principles themselves of the human mind. His error is, that he carried that theory too far; that he included in it notions which are not part of the fundamental principles of the mind, and thus involved his theory in vagueness and paradox. The war of nominalism and realism is well known to every one, who has looked into the history of philosophy, or of theological opinion. This found its occasion in the wide generalization of the Ideal Theory. Had Plato restricted his theory to such notions as really exist in the mind; and had he not extended it, without discrimination, to those which belong to general terms, and which are purely notional; there would not have been that ground for controversy on the subject. As the case has been,—one class of disputants, looking to the generalizations of language, the genera and species of logic, took the nominalist view of the subject,—

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[1] *Meno*, pp. 352–361.

[2] *Phædo*.

[3] Plato characterizes them; the one, as the τοῦ ὀντος στασιωται; the others, as ὁι ῥεοντες. *Theæt.*

imputing to the whole of the ideas the attribute of one portion of them ;—the other class of disputants, justly observing the reality of certain general principles, became the advocates of realism throughout. What has been already said on the dialectical origin of the theory, will sufficiently account for the confusion of two such dissimilar classes of principles in Plato's system.

How shall we wonder, therefore, that the great logical philosopher who followed him should find it necessary to combat the theory of Ideas in the undefined form in which it had been left by its author. As thus left, it stood in the way of those exact arrangements of the objects of thought which the rigorous method of Aristotle required, and introduced a class of existences for which he could find no place in his system.

Nor, further, will it be matter of wonder that controversies should have arisen in the schools respecting the nature of the Ideas ; such as, whether they subsisted by themselves, or were bodies, or actually separable from sensible things, or only separable from them in thought; or whether they were locally situated anywhere, or only in the Divine Mind. The establishing of the theory in its general form was the great business of Plato : it was enough for him to have projected it above the horizon of philosophy. Others would elaborate it after him with more or less skill. Various speculations would be raised concerning it ; and controversy would at length reduce it to more definite form, and a precision beyond the contemplation of its author.

But, however just and important the Ideal Theory is in its connection with metaphysical science, it is but too clear that it retarded the advancement of sound physical philosophy, by its substitution of final causes for physical, and consequently withdrawing attention entirely from the latter. It would follow, indeed, from the suspicion thrown over the informations of sense, and the undervaluing of experience, that physical science would be slighted under such a system of philosophy. But the dominion of the theory of Ideas would necessarily exclude any other consideration in order to the truth, but that of tendencies or final causes. No other view of nature, but that supplied by this theory, would be conceived to possess the stability which science demanded. Accordingly, hypotheses would occupy the place of investigation here. The philosopher would be speculating on what ought to be, instead of observing accurately what is ; and assuming *a priori* notions of " the best," in order to determine the law of physical facts. The principle, " that all things are constituted for the best," no doubt holds good in physics as well as in other studies of the divine workmanship ; but it is here the termination of inquiry, not the commencement. It may even be employed instrumentally in the process of inquiry, to lead the mind to a point to which investigation should be directed : and this it may effect in two ways. Either, from considering the good intended in the structure of some object, we may be led to see the parts of that structure in a way which discloses their real organization, and which we should otherwise not have observed ; or, from taking our view of an object, not as it is actually exhibited in inferior specimens, or in those states of it in which it is seen only in progress, or under distortion, but from the most perfect specimens,—those most answerable to a divine intention or tendency to the best,—we may judge what it *is*, by considering what it *would* or *should be*. But to lay down final causes as principles from which the truths of physics may be deduced, is, as Bacon says, to corrupt natural philosophy with theology, and to render it barren of all fruits.

Such, then, is the state of Plato's natural philosophy. In fact, though he asserts the importance of physics in his own sense of the term, the science has no place in his philosophy. He goes so far indeed as to say that no art can flourish apart from a knowledge of physical truth ; and he attributes the imperfect rhetoric of his day to its want of such a foundation.[1] But even whilst he imputes the superiority of Pericles as an orator to his studies under Anaxagoras,[2] he strongly objects to the system of that philosopher, as we have already seen, on account of his leaving out all consideration of final causes.

Accordingly, in the dialogue which fills up this department of his system, he speaks in the person of the Pythagorean, Timæus, and strictly follows the Pythagorean notions. The detail of this dialogue consists of a history of the order of the formation of the universe in all its parts ; commencing with an account of the universe at large, and the hierarchy of the heavens, and ending with a minute explanation of the structure of man, in regard to his moral and intellectual, as well as his physical powers. And here mathematical figures and proportions are the principles into which the composition and motions of all bodies are resolved. But the theory on which the whole speculation turns, and which gives the explanation of the phenomena, is the theory of " the Best." It is an account of Good operating throughout the universe, conforming everything to itself, and constraining the untoward nature of body to yield to its sovereign power. An intelligent and good author of all things is assumed ; and his order of proceeding is inferred from that which presents itself to our view as " the best." Thus the Father of the universe constructs it after the eternal unchanging pattern ; " for that is the noblest of generated things, and the best of causes." He formed by his immediate operation whatever is of eternal unchanging nature. Nothing, indeed, but himself, is immortal and indissoluble by its own nature ; but, good as he is, he can never be disposed to destroy what is good. And therefore the fabric of the universe and the celestial beings, the generated and visible divinities included in it (with the highest order of whom Plato's description identifies the luminaries of the heavens), subsist eternally, not of themselves, but by virtue of their participation of good."[3] Whatever is subject to death,—as the bodily nature of man and brutes,—being imperfect, is the work of the generated divinities, imitating the power of the Supreme. It is with these secondary Gods that he connects the popular mythology ; deriving from them the parentage of Saturn, and Jove, and the other objects of heathen worship ; and leaving the further account of their origin to be given by the current tradition. Thus the supreme God is described as the author of all good throughout the universe ; and where anything of evil or imperfection is, the agency of the subordinate powers, and the irrational nature of body, are interposed to guard him from imputation of evil.

Derived as his history of the universe evidently is from the early theogonies, it is very remarkable that it keeps clear altogether of the oriental dualism. There is but one active principle in his system of the universe, the principle of Good ; and nothing forms or moves but that only. " Let us not," indeed, he expressly says in another place, " conceive that there are any two gods, of contrary sentiments, causing the revolution of the universe."[4] He seems indeed to personify the irrational force of body, where he describes it under the name of *αναγκη*, necessity.[5] But he is evidently only speaking in metaphorical language here (that language probably derived from personifications found in the early cosmogonies), intending to represent that inert power by which nature, as we speak, acts according to its laws.

It must have been observed all along how important a place the nature of Body, *σωματοειδες*, occupies in Plato's philosophy. He has nowhere, however, attempted to give any positive description of the nature of Body. It is, in truth, rather a condition in order to the development of the ideal theory in connection with the phenomena of sensation, than any positive nature, according to his conception of it. He has left it in the most mysterious form: nor does he seem indeed to distinguish it from Space, when he shadows it out by negatives of the attributes of all actual existence. In giving an analysis of production, γενεσις, he enumerates three principles as concerned in the process: 1. The thing produced; 2. That in which it is produced; 3. That from which the thing produced takes the pattern of its production; depicting them under the analogy of the father, the mother, and the offspring.[1] The notion of body is here represented by the intermediate term of the three, namely, that in which the production takes place. "The nurse," "the general receptacle," and "the laboratory," ἐκμαγεῖον, are also expressions by which he endeavours to characterize it, as being in its own nature incapable of being presented to the senses or the intellect. "As a person," he says, "observing a perpetual succession of figures moulded of gold, if asked during the process what was moulded, could only safely answer, that it was gold;"[2] so we must be content to speak of this nature, calling it only a receptacle of forms or species, and not attributing to it any particular species whatever. The tendency of this theory of Body is obviously to remove all material phenomena from the class of real existences. And it seems to point to the origin of Plato's ideal theory in some older philosophy avowedly idealistic. At any rate, the speculation concerning body, as it stands in his system, leaves a hiatus in the transition from the world of Ideas to that of material existence.

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[1] *Phædrus.*

[2] *Ibid.*

[3] *Timæus*, pp. 303, 325.

[4] Μητ' αὖ δυο τινε θεω φρονοῦντε ἑαυτοις ἐναντια στρεφειν αυτον. (*Pol.* p. 30.)

[5] *Timæus*, p. 339.

The doctrine of Soul, as delivered by Plato, is properly the connecting link between the worlds of being and sensation. Hence is derived the importance of the theory of the immortality of the soul in his philosophy. For it is in the soul that the eternal and immutable is found in the presence of the incipient and evanescent; the intellectual idea in contact, so to say, with the phenomena of sense. The soul partakes of change, as it is connected with the bodily nature: it is eternal and unchangeable, as it is the seat of intelligence.

Soul, then, according to Plato, is the necessary condition for the development of intelligence in the universe, as Body is for the existence of sensation. Soul, therefore, was necessarily prior to Body, as the first condition in order to the constitution of the universe. It was the animating principle by means of which the Deity, when he brought the world out of the disorder and confusion of unreason, communicated intelligence to it, fashioning it after the pattern of the eternal ideas. And not only is the whole universe thus ensouled by the immediate agency of the Deity; but every particular system in it, in which any degree of intelligence is found united with body, has in the very gift of that intelligence a soul originally imparted to it by the Father of the universe himself.

This is the ultimate account of that immortality which Plato attributes to the soul of man. It is not as a *human* soul that it is immortal; but it derives an eternal existence from its being among the original intelligent units of the animated universe. We see indeed a constant production of living things in the world; but it is not, as they have being, that they are thus *produced* or *generated*. This is the result of that "diverse" nature which was blended in their original composition with their higher principles, viz. the natures of "sameness" and "being."

For these are the three principles into which Plato analyses Soul,—the principles of the SAME and the DIVERSE, and BEING;[3] and by these he explains the phenomena of its actual existence. No time can be assigned, then, to the origin of that which by its nature IS, and is the SAME essentially. No one soul, therefore, can now *begin* to exist. And again, whatever once exists can never cease to exist, unless there is anything capable of destroying its principles of Sameness and Being. But Death, as he shews, has no such power. It may disengage the soul from its present body by dissolving the body; but it cannot affect the essential vitality which is in the soul. This essential vitality is the direct contrary to death. It therefore recedes when death comes, according to that law of Contraries, which holds throughout the world of generation and corruption, and which is the agent in all changes. But it still lives as vigorously as ever, and returns to animate another body in the course of Generation.[4] Nor, for the same reason, can it maintain an unvaried perpetuity of existence. It remains ever undestroyed; but from that "diverse" principle which enters into its composition, it both alters in its internal character, and only imperfectly imitates the eternal nature by a successive re-appearance in the forms of new bodies.[5] Thus, whilst it returns to the sensible world, it migrates from the male to the female sex, or to forms of the lower animals, according to that condition of purity in which it departed from its last body, or its previous degree of intellectual cultivation. For, as we may observe, there is no original distinction, according to the theory, between the soul of one man and another, and the soul of man and brute. All are equal in intelligence and goodness, as the immediate work of the Divine Author. The varieties in the characters of souls arise from the operation of the inferior deities who framed the bodies of men and brutes, and the use which individuals may make of their circumstances in the world. Whilst the number of souls, then, remains the same, they are continually changing their habitations, and passing by death from one body to another in the different forms of animal life; undergoing degradation with the forms of inferior animals, or elevation with those of superior nature, according to their state in a former existence.[6]

The theory of the immortality of the soul thus rests entirely on the Theory of Ideas. It is the universality, and being, and truth, and perfection of the Ideas which prove the soul to be eternal.[7] Ideas are found existing in the mind, but their acquisition cannot be traced to any particular period of a man's present life. They have been there from time immemorial, for no one can say when they first appeared in his own mind. They were therefore born with us; and if so, they must have had existence before our birth: and who can limit that existence? They have existed, for ought we know to the contrary, from all eternity: and who, then, shall limit their existence by any future period? why may they not be born with us in a life subsequent to the present, as they were born with us in the present life, and so on to all eternity in endless generations? This is in substance the train of reasoning by which Plato seeks to establish the immortality of the soul. A similar argument has been reproduced in modern metaphysical treatises, variously modified and stated, but the same in substance. How little calculated it is to produce practical conviction, whilst we admire its ingenuity, is evidenced by Cicero's confession, that whilst he wept over the *Phædo*, his mind retained no deep impressions from the argument.[8]

This brings us to the consideration of Plato's ethical system, in its vital connection with his physical and metaphysical doctrines.

The two great principles on which his ethical system reposes, are; 1*st*, that no one is willingly evil;[1] 2*d*, that every one has in his own will a power of inducing changes in his character.[2]

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[1] *Timæus*, pp. 342–344.

[2] *Ibid.* p. 344.

[3] *Ibid.*

[4] ’Ανωλεθρον δε ὀν γενομενον, ἀλλ’ ουκ αἰωνιον. (*De Leg.* x. p. 106.)

[5] *Phædo; Meno.*

[6] *Timæus*, p. 433; *Phædo, ad fin.*

[7] ’Ουκοῦν, ει ἀει ἡ ἀληθεια ἡμῖν τῶν ὀντων ἐστιν ἐν τῇ ψυχῇ, ἀθανατος ἀν ἡ ψυχη εἰη. (*Meno*, p. 361.)

[8] Cicero, *Tusc. Qu.* i. 11.

These principles are only the counterpart ethical expressions of his theories of immutable Being, on the one hand, and of the world of phenomena, or mere Becoming, on the other.

For the soul of man, so far as it has any good or truth in it, is framed after the pattern of the eternal Ideas of the good and true. These Ideas, under the various moral aspects which they present, constitute its moral nature. All its desires, therefore, naturally tend to the Good and True. These qualities are what the soul would be. They are the mysterious realities to which it is striving to attain, in all those various efforts after Pleasure which it makes in the present life;—unconscious it may be, as it is in fact in the depraved, of the true nature of the objects to which its affections ultimately point. Still, if it be conceded that Ideas are the only proper Beings, and that everything else is phenomenal, or the mere product and offspring of the generating power of the eternal Ideas, it must also be admitted, that nothing else can be the real source of moral phenomena but the Good and True. In the moral, no less than in the physical world, a constant succession of passing events is found to take place. We perceive a variety of affections in the nature of man as he is in the world, directed to a variety of objects, each aiming at some particular gratification; one desire and its gratification passing away, and others succeeding it in endless flow. All this restless course, then, of moral events exhibited in the life of man is phenomenal; not in the sense of its having no reality whatever, but of its having no permanent reality—of its being no more in the result than effort towards being—restless, endless effort towards that which may give rest and full satisfaction, and stable being.

This ultimate object, then, however indistinctly sought, is the aim of every individual soul of man. Some, indeed, avowedly make mere sensual gratification the end of their desires. They endeavour to satisfy themselves with the limited and the evanescent. But the true cause of all that perverted activity which they display, is the Good itself. They know not what the Good is; but they love it in spite of themselves, and bear evidence, by their life of unceasing pursuit, that they are secretly actuated by the desire of it,—and that they can find no rest in anything short of it. Their soul, originally formed in the likeness of the Deity, can never willingly be separated from its Divine image. In the midst of its wildest aberrations, it feels the attraction of like to like, impelling, and at the same time reclaiming it to right.

This accordingly is Plato's meaning in the principle, which he so emphatically lays down, that "no one is willingly evil." It is very different, we may observe, from saying that no one commits evil willingly. And Plato himself takes care to guard his theory from this misconstruction. He readily grants, that acts of wrong are distinguished by being voluntary and involuntary, without which there could be neither merit nor demerit; but he strenuously maintains that this distinction does not apply to evil itself. It is in all cases involuntary. No one can choose it in itself. It is necessarily the object of aversion, as the good is invariably the object of choice and pursuit.

How is it, then, it will be inquired, that men do become evil;—that whilst they are really seeking to be conformed to a divine pattern, they practically do what is evil, and, losing more and more of their likeness to the Eternal Being, conform themselves rather to the fleeting character of the world of sensation?

The explanation is found in the other great principle of Plato's philosophy, the theory of Becoming, to which we have referred. Change is the characteristic of all that belongs to this subject; as immutability is the characteristic of Being. The course itself of successive phenomena may be varied by impressions from circumstances. In the soul there is a principle of change in the power of regulating the desires,—in indulging them to excess, or moderating them, according to the will. And the circumstances in which the soul is placed, as connected with the sensible world by means of the body, present the occasion for such change. The humours and distempers of the body produce discomposure in the soul. It becomes diseased analogously to the body. This state of disease is what is commonly called folly, *ἀνοια*; and it takes the form either of madness, *μανια*, or of mere ignorance, *ἀμαθια*. Where even ignorance only is the result, the internal harmony of the soul is disturbed. Pleasures and pains are unduly magnified; the democracy of the passions prevails; and the ascendancy of reason is cast down. In addition to these disturbances or ailments through the body, come the influences of evil governments, evil public lessons, evil education. Hence the soul is changed from what it was when it first came from the hands of its Divine author. The eternal Ideas after which it was framed are not effaced from it. This cannot be; for then it would cease to have being; but it loses distinct apprehension of them,—mistakes appearances of good for good itself,—and under that delusion willingly does evil, and presumes on obtaining happiness by a course of evil conduct.

But the same principle of change in the soul gives an opening also for its moral restoration. As the soul is deteriorated by the contagion of the body, so it may also be restored to a sound state by remedial treatment. The yielding to every passing desire, and suffering the desires to grow out of proportion, and destroy the harmony of the soul, is the cause of men's falling into that blindness which hides the good from their mental eye. By restraining them, and moderating the desires, the internal disorder is gradually corrected; reason resumes its ascendancy; the soul once more "sees and hears aright," and thus returns to that good to which its desires naturally tend. It is a long process, indeed, by which the restoration is effected; a process of gradual purification, *καθαρσις*, of the soul, by chastisement and suffering. Nor is it accordingly completed in a single life; many courses of existence must be passed through. Not only is the present life of the soul a consequence of its conduct in a former one; but it is destined to many successive stages of existence, each adapted to the character acquired at the stage next preceding, until its defilements are purged away.

These ethical doctrines of the philosopher, when divested of the extravagance of his theory, so far accord with the truth both of inspiration and experience, as they indicate, that the utmost man can do in the present life is insufficient to restore in him the lost image of God. Whilst they lay down this truth under the disguise of the remedial process of the transmigration of the soul, they further agree with the inspired authority, and with experience, in imposing on man the duty of *commencing* the process of restoration, and in holding him strictly responsible for the state of his mind and affections, through that power of self-direction and capacity of improvement by discipline, with which he has been endued. Thus does he also bear evidence both to the fact of the perfection of man at his creation, and that of his existing corruption. But he differs from the Scripture account of that corruption, in making it originally a physical rather than a moral debasement,

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[1] *Timæus*, 218; *De Legibuc*, ix.

[2] *De Legibus*, x.; *Ibid.* v. p. 212; *Ibid.* ix. p. 17; *Phileb.* p. 231.

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and representing it as taking place by a gradual process, and not by a sudden and entire fall, the effect of a first transgression of a positive divine command.

The Sophists, indeed, boasted of their power of transforming the characters of men, and accordingly made great profession of "teaching virtue."[1] But they coupled with this pretension, the admission, that all opinions on moral, no less than on other subjects, are equally true. All opinions in morals, they said, are true; "but all are not good. What we would effect, therefore, is to lead men to such opinions as we know also to be both good and wise."[2] But this was a mere evasion; for if all opinions are equally true, then must also each man's view of good be true, as well as that which his instructor would inculcate on him; and there is no fixed standard to which he may be conformed. Plato's theory of good, as the sole object of desire,—or the invariable tendency of the will to good, and its invariable aversion from evil,—was a strong ground of opposition to the sophistical doctrine. It pointed out that there was a principle in man superior to instruction, and independent of the accidents of worldly circumstances, the Θεος μετρον, the "God-measure," the fixed Divine standard, to which all moral teaching should be directed, and from a reference to which all moral discipline obtained its value.

From this mode of enunciating the fundamental principles of morals, it followed, that the practical morality which Plato teaches, should be directed to the means of removing the false appearances of good by which the mind is deluded to evil. He shews, accordingly, that there are false pleasures as well as false opinions—that men's ignorance extends, not only to mistakes in regard to their wealth or bodily accomplishments, but as to their moral characters; for that most men think themselves better than they really are.[3] Thus does he apply to morals more particularly, the general confession which his philosophy exacts of its disciple on all subjects, that he knows not what he presumed he knew, and sends every one to learn himself, in order that he may be a moral man.[4]

This, therefore, according to Plato, is the great purpose for which philosophy must be cultivated. Philosophy alone can open the eyes to see the true value of things, and alone elevate the mind from the evanescent region of the phenomenal world to the seat of true and eternal Being.

For the same reason Dialectic, as *immediately* conversant about the Ideas of the good and true, is the ultimate study of him that would seek to educate and improve the powers of his soul to the utmost.

Philosophy and morality, in fact, in his system, perfectly coincide. The love of truth is also the love of good, and the love of good is the love of truth.[5] The same process by which the good man is effected, philosophically viewed, is a power of analysing pleasure and pains, an art of mensuration, enabling the mind to discriminate between Truth and Good on the one hand, and their semblances on the other, and distinctly to apprehend them, under whatever disguise they may be presented and obscured by the senses.[6] Morally viewed, it is the one motive of the love of truth and good predominating over, and purifying, and absorbing into itself, every desire of human nature.[7] In the first view, it is wisdom or philosophy; in the latter, it is purification,—and perfect virtue,—and discipline of immortality,—the resemblance and participation of the Deity.[8]

These views of moral truth are in themselves certainly grand and ennobling. As guides, however, to duty, they are deficient in that particularity and homeliness of application, which are required for the real business of morality. Their tendency, too, to contemplative mysticism is obvious, left as they are by Plato in undefined outline, and clothed in the charms of his imaginative eloquence. Nor shall we wonder that they have easily combined with the feeling of asceticism, so congenial to the human heart. The contempt which they throw over everything belonging to the bodily nature of man,—the delusiveness imputed to the senses, without any limitation of it, or guard against abuse of the theory,—and the abstractedness from the world which they propose,—admit of being construed into a theory of mortification of the body, and of the purifying efficacy of self-inflicted punishments. These tendencies, indeed, of Plato's ethical doctrines, were, not long after his time, exemplified in the apathy and austerity of the Stoic morality. And it is well known to what extent they have been developed in the teaching and practice of religionists of all creeds. It cannot be denied, also, that where they take hold of a morbid and susceptible temperament of mind, they tend to substitute, in such a case, the morality of imagination and sentiment for that of common sense and household feeling, and to fritter away the convictions of duty into mere proprieties of taste; so that even whilst they elevate the character above sordid and vulgar seductions of pleasure, they emasculate and corrupt it, through the very excess of its refinement.

As bad education was regarded by Plato as the other great cause of human corruption, in addition to the influence of Body on the soul, he directs a large portion of his philosophical disquisitions to correct the evil arising from the second source. His ethical discussions go to the limiting of the desires, and curing the diseases produced by them in the soul. His political discussions have for their immediate object, the laying down right principles of education, and enforcing them by the constitution, laws, and power of the state.[9] His two great works, the most elaborate of his writings, the Dialogues of the *Republic* and the *Laws*, are rather theories of Education than of Government and Laws. The former indeed inquires more particularly into the principles on which a right government may be formed; whilst the latter gives a systematic view of the principles of legislation. Both, however, have in view the improvement of human nature by social institutions expressly framed for that purpose. It has been supposed that in the *Republic* we have his theory of a perfect state, and in the *Laws* a practical exemplification of the theory. But this is clearly a mistake. Both are doubtless intended by Plato as theoretical disquisitions on the political matters of which they treat, whilst the real matter in hand is Education.[10] This is expressly asserted by Plato himself, when he compares his legislation to the method of the philosophical physician.

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[1] Gorgias, however, laughed at the other Sophists for pretending to teach virtue. He professed only the art of words. [2] *Protag.*

[3] Πολυ δε πλεῖστοι γε, οἶμαι, περι το τριτον εἰδος ἐν ταῖς ψυχαῖς τουτων διημαρτηκασιν ἀρετῆς, δοξαζοντες βελτιους ἑαυτους, οὐκ ὀντες. (*Philebus*, p. 285.)

[4] Το γνῶθι σαυτον, λεγεις, ὦ Σωκρατες, κ. τ. λ. (*Ibid.* p. 284.) This is drawn out in a beautiful passage of the *Charmides.* Σχεδον γαρ τι ἐγωγε αὐτο πουτο φημι εἶναι σωφροσυνην, το γιγνωσκειν ἑαυτον, κ. τ. λ. (*Charm.* pp. 130–135.)

[5] Μητ᾽ εἰς τινας ὠφελείας ἐπιστημῶν βλεψαντες, μητε τινας εὐδοκιμιας, ἀλλ᾽ εἰτις πεφυκε τῆς ψυχῆς ἡμῶν δυναμις ἐρᾷν τε τοῦ ἀληθοῦς, και παντα ἑνεκα τουτου πραττειν. (*Philebus*, p. 305.)

[6] *Polit.*; *Protagoras.* He also characterizes it as a knowledge of geometrical equality, opposed to πλεονεξια.

[7] *Conviv.* p. 247, *et seq.*

[8] Διο και πειρᾶσθαι χρη ἐνθενδε ἐκεισε φευγειν ὁτι ταχιστα· φυγη δε, ὁμοιωσις θεῷ κατα το δυνατον· ὁμοιωσις δε, δικαιον και ὁσιον μετα φρονησεως γενεσθαι, κ. τ. λ. (*Theætet.* p. 121.)

[9] *De Legibus*, vii. p. 354.

[10] Πρῶτον δη οὖν προς τον λογον, ὁρισωμεθα παιδειαν τι ποτ᾽ ἐστι, και τινα δυναμιν ἐχει· δια γαρ ταυτης φαμεν ἰτεον εἶναι τον προκεχειρισμενον ἐν τῷ νῦν, λογον ὑφ᾽ ἡμῶν, μεχρι περ ἀν πρὸς τον θεον ἀφικηται. (*Ibid.* i. p. 41.)

When the mere empiric, he observes, should hear such a physician discoursing to his patient of the origin of the disease, and ascending to the speculation on nature, he would be disposed to object that such proceeding was folly; "for it was not healing the sick man, but rather educating him, as if he wanted to become a physician, and not to be made well."[1] The like objection, he says, might be applied to his method of legislation; for, "whoever pursues the inquiry concerning laws," he adds, "as we are doing now, educates the citizens, but does not legislate."[2] And he goes on to say, in the person of the chief speaker, addressing the other interlocutors of the Dialogue, that in their work of legislation they were at leisure, as speculators on the subject, to consider, not what was most necessary, but what was best.[3]

We are not to suppose, then, that Plato had in view the actual foundation of a state, according to the principles of government and legislation laid down in his two famous dialogues. His object was to give an example of the most perfect life,[4] free from those impediments which all existing governments and laws threw across the path of the virtuous man. As philosophy is the guide of private life, elevating it to the knowledge of the Good and True, so he would have philosophy also seated on the throne of government, and exhibit the eternal Ideas of Good and Truth, modifying society after their pattern. Hence it is that he overlooks impossibilities in his arrangements; as is pointed out by Aristotle in his acute comments on the leading points of Plato's political theories.[5] All is sacrificed, in fact, to the one great object of Plato's mind, the sketching of the Idea of the Good as a social principle, apart from the evil influences of society.

The most extravagant hypotheses, accordingly, are put forward in this part of his philosophy; not indeed with a view of their being ever exemplified in any institutions of real life, but in extreme contrast with the existing selfishness of human society, and as theoretic developments of the unchangeable idea of good. Such, for example, is his theory of a community of wives and children, and the training of women to the hardiest exercises of the gymnasium and of war. We justly take exception at the immorality and unnaturalness of such hypotheses. But Plato looks down upon man from the height of his sublime theory. He sees everything in the unity and invariableness of that theory, and overlooks distinctions deeply founded in the nature of man. Thus it is that in his view man himself becomes a thing of little consideration or importance,—a sort of plaything of the Deity, θεου τι παιγνιον, scarcely worth any serious attention. "You disparage altogether the race of man," says an interlocutor in the Dialogue of the Laws. "Wonder not at it," replies the Athenian; "but make allowance for me; for it was from looking off to the Deity, and under this impression, that I said what I have now expressed. However, let it be granted that our race is not insignificant, if you like, but worth some serious consideration."[6] It is in this spirit that he himself sports with human nature, as if human beings were only so many chessmen, to be moved on the board, so as to display the admirable design of the disposing mind, and illustrate the working of the eternal Ideas. His fault is the same as in his physical speculations, that of commencing from the final cause, or the notion of the Best, and forming the world of social life after that, instead of rising from the study of its actual formation to the notion of the Best;—or at least in supposing, that he could arrive at a just view of the divine pattern of Good, by presenting a theoretic copy of it, after his own conceptions of the Best. But such extravagancies as those we have referred to, could only have proceeded from so bold a mind as that of Plato,—a mind, not checked by the repulsiveness of particular consequences from pushing a theory to the utmost.

At the same time, this fundamental notion of the Divine standard and pattern on which he proceeds, imparts a solemn dignity, in the midst of these excesses of the spirit of theory, to the substance of his speculations on government and laws.

Religion is thus secured as the basis of all right government and legislation. That government only which most resembles a theocracy is, in Plato's view, a true polity. All others, popularly termed governments, as democracy, oligarchy, aristocracy, monarchy, are merely settlements of cities, and not *Polities*,[7] being called after that power which has the ascendancy, in each over the other parts of the state. So far as a state is truly such, it ought to be named, he says, after the true God, the lord over all intelligent beings. Governments, as they exist, are only the results of the struggles of contending factions: whence we find, as he observes, one party in the ascendancy excluding and depressing another, in order to its own maintenance, and no concern taken for the welfare of the whole community. To remedy this general evil of existing governments, he would have the simple and straightforward course of the divine procedure brought before the minds of men, and a conformity with that procedure inculcated on them as the only rule of life and happiness. "God," he teaches, in an animated and noble passage,[8] "as the ancient story is, holding the beginning, and end, and middle of all things that are, describes a straight line, according to nature, as he walks his circuit.[9] In his train ever follows Justice, the avenger of those that are left behind by the divine law; to which, he that would be happy, keeping close, follows in the train, humble and orderly; but whoever is puffed up with high boasting, or elated with wealth, or honours, or grace of person, together with youthfulness and folly,—his soul burning with insolence, as presuming, that he requires neither ruler nor any guide, but is competent even to be a guide to others,—is left, forsaken of God. And being left, and taking to himself others besides, such as he is, he frolics, throwing everything into promiscuous confusion. And to many he seems to be some one; but, after no long time, undergoing a retribution, of which he cannot complain, to Justice, he utterly subverts himself, and his house, and his city."[10]

Here we have emphatically recognized the great truth, that the foundations of all government and law are laid in the unchanging nature of the Divine Being. The law of right, as exemplified in the dominion of party, is the law of the strongest, fluctuating with the accidents of power, and never attaining to any permanent being. Such was the law of right, as taught by the Sophists, from city to city, and which was fully established in public opinion throughout Greece,—not only as manifested in the factious character of the particular governments, but avowedly declared and acted on as a principle of conduct. "It is nothing," say Athenian ambassadors, "out of the course of the established opinion of men concerning the Divine Being, or

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[1] *De Legibus*, ix. p. 11.

[2] *Ibid.*

[3] *Ibid.* p. 12.

[4] Πᾶσα οὖν ἡμῖν ἡ πολιτεια ξυνεστηκε μιμησις τοῦ καλλιστου και ἀριστου βιου· (*Ibid.* vii. p. 380.) Ταῦτα δη καθαπερ ἴσως ἐν μυθῳ, τανῦν λεγομεν' ἐστιν εὐχαι· πολυ γε μην ἀριστα, ἐιπερ γιγνοιτο ἐν πασαις πολεσι γιγνοιτο ἀν· (*Ibid.* viii. p. 423.)

[5] Aristot. *Politic.* ii. app. 1, ver. 4.

[6] *De Legibus*, vii. p. 353.

[7] *Ibid.* iv. 178.

[8] Χρῆν δ' ἐιπερ τοῦ τοιουτου την πολιν ἐδει ἐπονομαζεσθαι, το τοῦ αληθοῦς τοῦ τῶν νοῦν ἐχοντων δεσποζοντος θεοῦ ὀνομα λεγεσθαι. (*Ibid.* p. 179.)

[9] The train of thought is entirely mathematical: 'Αρχην τε και τελευτην και μεσα τῶν ὀντων ἁπαντων ἐχων, ἐυθεῖαν περαινει κατα φυσιν περιπορευομενος· (*Ibid.* iv. p. 185.)

[10] *Ibid.*

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their sentiments concerning themselves, that we expect or do. For we hold that the Divine Nature, so far as we can judge of it, and human nature, as we see clearly, by an instinctive necessity, ever exercise power where they can obtain the mastery. Nor are we the first, either to propose the law, or to use it when laid down: it was in being when we took it up; and it will subsist for ever, for us to transmit to others after us; and we merely act upon it; convinced, that yourselves, no less than others, were you placed in the same power in which we are, would do so."[1] Here, then, is the law which belongs to the region of instability,—to that nature which is ever *becoming*, and never *is*. Contrast with this Plato's principle, which deduces the origin of law from the eternal IDEA of GOOD, and it will then be more distinctly seen what the spirit of Plato's legislation really is.

It follows, indeed, from his principle, that all instituted law is imperfect.[2] And he admits, accordingly, that if a perfectly virtuous ruler could be established on earth, it would be best that the business of government should be carried on by his will; which would in such a case be only the copy of the Divine exemplar of right. But as this is past hope in the present condition of human things, the substitute for the more perfect system is the institution of laws framed after the eternal Idea of Good; not laws adapted merely to the preservation of a particular form of polity, but embodying in them the immutable principles of right. And even such laws, as being matters of institution, are inferior in dignity to unwritten laws—the principles of right—which, themselves resting on no external sanction, are yet the conserving principles of all positive laws.

Having his eye fixed on the eternal pattern of the good and the true, Plato looked with a feeling of disappointment and disgust at the several forms of polity which the states of Greece exhibited. He is generally thought to have inclined to a preference of aristocracy, and to have regarded with aversion all popular government. But though it is probable, that, from what he saw of the tyranny of an unrestrained democracy, he sighed in secret for a better order of things, we cannot conclude from his political speculations that he regarded any single polity as the best. He, in fact, condemns all particular forms;[3] and when he asserts a preference, it is for a polity such as was nowhere seen in his times, combining in it monarchy, aristocracy, and democracy.[4] But in his view, as governments then existed, they were all one-sided; the dominion of one part of a community over the rest, and not the dominion of good over the whole. This dominion, as we have observed, was only to be found in the government of God over the world, and to it, therefore, he would have all human government conformed. His sole preference, then, is for a theocracy, if such could be realized on earth. His slighting manner of speaking of the lower orders of society, and of all indeed but those who are gifted with superior talents and other natural endowments, is to be ascribed to his general low estimate of human nature, considered apart from that cultivation, which the highest and most intellectual studies impart to it.

Respect for antiquity and prescriptive authority is strongly inculcated by Plato. In nothing was the changeableness of all generated things more evident than in the ever-varying forms of the states of Greece, and especially of Athens itself. The democracy of Athens had been an universal market, παντοπωλιον, as Plato terms an extreme democracy of all sorts of polities.[5] And laws had so far lost their force there in the most corrupt times, that everything was transacted by the decrees of the day; the variable determinations of popular assemblies being substituted practically in the place of the records of former experience and wisdom. Early legislators had devised expedients for counteracting this love of change on the part of their countrymen, as Solon, for instance, and Lycurgus, had done. And in some instances, we find a temporary and partial expedient adopted, by the popular assembly itself fixing the penalty of death to the proposal of rescinding a measure before a certain period.[6] Plato's expedient was supplied by the principle itself of his philosophy. If the Idea of Good was eternal and unchangeable, the constant pursuit of change must lead men astray from their happiness and the truth. They must be called back, therefore, from that which is present and passing, to the recollection of the past. They must not look on wisdom as a thing which is different to-day from what it was yesterday, or in former times, but hold it as what by its very nature is unalterable. To regard it as susceptible of improvement in the lapse of time, would be to deny its proper Being, to reduce it to the condition of mere Becoming. A distrust in the wisdom of any existing generation of men, and a sacred reverence for that of former generations, and especially for the earliest traditions of knowledge, would naturally be inculcated in such a philosophy. Thus he highly commends the Lacedemonian and Cretan polities for the provision, that no young man should inquire whether the laws were good or bad, but that "all should with one voice and with one mouth agree in declaring that everything in them is well appointed, as being by the appointment of gods;" and that no other sentiment should be allowed to be expressed. Further, not even does he permit a young person to be present when such matters are considered by the old.[7] In the same spirit, the Egyptian immutability in the arts for thousands of years, is admired, as a proof of admirable legislative and political wisdom.[8] Even in regard to the fine arts, and to sports and amusements, he reprobates the tendency to innovation, as dangerous to the serious institutions of a state, on the ground, that changes in these lighter matters "imperceptibly change the manners of the young, and bring what is primitive into disrepute, and what is modern into repute;" and that there cannot be a greater mischief to states than such a habit of "blaming antiquity."[9]

All this, which under certain limitations may be true, appears, when thus broadly laid down by Plato, a misapplication of the proper sanction of religious truth to truth in general. In religion, the only question being what is really taught by its Divine author, there can be no addition made in the course of time to the truths revealed, except by another divine revelation, though there may be advancement in the exposition and teaching of it. What is primitive and ancient, accordingly, in this subject, once fully ascertained to be so, is the truth, and the whole truth. Only we must not mistake antiquity of exposition and comment, for primitiveness of the truth itself; for these admit of improved knowledge by human study, when the original truth itself does not. The contest between the advocates of the respective claims of the past and of the present, in the matter of knowledge, is doubtless much older than the time of Plato. But his authority and eloquence have probably been mainly instrumental in starting and sustaining the controversy in modern times, through the early reception of his philosophy into the literature of the Christian church.

But we may further see a reason for the stress which Plato lays on the wisdom of prescription and authority, in that state of public opinion to which he is addressing himself. It was not, as might be supposed, a state of things corresponding exactly to a demand for religious or civil changes, in our days, under established governments and institutions. The question of change is now gravely discussed, and deliberately carried or rejected, not with the view of unsettling everything, but in order that some particular institution or law may be *established* for the future. Except in violent outbreaks of human passions long pent up within artificial restraints, exasperated by resistance, and at length forcing their way out, and levelling all barriers before them, as in the instance of the French revolution, it cannot be said with truth, of the struggles for particular changes in modern institutions, that they have been actuated by the mere desire of change, and the hatred of everything established. The religion and the civilization of modern times have in some measure presented a check to this. But at the centre of movement in Greece, change was the order of the day. Athens would neither rest itself, nor suffer other states to rest. When its very demagogues are forced on some occasions to endeavour to repress this incessant changeableness; as Cleon was, when he told the Athenians it was better "to have worse laws unmoved, than good laws perpetually changed;"[1]—it is evident that the spirit of change was then developed in its most fearful form. For we find the magician himself who had evoked it, starting in terror at the apparition, and finding it too strong for his direction and control. *Δοῦλοι ὀντες τῶν ἀει ἀτοπων, ὑπεροπται δε τῶν ἐιωθοτων*, "Slaves of every new extravagance, but despisers of accustomed things,"[2] are the words with which he attempts to exorcise it, and which the historian of the times puts into the mouth of one who, as the creature of the system, could most pointedly characterize it. Such was that spirit, then, against which Plato had to contend. It was an enemy not only to the existing government, but to all government, and all law, and all religion and morality. It demanded, therefore, the most forcible counteraction. It was to be met by inculcation of the opposite. According to his own universal principle, contrary was to be expelled by contrary. Everything that was ancient was to be upheld, accordingly, as worthy of veneration and acceptance, simply because it was ancient. The voice itself of antiquity, though speaking without evidence, was to be received with implicit acquiescence and submission. Thus it is that Plato is found strenuously appealing to the instinctive feeling of his countrymen, which they still retained in spite of the prevailing folly,—the feeling with which they so fondly reverted to their early glories, and delighted to view themselves in the past;—and labouring to correct their vacillations of present opinion by recalling them to the stable lessons of *memory*.

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[1] Thucyd. v. 105.

[2] Ὁτι νομος οὐκ ἀν ποτε δυναιτο το τε ἀριστον και το δικαιοτατον, κ. τ. λ. (*Polit.* p. 82.)

[3] Ἀλλα την προσηκουσαν αὐτῇ τινα τῶν νῦν λεγεις πολιτειῶν· οὐδ᾽ ἡντιναοῦν εἰπον, κ. τ. λ. (*Rep.* vi. p. 96.)

[4] *De Leg.* iii. pp. 137, 138.

[5] *Rep.* viii.

[6] Thucyd. ii. 24.

[7] *De Legibus*, i. 24, 25.

[8] *De Legibus*, ii. p. 67.

[9] *Ibid.* vii. pp. 338, 339.

Political philosophy, then, according to Plato, is the history of those changes which the will of man produces in the matter of government and laws, and an endeavour to limit those changes by restoring in the social world the primitive order and rule.

Education is the means by which those changes are counteracted. It avails itself of that principle of contrariety by which all changes are carried on; and endeavours to expel the evil by inducing the good. The process by which it carries on this effect is, a discipline of the intellect, prescribed by the state, and promoted by all its institutions and customs, framed, as these are supposed to be, after the idea of the Sovereign Good. That discipline lays down a course of exercise for the body as well as for the intellect, that the body may be brought into the best condition, in order to the exercise of the intellect. The intellect itself it conducts through the steps of the several sciences, from the bodily and sensible to the unembodied and intellectual,—from the phenomenal and changeable to that which has real being, and is unchangeable. And thus in Plato's system it is classed under the two comprehensive heads of Gymnastics and Music; the latter term being understood, according to its derivation, to denote literature in general. Philosophy itself was the ultimate attainment of education,—the result of the whole intellectual training of the accomplished man. Ostensibly, under this system, there was no peculiar discipline of the heart. Indirectly there was; so far as it inculcated purification and self-denial. But the strengthening and elevating of the intellect was its direct object. Its tendency was thus to exalt the virtues of the intellect above those of the heart; and, in opposition to the evidence of facts, to assert the power of knowledge over the determinations of the will. Not that Plato denies the existence of what we call self-command, or that controlling of the passions which is the result of a previous struggle with them. But he did not admit (as Aristotle does, and urges against him[3]) that reason could ever be overpowered by the passions, or that if there were a distinct knowledge of the truth in the mind, it could give way to passion.

In the matter of Religion, Plato's theory of Ideas led him to see that there were truths above the evidence belonging to Experience, and which must be received solely on the ground of the Divine authority. For whilst he taught that the mind of man must work its way up to the Ideas by a course of argument and examination of evidence, yet, having reached the Ideas themselves, it had attained the ultimatum of truth; no further evidence of these was to be sought; they carried their own light in themselves. So, when any truth was presented to the mind, which related immediately to the Divine Being, it was not to be supposed capable of being examined in itself, and established on any higher ground of internal evidence, but must at once be admitted, if there were sufficient external authority for it. The only question respecting such truths is, are they *historically* true? Is it certain, or at least highly probable, that they have descended to us from the Father of Lights himself? Have we reason to think that they were originally real divine communications,—and are they vouched to us as such by a competent evidence?[4] Now, in regard to the primary principles of the mind, such as we have before spoken of, though they are not evidenced by any higher principles, or by any conclusions from Experience, they carry their own evidence, by their invariable presence in the mind on certain occasions, being naturally suggested by such occasions to every rational understanding. But the truths of religion are of a different nature. They cannot be authenticated by the mind itself to itself, as being out of its range of thought. They must therefore be authenticated from without. And in regard to these, accordingly, we must appeal to the Reason and Word of God, as the simple, and proper, and unanswerable vouchers of them.

This is the account of Plato's disclaimer of all evidence, either of demonstration or probability, on matters strictly divine, and his frequent appeal to mythic traditions when his discussion touches a mystery of the Divine Being or the Divine conduct. He resolves the whole authority of such matters into the evidence of "ancient story," *παλαιος λογος*,[5]—and "primitive hearing," *ἀρχαια ἀκοη*,—and "learning hoary with time," *μαθημα χρονῳ πολιον*.[6] In speaking of the generation of the subordinate divinities, in the *Timæus*, he makes an observation applicable to the whole subject of divine things as treated by him. Instead of entering into explicit accounts of them, he observes that the subject is "too great for us, and that we must believe those who have spoken before, being the offspring of gods, in the way in which they said it, and because they must be conceived to have known their own ancestors;" adding, that we cannot refuse credit to the "sons of gods, although they speak without probabilities and necessary demonstrations, but must follow the rule of believing them on their word, as declaring what belongs to them."[1] He commends, too, the primitive generation of men for their docility in following rules of life founded on oral tradition,—their "holding as true what was said τα λεγομενα, concerning both gods and men."[2] Again, speaking of the state of the dead, and their interest in the concerns of men on earth, he appeals to the same kind of evidence. "We must believe," he says, "the voices of others in such matters, so current as they are, and so extremely ancient; and it is enough for our belief that legislators, unless they be proved absolutely unwise, have asserted them."[3] So justly does he insist on the reasonableness of being content with the voice of a declaratory authority in matters incapable, by their nature, of a direct evidence from our reason.

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[1] Thucyd. iii. 37.

[2] *Ibid.* c. 38.

[3] Aristot. *Ethic. Nic.* vii. 2. Aristotle, though controverting the extreme view of the doctrine of Plato on this point, in the result nearly coincides with him. *Ibid.* c. 3.

[4] Ἐαν ουν, ὠ Σωκ., πολλα πολλων εἰποντων περι θεων και της του παντος γενεσεως, μη δυνατοι γιγνωμεθα παντη παντως ἀυ τους αὐτους αὐτοῖς ὁμολογουμενους· και ἀπηκριβωμενους λογους ἀποδουναι, μη θαυμασης, κ. τ. λ. (*Timæus*, p. 304.)

[5] Ονπερ ὁι παλαιοι τε και σοφοι λεγουσιν· ὁ ὁμοιος τῳ ὁμοιῳ. (*Gorgias*, p. 137.)

[6] *Timæus*, p. 291.

By the heathen philosopher, in the absence of an authentic revelation, the authority for such truths was naturally sought in ancient traditions,—traditions mounting up beyond all memory of their origin, and therefore referable to times when the world was yet fresh from the hand of God. The voice of remote and undefined antiquity, indeed, by a natural delusion, represents itself to the mind as but little different from the sanction of eternal truth. For it is but a slight and imperceptible transition from the indefinite to the infinite. Many such traditions were found in the heathen mythology, connecting themselves with another order of things, when gods conversed with men on earth. Some of them, certainly, were full of absurdity and profaneness; and all were disfigured with the colouring of fable; but still there were some, beautiful in the conception, and sublime and impressive in the doctrine. Of this latter character, for the most part, are those exquisite mythical legends, with which Plato has diversified his discussions, throwing the solemnity of religion over truths which he would especially enforce.

Thus, though he has elaborately argued the immortality of the soul, he is not content to leave the question on those abstract grounds of conviction. He feels that the conviction which may practically influence the conduct, must be drawn from another source,—that of a simple belief in some authority declaring it,—when he closes the discussion, as in the *Phædo*, and in other places, with a scenic representation, from the legends of ancient tradition, of the doctrines which he has been enforcing. The whole of the *Timæus*, in fact, is a legend rather than a philosophical inquiry. It appeals, for the reception of its truths, to the shadows with which it veils them, and the mystic echoes of sounds heard by the listening ear from afar. In that legend, indeed, we have very considerable evidence of the pure source, from which the heathen world drew much of the sacred truth that was wrapped up and disfigured in their fables. We perceive in such a document of ancient philosophy, at once the sure and wide-spread knowledge resulting from a scriptural Revelation, and the obscurity and fallibility of the information of Tradition. To this effect are the description in the *Timæus*, of the universe as the "one" work of the "one Supreme Being,"—as the "visible likeness of one himself the object only of intellectual apprehension,"—as the "only-generated," μονογενης, of the Father of all things; and the strong assertion of the goodness, and beauty, and perfection of the universe; and particularly, in reference to this, that striking passage, "When the Father who generated it, perceived, both living and moving, the generated glory of the Everlasting Divinities, he was filled with admiration, and, being delighted, he further contemplated the working it still more to a resemblance of the pattern."[4] Add to these instances the simple and magnificent words which he has put into the mouth of the Father of the Universe, as an address to the generated gods, respecting the formation of the bodies of men and other living creatures.[5] The attributing to Him a speech at the first formation of man, is alone sufficiently remarkable; and the plural address with which it opens, makes the correspondence still closer to the sacred words, "*And God said, Let us make man in our image, after our likeness.*" The order of the generation of things, it may be further observed, agrees with the order of the creation. First the heavens and the earth are produced, and then the living creatures; and among these Man, designated as "the most religious of animals."[6] But at the same time there is much confusion and degradation of the high subject. We look in vain for those sublime features of the inspired account, that the creation arose out of nothing, by the word of God. This is darkly intimated in the shadowy nature which the narrative assigns to Body; but, though it be but a shadow, Body still subsists in his system, as the co-eternal contrary of the Divine Intelligence. Traces of the descent of holy truth, in the like disguise, appear in the references found in Plato to early deluges and genealogies;[7] to the notion of God as the shepherd of his people;[8] and to accounts of variations in the course of the rising and setting of the sun.[9]

Such, then, is the character of Plato's philosophy, both in its general method, and in its results, as a theory of the universe, and an information respecting the leading branches of human knowledge.

It was concerned, we find, more in investigating and establishing first principles, than in drawing out results; in exciting the love of wisdom, rather than in aiding in the research after it. With him, indeed, philosophy and its method of inquiry, as we have seen, are one; and, in like manner, philosophy and its several branches coalesce in his system into one. We have spoken of his logical, and physical, and ethical doctrines, as if they were distinct subjects; but in his mind the one theory of Ideas held these several doctrines in its embrace, and made them indissolubly one with itself. For his design throughout is, to establish universal principles common to every subject, and on these to build a structure of philosophy,—a counterpart in the human mind to the universe itself, and comprehending therefore all that relates to the Deity, to man, and to the world. He would place the mind of the philosopher far above the scenes in which man lives, and endue him with a keenness and range of vision, extending over the whole region of speculation, and leaving no part, either from its largeness or from its minuteness, unexplored. The problem which he undertakes to solve is, how all things are both one and many; how, amidst the multiplicity of phenomena with which we are surrounded, a real unity still subsists and pervades the whole. He proceeds on the conviction, that to attain to this unity, so far at least as our faculties will enable us to attain to it

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[1] *Timæus*, p. 324.

[2] *De Leg.* iii. p. 111.

[3] *De Leg.* xi. 150.

[4] Ὡς δε κινηθεν τι αὐτο και ζων ἐνενοησε τῶν ἀιδιων θεῶν γεγονος ἀγαλμα ὁ γεννησας πατηρ, ἠγασθη τε, και εὐφρανθεις, ἐτι δη μᾶλλον ὁμοιον προς το παραδειγμα ἐπενοησεν ἀπεργασασθαι. (*Ibid.* pp. 316, 317.)

[5] Θεοι θεων ὧν ἐγω δημιουργος, πατηρ τε ἐργων, κ. τ. λ. (*Ibid.* p. 325.)

[6] Ζωον το θεοσεβεστατον. (*Ibid.* p. 326.)

[7] *Polit.* p. 290; *De Leg.* i.

[8] Θεος ἐνεμεν αὐτους αὐτος ἐπιστατων· καθαπερ νῦν ανθρωποι, ζῶον ὂν ἑτερον θειοτερον, ἀλλα γενη φαυλοτερα αὐτων νομευουσι. (*Polit.* p. 35.)

[9] *Polit.* p. 28. The same are evidently referred to by Herodotus in *Euterpe*, 142.

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(for in itself it is incomprehensible and ineffable), is to find the clue to that maze of sensible things which bewilders human observation. He was not intent, therefore, on distinguishing and arranging the several branches of knowledge, but on bringing all into subjection to his commanding theory of the perfect unity. He has not, in fact, elaborated, or even sketched, any one particular science. He has shewn how the sciences may be distributed, or rather furnished hints for such a distribution. But he has left the task of doing so to others after him, as subordinate agents, filling up the details and supplying the omissions of his system. His was characteristically a one-making mind. It analysed,—not, however, for the purpose of finding and arranging the component elements of a subject, but in search of the one vivifying principle, which gives form, and truth, and goodness, and beauty, to everything. He omits, accordingly, to examine with minuteness into secondary agencies, which are the proper study of the particular sciences, in order that he may direct attention to the master-principle, by which all subordinate principles are held together, and by which they work as concurring causes in the infinite variety of actual phenomena with such energy and constancy of operation.[1]

It was left for his pupil Aristotle to take up the business of philosophy where he had designedly left it unfinished, and, by a more rigorous method, to introduce order into the field of science, by assigning to each particular science its distinct objects and office.

It required, indeed, some philosopher worthy of such a master to take up the subject where Plato had left it, and to carry it out to the fulness of an instructive method, and a systematic exposition of truth; and such a successor was found in Aristotle. Aristotle, as controverting the Theory of Ideas, may perhaps be regarded by some as an antagonist, rather than a successor, to Plato. But every succeeding system of philosophy is partly a polemic against its predecessor, by whose labours it nevertheless has profited. So it was with the great movement of mind commenced by Plato. It languished under Speusippus and Xenocrates, and the still more remote successors in the Academia. But in the Lyceum, the rival school in name, but the rival only as the vigorous offspring of the declining parent, a crowd of hearers such as that whom the great magician of the Academia had called around him, was once more assembled, and Athens again assumed the form of an university. In Aristotle's system, accordingly, we see the productiveness of those germs of philosophy which the genius of Plato had planted and reared. Others cultivated the germs themselves; and some fostered them into a wild luxuriance. It was by being engrafted on the sturdy stock of Aristotle's mind, that they received fresh vigour, and produced fruits, though not strictly their own, yet partaking of their life and richness.[2]

If we take Plato's philosophy as a whole in its complex form, not simply as a system of philosophy, but a system in which philosophy, and eloquence, and poetry, and deep religious and moral feeling, are harmoniously combined, it stands alone in the history of literature. There is nothing which approaches to it under this point of view, nothing which may be properly regarded as a continuation of it. It is a splendid work of rare genius, like the Homeric poems or the Minerva of Phidias, which no other artist has ever equalled. Philosophical dialogues have been written in imitation of those of Plato; but how unlike to them, how altogether inferior to them in conception and execution! There is learning, and eloquence, and grace, in whatever the accomplished mind of Cicero has touched. But compare his most finished specimens in this way with the Dialogues of Plato, and what a deficiency appears! Dignity and refinement of mind, and an acquaintance with the stores of philosophy, shine forth in the Dialogues of Cicero. But we miss altogether the depth and the exquisiteness of thought, the range and the minuteness of vision, the exactness of reasoning, the lively sketches of character and manners, which interest and astonish us by their combination in the Dialogues of Plato. Xenophon had great knowledge of human nature, and has thrown an air of great naturalness over his simple descriptions, whether it is conversations and moral lessons that he relates, or stirring scenes of history. But his Socratic dialogues do not admit of comparison with the elaborate efforts of Plato. They were clearly intended only as accounts of what Socrates had taught, and did not aim at any artist-like effect, as compositions. Or, if we turn to the *Symposium* of Plutarch, there, again, much as the author admired and studied Plato, we observe an entire want of that tact in the management of the dialogue, which so engages our attention amidst the subtilties of Plato's discussions. If we compare, again, the imitations of Plato in the Dialogues of Berkeley and Shaftesbury, we find the like contrast as in those of Cicero. Superior as these are in composition to other efforts of the kind in our language, they still give no proper representation of the spirit or the form of the Platonic Dialogue. There is no life in the interlocutors of these Dialogues; and the author himself is scarcely concealed behind their masks. Nor are there any touches of natural feeling or incident to connect the argument with the personality of the speakers; such as those in the *Phædo*, where the discussion opens with the loosing of the chains from the limbs of Socrates, his bending and rubbing his leg, and expressing the pleasure arising from the contrast of his pain before; circumstances, not merely thrown in by way of dramatic interest, but leading, in immediate application, to the argument in hand. As we have said, then, the philosophy of Plato taken in connection with the admirable compositions in which it is contained, stands alone in the history of literature. It is due to the charm of the composition, that the interest of the reader is sustained amidst much of dry abstract speculation, requiring the closest attention, and considerable acquaintance with the subjects of philosophical discussion, in order to follow it. It was this charm in great measure, doubtless, which rendered the writings of Plato, in spite of their abstruseness and subtilty in many parts, so acceptable to Grecian taste. He had his critics also and censors; but all seem to have concurred in placing him at the head of the philosophical writers of Greece. Objection was taken by some to the severity of his sarcasm against the leading Sophists and other great names. Complaint, too, was made of his putting sentiments and words into the mouth of Socrates which Socrates had never used; and of his anachronisms, in bringing together in conversation, persons, who, from the period at which they flourished, could never have met. But these were merely minute criticisms. It was seen by those who entered into the spirit of his writings, that he was still the great master throughout,—that he was not giving, in his Dialogues, a history of individuals or of the times, but a general character of classes of men, and the prevailing tone, both of philosophical discussion and of popular opinion. The enlightened critic saw that Socrates, for example, is not pourtrayed by him simply as Socrates, but as the characteristic spokesman of the system on which he is engaged;—and in like manner, that when he brings together persons of different periods, he overlooks the anachronism, that he may enunciate the doctrines inquired into, in their proper person.

The perfection to which he wrought the style of his most elaborate Dialogues, will be apparent to those who study them accurately under this point of view. So fastidious, indeed, is the taste with which they have been wrought into their present form, that it cannot be duly appreciated without an accurate and even delicate observation. Every word seems chosen with care, and every clause of his periods made to flow with its proper rhythm; and this effect at the same time is produced out of the ordinary materials of the language. The words and idioms are those of conversation, and the way in which they are put together seems, at the first view, to be as unstudied as mere conversation. But the result is an exquisite composition, in regard to which we are at a loss to pronounce, whether the depth and the elegance of the thought, or the grace and propriety of expression, most prevail.[1] It is quite evident that he was not the first to compose Dialogues, were we to look simply to the finished form in which his Dialogues have been executed. They are, doubtless, not the first efforts in that way. But the school of Elea had preceded him in this style. More particularly, however, we are told, that Alcamenus of Teos was the first to write Dialogues; or at least his is the earliest name to which, on the testimony of Aristotle, in a work now lost, the honour of originating the Dialogue has been assigned. But we need look no further than to the Greek drama for the first thought of the Platonic Dialogue. The Mimes of Sophron, and the Comedies of Epicharmus, probably furnished materials from which he was enabled, if not to mould, at least to enrich his Dialogues. The Mimes of Sophron, indeed, it is said, found a place under his pillow.[2] And what are the *Protagoras*, the *Gorgias*, and the *Symposium*, it may be asked, the particular Dialogues in which he has most fully displayed his dramatic power, but philosophical comedies in prose, analogous to the *Clouds* of Aristophanes, and only differing from that play, as addressed to a higher class of hearers, and as intended, not to call forth the applause of spectators, but to elicit thought from a reader.

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[1] Ταῦτ' οὖν παντ' ἐς, των ξυναιτιων, οἷς θεος ὑπηρετουσι χρηται, την του ἀριστου κατα το δυνατον ἰδεαν ἀποτελῶν. (*Tim.* p. 336.) The genesis of the universe is from the union of νους and ἀναγκη, and the dominion of νους over ἀναγκη causes ἀναγκη to bring τῶν γιγνομενων τα πλειστα ἐπι το βελτιστον. (*Tim.* p. 339.)

[2] Dionysius of Halicarnassus speaks justly of Aristotle, as ὁ γνησιωτατος αὐτου μαθητης. (*Ep. ad Cn. Pomp.*)

Nor, in touching upon the peculiar excellencies of Plato's Dialogues, ought we to omit to notice especially, under this point of view, the delightful mythic narratives, with which he has adorned and relieved his abstract discussions. The art with which he has introduced them is most admirable. They are openings of rich scenery, suddenly presented to the view when least expected;—tales of an Arabian night succeeding to a morning's pastime of disputation in some school of Greece;—solemn shadows from an unseen world, casting their majestic forms over some ordinary incident of daily life. But they are not to be regarded only as embellishments and reliefs to the argument. They bear an important part in the teaching itself of his philosophy. They soften down the outline of his reasonings,—taking from them that positive didactic form in which they might appear, amidst the strife of debate, and as wrought out by discussion. The knowledge which his theory aims at imparting, is that of Reminiscence, as we have shewn; and he would not, accordingly, have the results of his inquiry present themselves as anything else but Reminiscence. We are, indeed, to search out the reasons of things. We are not to rest in mere opinion, but to battle our way against error and falsehood, until we rise to the eternal Ideas, the causes of all knowledge, as they are the causes of all Being. Still, we are not to suppose that we can distinctly comprehend the eternal Ideas in themselves. Though they are at last intellectually discerned, it is only "at the last," and that "scarcely."[3] For they carry up the eye of the soul to the fountain of all knowledge,—the Divine Being himself, who cannot be conceived, much less defined in words.[4] The mythic legends admirably combine with the refutative form of the discussions to leave this impression of indefiniteness on the mind. Whilst the mind's eye is directed steadily to the objects which can alone give stability and certainty to its knowledge, we are thus throughout reminded by Plato, that we live amidst shadows and darkness, and that our eye must be purified and endued with heavenly light before it can look undazzled on the TRUTH itself. (I. I.)

PLATONIC, something which relates to Plato, his philosophy, his opinions, or the like. Thus, Platonic love denotes a pure and spiritual affection, for which Plato was a great advocate, sa subsisting between the different sexes, abstracted from all carnal appetites, and regarding no other object but the mind and its beauties; or it is even a sincere, disinterested friendship subsisting between persons of the same sex, abstracted from any selfish views, and regarding no other object than the person, if any such love or friendship has aught of a foundation in nature.

PLATONIC Year, or the *Great Year*, is a period of time determined by the revolution of the equinoxes, or the space wherein the stars and constellations return to their former places in respect of the equinoxes. The Platonic year, according to Tycho Brahe, is 25,816; according to Ricciolus, 25,910; and according to Cassini, 24,800 years. This period once accomplished, it was an opinion amongst the ancients that the world would begin anew, and the sameseries of things return in the same order as before.

PLAUEN, a city of the kingdom of Saxony, in the circle of Voightland, and the capital of a bailiwick of the same name. It is situated in a beautiful valley upon the banks of the Elster, is surrounded with walls, and contains 608 houses, with 7200 inhabitants, more than one half of whom are employed in making muslins and other kinds of cotton goods of fine quality. Woollen cloths, paper, and hosiery, are also extensively fabricated.

PLAUTUS, M. ATTIUS, the father of Roman comedy, was born of humble parents, in the Umbrian village of Sarsina. He flourished during the second Punic war; and his death happened B. C. 184, when Terence had reached his ninth year. Of his private circumstances we are entirely ignorant; but fortune, which had blessed him with extraordinary talents, does not appear to have been very bountiful in worldly goods. To gain a livelihood, he was compelled to have recourse to the most laborious employments; yet still he contrived to write comedies, by the sale of which he added something to his enjoyments. The number of comedies composed by Plautus, or at least known under his name, was, according to Aulus Gellius, about one hundred and thirty, of which L. Ælius considered only twenty-five as genuine productions. Gellius imagines that the others, if they were not composed by Plautus, belong at least to the poets of that period, and had been read and amended by him; so that in this manner they had acquired his style and character. Varro considered as genuine only twenty-one, which were hence called *Varronianæ;* and perhaps a few others, from their similarity of style. Changes in the text and in the arrangement, which were brought about at the will of the ædiles, to whom he sold the plays, and even of the actors who were employed in performing them, became still more frequent after the death of the poet. The substitution, too, of the plays of another unknown poet, Plautius, for those of Plautus, has increased the difficulty of distinguishing the genuine productions of the poet from those erroneously ascribed to him. Thus we find grammarians and critics, such as Ælius, Volcatius, Sedigitius, Claudius, and Aurelius, writing treatises respecting the genuine pieces of Plautus. The number of comedies which have been preserved, though by no means quite perfect, amounts, according to Varro, to twenty. The *Querolus* or *Aulularia,* written in prose, though found in the manuscripts of Plautus, and even cited by Servius as belonging to him, is considered by some as of a later date, probably of the time of the younger Theodosius. Vossius and Tirlemont considered Claudius Rutilius Numatianus as the author, whilst Vincent was rather inclined to suppose it the production of Phædrus, the celebrated writer of fables. All the manuscripts of Plautus which have yet been discovered, with the exception of the Palimpsest of the Ambrosian Library, seem to be of a recent date, and must have flowed from a common source, as the same passages are corrupt in all.

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[1] The fastidiousness of taste with which he touched his compositions, is illustrated by the account of the opening of the *Republic* having been found with the clauses variously transposed. Dionys. Hal. *De Comp. Pub.* 25.

[2] Diog. Laert. in *Vit.*

[3] Ἐν τῷ γνωστῷ τελευταια ἡ του αγαθου ἰδεα και μογις ὁρασθαι. (*Rep.* vii. p. 133.)

[4] *Tim.* p. 303.

It is usually supposed that we are indebted to the grammarian Priscian for the order in which we find these twenty plays arranged; and he, too, is the author of the short arguments prefixed to each comedy in some of the old manuscripts. The purity of the language proves their remote antiquity, even though we be inclined to think that Plautus is not the author. The plays are found generally in the following arrangement. *Amphitrus,* called by Plautus himself in the prologue a tragi-comedy, because gods and princes are the principal characters, and tragic events are brought upon the comic stage; it has been imitated by Boccacio, Molière, and Dryden. *Asinaria,* in imitation of the Greek play 'Οναγρος of Demophilus, exhibiting in strongly-marked characters the corruption of Greek manners. *Aulularia,* one of the best, distinguished by its Roman colouring; but its end is wanting: it is the foundation of Molière's *Avare.* *Captivi,* according to the opinion of the poet himself, one of his most successful efforts, which is recommended particularly by the moral feeling that pervades it. The subject is more grave, and the coarse licentiousness and extravagance which disgust us in his other plays are here thrown into the back-ground, whilst a purely moral character steps forward, without any diminution in the comic vigour and genius of the poet, who must have written it in the latter years of his life. *Curculio,* from the name of the parasite who acts the chief part. *Casina,* in imitation of the Κληρουμενοι of Diphilus. *Cistellaria.* *Epidicus,* a play highly thought of by the author. *Chrysalus* or *Bacchides,* in which the prologue and beginning are wanting: the copy which Lascaris pretended to have found in Sicily is not considered as genuine, being probably the work of Petrarch. *Phasma,* or *Mostellaria,* in modern times imitated by Reynard and Addison. *Menæchmus,* also imitated by Reynard, and even by Shakspeare in some parts. *Miles Gloriosus,* one of his most successful pieces, which reminds us of Holbein's Bramarbas. *Mercator,* in imitation of the 'Εμπορος of Philemon. *Pseudolus,* one of the favourites of the poet, as appears from Cicero. *Pœnulus,* represented probably about 191, and therefore to be numbered amongst the latest plays of Plautus. This is proved by the labour he has bestowed upon it, the superior manner in which it delineates character, and the skilful arrangement of the whole. It is remarkable for the introduction of Carthaginian words, the only monument of the language which remains, with the exception of coins and inscriptions; and it has therefore been frequently referred to by the learned of ancient and modern times. *Persa,* from which Pliny quotes some verses that are not found in the play which has come down to us. *Rudens,* a beautiful play, in imitation of the Greek of Diphilus. *Stichus.* *Trinummus,* in imitation of the Θησαῦρος of Philemon: after the *Captivi,* it is the most remarkable play, both in regard to the design of the whole, and the delineation of character, as well as in the skilful arrangement of individual parts. *Truculentus,* also a favourite of the poet. Besides these, we have likewise the names and fragments of many other comedies.

These comedies belong to the class of *Comœdiæ Palliatæ,* and are so far to be considered as free imitations of the works of the Greek comedians of the new school; yet it would be doing injustice to the talents of Plautus to suppose that he imitated slavishly the Greek originals, and copied their works without asserting his own intellectual powers, or making changes both in relation to the form and design of the whole, as well as of its individual parts. The bold manner in which he made use of the Greek materials, by which the poet was able to bring into play his natural genius and vein of comic humour, and the frequent introduction of Roman characters and customs, even into the midst of Greek plays, distinguished Plautus from the polished Terence, who adhered much more closely to the Greek originals. It marks him as the genuine poet of the people, who knew how to create a popular drama, and thereby to furnish amusement for the lower ranks of life. He sold his plays to the ædiles, and therefore must have written them expressly for the diversion of the people. We need scarcely doubt that the poet would have taken a still wider range, and have exhibited still more of the true national character of the Romans, if he had not had before his eyes the fate of Nævius, to warn him from the dangerous path on which he was entering. The entire loss of the Greek originals prevents us from being able to decide how much of his materials the poet borrowed, and how far he imitated them in the design and conduct of his plays. Plautus must have made more use of the productions of the Attic comic writers than of those of the Sicilian poets. Yet Epicharmus and some others he had evidently read with much care, and may also have imitated them, as he certainly did in respect to Theocritus. The prologue, which is generally thought to have been wanting to the Greek comedy, was peculiar to him and his imitators. The poet was chiefly distinguished by the raciness of his wit, and the original and spirited manner in which he treated his subjects. But as it was not the higher and more polished classes of society for whom he wrote, but rather for those in humble life, from which he himself had sprung, we may expect to find in his comedies much low buffoonery, as well as many words and expressions bearing a double meaning; and here and there he oversteps the bounds of modesty and decency, which may however be forgiven, in return for the rich vein of humour which will always stamp Plautus as one of the most original of the comic poets of Rome. For this reason, however, much caution ought to be used in introducing the young to an acquaintance with the writings of Plautus.

The language of Plautus is natural and forcible, though not always harmonious and musical. Neither is it free from a certain harshness and ruggedness, apparent in the use of old forms of words and expressions, which became obsolete in later times, though we may ascribe this to the still uncultivated state of the language. The form of the verse is not regular; indeed the prosody and metre are both treated with so much carelessness, that we are almost inclined to believe that the poet either refused to submit to the trammels of a regular metre, or was unacquainted with the laws and rules of prosody. Yet of late a more minute examination of his writings, and a more profound study of the principles of Latin prosody and metrical laws, have led writers to take a different view of the subject. Many of the ancients bestowed unmeasured praise on the language of Plautus; yet we need not be surprised at the less favourable opinion pronounced by Horace, whose taste was formed upon a purer Greek model.

The earliest edition of Plautus is that of Venice, 1472; and the best is that published by Brunck, Bipont, 1788, in three vols. 8vo.

PLAYFAIR, John, a mathematician and philosopher of great eminence and celebrity; and so peculiarly a benefactor to this publication, as would have made it fit that some memorial of him should be preserved in these pages, even if it could have been surmised that it might not have been found in any other place. There are few names, however, in the recent history of British science that are more extensively or advantageously known, or of which the few particulars that remain to be recorded will be more generally interesting. His life, like most others that have been dedicated to the silent pursuits of learning and science, does not abound in incidents or adventures; but it is full of honour, both for the individual and the studies to which he was devoted, and may be read with more profit than many more ambitious histories.

He was the eldest son of the Reverend James Playfair, minister of Benvie, in Forfarshire; in which place he was born on the 10th of March 1748. He resided at home, under the domestic tuition of his father, until the age of fourteen, when he entered at the University of St Andrews; and was almost immediately distinguished, not merely for his singular proficiency in mathematical learning, but for the extent of his general knowledge, the clearness of his judgment, and the dignity and propriety of his conduct. A remarkable testimony to this effect has been made public in an early letter of Principal George Hill, who was at this time one of his fellow-students, and was himself so remarkable for early talent, that we find it recorded of him, that he had privately composed an excellent sermon in the tenth year of his age. A youth of this description cannot be supposed to have been very indulgent in his estimate of the merits of his competitors; and it could therefore have been no ordinary measure of ability that called forth the following ingenuous avowal, in a confidential letter to his mother: "Playfair has very great merit, and more knowledge and a better judgment than any of his class-fellows. I make *no* exceptions; my parts might be more showy, and the kind of reading to which my inclination led me was calculated to enable me to make a better figure at St Andrews; but in judgment and understanding I was greatly inferior to him."[1] It is scarcely a stronger, though undoubtedly a very different proof of his rare attainments, that when the professor of natural philosophy, Wilkie, the once celebrated author of the *Epigoniad*, was prevented by indisposition from delivering the regular lectures, he used generally to delegate the task of instruction to his youthful pupil. Wilkie, besides being a scholar and philosopher of no mean note, was a man of primitive benevolence and integrity, and of great vivacity in conversation; and the friendship which, in spite of the disparity of their years, was speedily formed between him and young Playfair, speaks as much for the social and moral character of the latter, as his substitution of him in the class-room does for his early proficiency in science. On this last subject we shall mention but one fact more. In 1766, when only eighteen years of age, he offered himself, with the approbation of his instructors at St Andrews, as candidate for the professorship of mathematics in Mareschal College, Aberdeen, and sustained, with the most distinguished credit, an examination or comparative trial, which lasted eleven days, and embraced nearly the whole range of the exact sciences. Out of the six competitors who entered the lists against him, two only were judged to have excelled him, the Reverend Dr Trail, who was appointed to the office, and Dr Hamilton, who afterwards succeeded to and long filled it with much reputation.

In 1769, he removed to Edinburgh, where his merit and modesty very soon introduced him to the friendship of Dr Robertson, Adam Smith, Dr Matthew Stewart, Dr Black, and Dr Hutton; with all of whom he continued on terms of the utmost cordiality during the whole period of their lives. In 1772, he was a candidate for the professorship of natural philosophy at St Andrews, vacant by the death of his friend Dr Wilkie. There was no comparative trial on this occasion; and he was again unsuccessful, under circumstances which have led one of the most dutiful sons of that university (Dr Cook, in his Life of Principal Hill) to remark, "how much it suffered in thus losing a man by whose talents its reputation would have been so highly promoted." In the course of the same year, the death of his father suddenly devolved upon him the burden of supporting the family, and admonished him no longer to delay the final election of a profession. He had been educated with a view to the church, and was every way qualified to accept a living on the establishment; but his decided predilection for science had hitherto made him hesitate about engaging in a vocation, the duties of which, he felt, if conscientiously discharged, would necessarily interfere, to a great extent, with the studies he was loth to abandon. In this emergency, however, he thought himself no longer entitled to indulge in those predilections, and accordingly made application to Lord Gray, the patron, for a presentation to the livings of Liff and Benvie, which had been filled by his father. His lordship was too well aware of his merits to hesitate about conferring so great a benefit on the parishioners; and immediately issued a presentation in his favour, although, from some challenge of his right to the patronage, induction was not obtained until late in the year 1773.

From this period until 1782 Mr Playfair was constantly resident at Liff, and occupied almost exclusively with the pastoral duties of his office. In this retreat his leisure hours were dedicated to the education of his younger brothers, and to a very close and intimate correspondence with Mr Robertson (afterwards Lord Robertson), the son of the illustrious historian, to whom he seems to have confined the remarks that occurred to him upon the different authors he perused, and the subjects of speculation which they suggested. We cannot help hoping, that some selection from this correspondence may one day be given to the public. In the year 1779, he contributed to the Transactions of the Royal Society of London a paper on the Arithmetic of Impossible Quantities, which exhibits, within a very small compass, a striking example of the rare and admirable talent of detaching the sound spirit of science from what may be termed its mysticism, and circumscribing, by the most precise and luminous boundaries, the vague and unlimited inquiries into which many mathematicians had been seduced by the nature of the instruments they employed.

In the year 1782 he was induced, by very advantageous offers, to resign his charge, and to superintend the education of Mr Ferguson of Raith, and his brother Sir Ronald; an arrangement which restored him, in a great measure, to the literary and scientific society of Edinburgh, and enabled him to gratify himself by a personal introduction to several of the most eminent cultivators of science in London. He had repeatedly visited Dr Maskelyne, astronomer royal, whilst that ingenious mathematician was busied, in 1774, in making a series of observations in Perthshire, on the attraction of mountains; and, whilst sharing the shelter of his tent on the side of Schehallien, contracted with him a cordial friendship, which continued unbroken for the remainder of their lives. Under these honourable auspices he made his first appearance in London in 1782, and was speedily introduced to all those in whom he was likely to take most interest. He seems to have kept a pretty full and correct journal of all that he observed during this journey to the metropolis; and a portion of it, which is prefixed to the late collection of his works, is, in our judgment, one of the most interesting parts of that publication. It is not only written with great elegance and accuracy, but affords, in the free, candid, and pointed observations which it contains on the different individuals with whom he comes in contact, a very remarkable proof of his quick and sagacious perception of character, and his power of selecting and turning to account, even in the fever and distraction of a first visit to such a scene, all that was really worthy of careful observation or permanent remembrance.

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[1] Dr Cook's Life of Principal Hill.

In 1785 he was received into the University of Edinburgh, in consequence of an arrangement between his two illustrious associates, Dr Adam Ferguson and Mr Dugald Stewart. Mr Stewart exchanged the chair of mathematics, in which he had succeeded to his father, for that of moral philosophy, which had been long filled by Dr Ferguson; who, finding that the delicate state of his health would prevent him from discharging the active duties of the mathematical professor, immediately devolved them upon Mr Playfair, for whom he procured the appointment of joint professor in that department.

In 1788 he published, in the Transactions of the Royal Society of Edinburgh, a Biographical Account of Dr Matthew Stewart, which is remarkable, not only for the ease and purity of the style, but also as containing a singularly clear and interesting account of the labours of Dr Simson in the restoration of the ancient geometry, and of the success both of him and Dr Stewart in adapting the elegant simplicity of the Greek methods of investigation to problems which had previously been regarded as insoluble except by the aid of the modern analysis. He also published, in the same year, a paper on the Causes which affect the Accuracy of Barometrical Measurements, which is written with all the perspicuity, caution, and sagacity that constitute the great excellence and the great difficulty of such disquisitions, where scientific principles are employed to give precision to physical observations.

In 1790 he published in the same Transactions a paper of still greater interest and delicacy, on the Astronomy of the Brahmins; a subject which had been recently recommended to the notice of the European scientific world by the curious and learned observations of M. Bailly, in his General History of Astronomy, but had never met with so minute and scrupulous an investigation as it now received at the hands of Mr Playfair. The whole treatise is written with a beautiful perspicuity, in an admirable spirit of candour and ingenuity, and in a style more elegant and spirited than had yet lent its attraction to subjects so recondite and abstruse. The publication accordingly attracted very general notice, both in Europe and in Asia; and gave rise to much discussion and research, the final value and result of which does not seem yet to be ascertained. This was followed in 1794 by a learned and very beautiful treatise on the Origin and Investigation of Porisms, in which the obscure nature of the very comprehensive and indefinite theorems to which this name was applied by the ancient geometers, is explained with the most lucid simplicity; and the extraordinary merits of Dr Simson, in deducing their true theory from the very vague and scanty notices of them which had come down to his time, are commemorated with a noble spirit of emulation.

In 1795 he published his Elements of Geometry, for the use of the pupils attending his class; a work which has since been held in such estimation by the public, as to have gone through five editions of a thousand copies each, four of which were called for since the work ceased to be used as a class-book in the University of Edinburgh. In 1797 he composed a sequel to his first paper on the Indian Astronomy, in the shape of Observations on the Trigonometrical Tables of the Brahmins; and also a masterly collection of Theorms on the Figure of the Earth. It is also understood that he occupied himself a good deal at this time in the preparation of an Essay on the Accidental Discoveries made by Men of Science while in Pursuit of some other Object; although we find no portion of this curious discussion in the collection of his works.

His excellent and ingenious friend Dr Hutton died in the year last mentioned; and Mr Playfair, having undertaken to draw up a biographical account of him for the Royal Society, was first led to study his ingenious but somewhat crude speculations on the Theory of the Earth, and afterwards to lend them the assistance of his own powerful pen in his Illustrations of the Huttonian Theory. This work, upon which he bestowed more time and labour than on any of his other productions, did not appear till 1802; and it was not till 1803 that he presented to their associates his admirable memoir of their departed friend.

Whatever opinion may be formed, now or hereafter, of the truth or soundness of the suppositions by which Dr Hutton endeavoured to explain the actual state and condition of our globe, it is impossible to doubt that Mr Playfair's illustration of that theory must always be ranked amongst the most brilliant and powerful productions of philosophical genius. The beautiful clearness and captivating eloquence with which the system itself is unfolded and explained, the spirit and force of reasoning with which all the objections to it are combated, the skill with which the infinite variety of facts which it brought into view are combined into one grand and legitimate introduction, and the judgment and extent of learning by which so many large and profound views of nature are brought to bear upon the points in discussion, and blended into one large and discursive argument, uniting the utmost logical precision with the richest variety of topics, and the highest graces of composition—are merits which have been universally acknowledged in this performance, even by those who have not been convinced by its reasonings, and have extorted, even from the fastidious critics of France, the acknowledgment that "Mr Playfair writes as well as Buffon, and reasons incomparably better."

The biographical account of Dr Hutton is by far the best of Mr Playfair's productions in this line, and contains not only an eloquent and luminous account of the speculations in which he was engaged, but, what is too often forgotten in this species of biography, a charming portrait of the individual, drawn, no doubt, by a favourable hand, but gaining far more in grace and effect than it can possibly have lost in correctness, from the softening colours of affection.

In 1805 he quitted the chair of mathematics to succeed Professor Robison in that of natural philosophy. The appointment of Mr Leslie as his successor in the chair of mathematics was opposed at the time by a majority of the presbytery of Edinburgh, and made the subject of very angry discussion, as well in various publications as in the General Assembly of the Church of Scotland. From both these fields of contention the opponents of Mr Leslie retired discomfited, and, in the opinion, we believe, of many of the lookers on, disgraced. Amongst the heaviest blows they had to sustain were those that parted from the hand of Mr Playfair. He first addressed a Letter to the Lord Provost, in which, after asserting, with infinite spirit and freedom, the dignity of the science in question, he openly imputes the new-sprung zeal for orthodoxy, which had prompted the attack on Mr Leslie, to a wish or design on the part of some of the clergymen of Edinburgh to obtain for themselves a number of the chairs in that university, which had hitherto afforded sufficient occupation to the undistracted industry of laymen: And when this denunciation brought upon him a series of acrimonious and unhandsome attacks, he replied to them all in a pamphlet of greater bulk, written in a style of which the high polish and elegance only serve to give a keener edge to the unsparing severity of the exposures which it conveys.[1] We do not know, indeed, where to find a more perfect model of polemical or controversial writing; and, much as it was to be regretted that an occasion should have arisen for employing such a pen and such a mind as Mr Playfair's on any temporary or personal theme, it is impossible not to admire the extraordinary talent and vigour with which, when the occasion did arrive, he could turn talents, exercised in far other studies, to the purposes suggested by the emergency.

In 1807 he was elected a fellow of the Royal Society of London, and soon afterwards presented to that learned body his Lithological Survey of Schehallien. In 1809 he contributed to the Edinburgh Transactions an excellent paper on Solids of the greatest Attraction, and in 1812 another on the Progress of Heat in Spherical Bodies.

In 1814 he published, in two volumes 8vo, for the use of his class, an elementary work of great value, under the title of Outlines of Natural Philosophy. For some years before this, he had been much occupied in digesting the plan and collecting the materials for a greatly enlarged edition of his Illustrations of the Huttonian Theory; with a view to which, he had not only carefully perused and extracted a vast body of voyages and travels, but had made various journeys, and very minutely examined almost all the places in the British dominions the structure of which promised to throw any light on the subject of his researches. No part of the work, however, was actually written, when the preparation for it was suspended by his being induced to draw up for this publication an introductory Dissertation on the Progress of Mathematical and Physical Science; a treatise which, though its author had written nothing else, would itself suffice to carry down his name with distinction to the latest posterity. The soundness of judgment, the beauty of the writing, the extent of knowledge, the candour and precision of the estimates of character, and the noble spirit of liberality and generous admiration for genius which breathes throughout the whole performance, give it an attraction which is rarely to be found in works of the same erudition, and render it not only one of the most instructive, but one of the most interesting publications that philosophy has ever bestowed on the world.

In 1815 he drew up for the Royal Society of Edinburgh a very interesting Memoir of his distinguished predecessor Dr John Robison, a philosopher in whose early life there was more adventure, and in his later days more political prejudice, than we usually find to diversify the history of men of science. Nothing can be more spirited and interesting than Mr Playfair's account of the former; nothing more manly and tender than his reluctant but decided protestation against the excesses of the latter.

After the general peace in 1815 had at last opened the Continent to British inquirers, Mr Playfair, at the age of sixty-eight, undertook a long journey through France and Switzerland into Italy, and did not return for a period of nearly eighteen months. His principal attention was directed to the mineralogical and geological phenomena of the different regions which he visited; and he made many notes with a view to the great object which he was not destined to accomplish, namely, the extension and new-modelling of his Illustrations of the Huttonian Theory. Every object of liberal curiosity, however, had for him an attraction as fresh as in his earliest youth; and the social simplicity and benevolence of his character and manners insured him a favourable reception in every new society to which he was introduced.

On his return from this expedition, he employed himself chiefly in preparing the Second Part of the Dissertation to which we have alluded; and he also drew up a Memoir on the Naval Tactics of Mr Clerk of Eldin, which was published after his death in the Philosophical Transactions, though only a fragment of a projected life of Mr Clerk, which he did not live to complete. His health had been occasionally broken for several years by the recurrence of a painful affection of the bladder, which appeared with increased severity in the early part of 1819, but was so far got under as to enable him to complete his course of lectures in the spring. It returned, however, in a still more distressing form in the summer, and at last put a period to his life on the 19th of July. Though suffering great pain during the last part of his confinement, he retained not only his intellectual faculties quite unimpaired, but also the serenity and mildness of his spirit, and occupied himself till within a few days of his death in correcting the proof-sheets of the Dissertation, the printing of the Second Part of which had commenced some time before his last illness.[2]

Before concluding these notices of Mr Playfair's scientific and literary labours, we have still to mention, that, from the year 1804, he was a frequent contributor to the Edinburgh Review; and that though most of his articles were of a scientific description, he occasionally diverged into the field of general literature, or indulged in the refinements of metaphysical speculation. Many of his scientific articles attracted great attention on the Continent as well as at home; and several of them are written with a force and beauty that might well entitle them to a higher place than the pages of a periodical publication. There is no general account of the great facts and principles of astronomy so clear, and comprehensive, and exact, nor half so beautiful or majestic in the writing, as his account of Laplace's *Mécanique Céleste*, in the eleventh volume of the publication just mentioned.

In this brief sketch of the events of Mr Playfair's life, we have purposely omitted any general account, either of his personal character, or of the distinguishing features of his intellectual powers and habits; thinking it better to give those by themselves, in the words in which they were recorded, to the satisfaction, we believe, of most of those who knew him intimately, in a periodical journal wherein they appeared a short time after his death. The portrait there given has been pronounced by one of the earliest and most illustrious of his surviving friends, "a faithful and perfect resemblance;"[3] and has accordingly been allowed a place in the prefatory memoir which his nephew has prefixed to the collection of his works.

"It has struck many people, we believe, as very extraordinary, that so eminent a person as Mr Playfair should have been allowed to sink into his grave in the midst of us, without calling forth almost so much as an attempt to commemorate his merit, even in a common newspaper; and that the death of a man so celebrated and so beloved, and, at the same time, so closely connected with many who could well appreciate and suitably describe his excellencies, should be left to the brief and ordinary notice of the daily obituary. No event of the kind certainly ever excited more general sympathy; and no individual, we are persuaded, will be longer or more affectionately remembered by all the classes of his fellow-citizens; and yet it is to these very circumstances that we must look for an explanation of the apparent neglect by which his memory has been followed. His humbler admirers have been deterred from expressing their sentiments by a natural feeling of unwillingness to encroach on the privilege of those whom a nearer approach to his person and talents rendered it more worthy to speak of them; whilst the learned and eloquent amongst his friends have trusted to each other for the performance of a task which they could not but feel to be painful in itself, and not a little difficult to perform as it ought to be; or perhaps have reserved for some more solemn occasion that tribute for which the public impatience is already at its height.

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[1] This piece is entitled Letter to the Author of the Examination of Mr Stewart's Short Statement of Facts relative to the Election of Professor Leslie, 8vo, Edin. 1806. It has not been reprinted in the collection of his works.

[2] Besides the DISSERTATION, Mr Playfair contributed the valuable biographical account of ÆPINUS, and the still more valuable article on PHYSICAL ASTRONOMY.

[3] Letter from Mr Dugald Stewart to Dr Playfair, in the Appendix to the Biographical Account of Professor Playfair, prefixed to the collection of his works, published at Edinburgh in 1822, in 4 vols. 8vo.

"We beg leave to assure our readers, that it is merely from anxiety to do *something* to gratify this natural impatience that we presume to enter at all upon a subject to which we are perfectly aware that we are incapable of doing justice; for of Mr Playfair's scientific attainments, of his proficiency in those studies to which he was peculiarly devoted, we are but slenderly qualified to judge. But we believe we hazard nothing in saying that he was one of the most learned mathematicians of his age, and among the first, if not the very first, who introduced the beautiful discoveries of the later continental geometers to the knowledge of his countrymen; and gave their just value and true place, in the scheme of European knowledge, to those important improvements by which the whole aspect of the abstract sciences has been renovated since the days of our illustrious Newton. If he did not signalize himself by any brilliant or original invention, he must, at least, be allowed to have been a most generous and intelligent judge of the achievements of others; as well as the most eloquent expounder of that great and magnificent system of knowledge which has been gradually evolved by the successive labours of so many gifted individuals. He possessed, indeed, in the highest degree, all the characteristics both of a fine and a powerful understanding; at once penetrating and vigilant, but more distinguished, perhaps, for the caution and sureness of its march, than for the brilliancy or rapidity of its movements; and guided and adorned through all its progress by the most genuine enthusiasm for all that is grand, and the justest taste for all that is beautiful, in the truth or the intellectual energy with which he was habitually conversant.

"To what account these rare qualities might have been turned, and what more brilliant or lasting fruits they might have produced, if his whole life had been dedicated to the solitary cultivation of science, it is not for us to conjecture; but it cannot be doubted that they added incalculably to his eminence and utility as a teacher, both by enabling him to direct his pupils to the most simple and luminous methods of inquiry, and to imbue their minds, from the very commencement of the study, with that fine relish for the truths it disclosed, and that high sense of the majesty with which they were invested, that predominated in his own bosom. Whilst he left nothing unexplained or unreduced to its proper place in the system, he took care that they should never be perplexed by petty difficulties, or bewildered in useless details, and formed them betimes to that clear, masculine, and direct method of investigation by which, with the least labour, the greatest advances might be accomplished.

"Mr Playfair, however, was not merely a teacher; and has fortunately left behind him a variety of works, from which other generations may be enabled to judge of some of those qualifications which so powerfully recommended and endeared him to his contemporaries. It is, perhaps, to be regretted that so much of his time, and so large a proportion of his publications, should have been devoted to the subjects of the Indian Astronomy, and the Huttonian Theory of the Earth. For though nothing can be more beautiful or instructive than his speculations on those curious topics, it cannot be dissembled that their results are less conclusive and satisfactory than might have been desired; and that his doctrines, from the very nature of the subjects, are more questionable than we believe they could possibly have been on any other topic in the whole circle of the sciences. To the first, indeed, he came under the great disadvantage of being unacquainted with the eastern tongues, and without the means of judging of the authenticity of the documents which he was obliged to assume as the elements of his reasonings; and as to the other, though he ended, we believe, with being a very able and skilful mineralogist, we think it is now generally admitted that that science does not yet afford sufficient materials for any positive conclusion, and that all attempts to establish a theory of the earth must, for many years to come, be regarded as premature. Though it is impossible, therefore, to think too highly of the ingenuity, the vigour, and the eloquence of those publications, we are of opinion that a juster estimate of Mr Playfair's talent, and a truer picture of his genius and understanding, is to be found in his other writings; in the papers, both biographical and scientific, with which he has enriched the Transactions of our Royal Society; his account of Laplace, and other articles which he is understood to have contributed to the Edinburgh Review; the Outlines of his Lectures on Natural Philosophy; and, above all, his Introductory Discourse to the Supplement to the Encyclopædia Britannica, with the final correction of which he was occupied up to the last moments that the progress of his disease allowed him to dedicate to any intellectual exertion.

"With reference to these works, we do not think we are influenced by any national, or other partiality, when we say that he was certainly one of the best writers of his age; and even that we do not now recollect any one of his contemporaries who was so great a master of composition. There is a certain mellowness and richness about his style, which adorns without disguising the weight and nervousness, which is its other great characteristic; a sedate gracefulness and manly simplicity in the more level passages, and a mild majesty and considerate enthusiasm where he rises above them, of which we scarcely know where to find any other example. There is great equability, too, and sustained force, in every part of his writings. He never exhausts himself in flashes and epigrams, nor languishes into tameness and insipidity; at first sight you would say that plainness and good sense were the predominating qualities, but by and by this simplicity is enriched with the delicate and vivid colours of a fine imagination, the free and forcible touches of a most powerful intellect, and the lights and shaeds of an unerring and harmonizing taste. In comparing it with the styles of his most celebrated contemporaries, we would say that it was more purely and peculiarly a *written* style, and, therefore, rejected those ornaments that more properly belong to oratory. It had no impetuosity, hurry, or vehemence,—no bursts or sudden turns or abruptions, like that of Burke; and though eminently smooth and melodious, it was not modulated to an uniform system of solemn declamation like that of Johnson; nor spread out in the richer and more voluminous elocution of Stewart; nor still less broken into that patchwork of scholastic pedantry and conversational smartness which has found its admirers in Gibbon. It is a style, in short, of great freedom, force, and beauty; but the deliberate style of a man of thought and of learning, and neither that of a wit throwing out his extempores with an affectation of careless grace, nor of a rhetorician thinking more of his manner than his matter, and determined to be admired for his expression, whatever may be the fate of his sentiments.

"His habits of composition, as we have understood, were not perhaps exactly what might have been expected from their results. He wrote rather slowly, and his first sketches were often very slight and imperfect, like the rude chalking for a masterly picture. His chief effort and greatest pleasure was in their revisal and correction; and there were no limits to the improvement which resulted from this application. It was not the style merely, or indeed chiefly, that gained by it; the whole reasoning, and sentiment, and illustration, were enlarged and new-modelled in the course of it, and a naked outline became gradually informed with life, colour, and expression, It was not at all like the common finishing and polishing to which careful authors generally subject the first draught of their compositions, nor even like the fastidious and tentative alterations with which some more anxious writers assay their choicer passages. It was, in fact, the great filling in of the picture, the working up of the figured *weft* on the naked and meagre *woof* that had been stretched to receive it; and the singular thing in his case was, not only that he left this most material part of his work to be performed after the whole outline had been finished, but that he could proceed with it to an indefinite extent, and enrich and improve as long as he thought fit, without any risk either of destroying the proportions of that outline, or injuring the harmony and unity of the design. He was perfectly aware, too, of the possession of this extraordinary power; and it was partly, we presume, in consequence of this consciousness that he was not only at all times ready to go on with any work in which he was engaged, without waiting for favourable moments or hours of greater alacrity, but that he never felt any of those doubts and misgivings as to his being able to get creditably through with his undertaking, to which we believe most authors are occasionally liable. As he never wrote upon any subject of which he was not perfectly master, he was secure against all blunders in the substance of what he had to say; and felt quite assured, that if he was only allowed time enough, he should finally come to say it in the very best way of which he was capable. He had no anxiety, therefore, either in undertaking or proceeding with his tasks; and intermitted and resumed them at his convenience, with the comfortable certainty, that all the time he bestowed on them was turned to good account, and that what was left imperfect at one sitting might be finished with equal ease and advantage at another. Being thus perfectly sure both of his end and his means, he experienced, in the course of his compositions, none of that little fever of the spirits with which that operation is so apt to be accompanied. He had no capricious visitings of fancy, which it was necessary to fix upon the spot or to lose for ever; no casual inspiration to invoke and to wait for; no transitory and evanescent lights to catch before they faded. All that was in his mind was subject to his control, and amenable to his call, though it might not obey at the moment; and whilst his taste was so sure, that he was in no danger of overworking anything that he had designed, all his thoughts and sentiments had that unity and congruity, that they fell almost spontaneously into harmony and order; and the last added, incorporated, and assimilated with the first, as if they had sprung simultaneously from the same happy conception.

“ But we need dwell no longer on qualities that may be gathered hereafter from the works he has left behind him. They who lived with him mourn the most for those which will be traced in no such memorial; and prize far above those talents which gained him his high name in philosophy, that personal character which endeared him to his friends, and shed a grace and a dignity over all the society in which he moved. The same admirable taste which is conspicuous in his writings, or rather the higher principles from which that taste was but an emanation, spread a similar charm over his whole life and conversation, and gave to the most learned philosopher of his day the manners and deportment of the most perfect gentleman. Nor was this in him the result merely of good sense and good temper, assisted by an early familiarity with good company, and a consequent knowledge of his own place and that of all around him. His good breeding was of a higher descent; and his powers of pleasing rested on something better than mere companionable qualities. With the greatest kindness and generosity of nature, he united the most manly firmness, and the highest principles of honour; and the most cheerful and social dispositions, with the gentlest and steadiest affections. Towards women he had always the most chivalrous feelings of regard and attention, and was, beyond almost all men, acceptable and agreeable in their society, though without the least levity or pretension unbecoming his age or condition; and such, indeed, was the fascination of the perfect simplicity and mildness of his manners, that the same tone and deportment seemed equally appropriate in all societies, and enabled him to delight the young and the gay with the same sort of conversation which instructed the learned and the grave. There never, indeed, was a man of learning and talent who appeared in society so perfectly free from all sorts of pretension or notion of his own importance, or so little solicitous to distinguish himself, or so sincerely willing to give place to every one else. Even upon subjects which he had thoroughly studied, he was never in the least impatient to speak, and spoke at all times without any tone of authority; whilst, so far from wishing to set off what he had to say by any brilliancy or emphasis of expression, it seemed generally as if he had studied to disguise the weight and originality of his thoughts under the plainest form of speech and the most quiet and indifferent manner; so that the profoundest remarks and subtlest observations were often dropped, not only without any solicitude that their value should be observed, but without any apparent consciousness that they possessed any. Though the most social of human beings, and the most disposed to encourage and sympathise with the gaiety and joviality of others, his own spirits were in general rather cheerful than gay, or at least never rose to any turbulence or tumult of merriment; and whilst he would listen with the kindest indulgence to the more extravagant sallies of his younger friends, and prompt them by the heartiest approbation, his own satisfaction might generally be traced in a slow and temperate smile, gradually mantling over his benevolent and intelligent features, and lighting up the countenance of the sage with the expression of the mildest and most genuine philanthropy. It was wonderful, indeed, considering the measure of his own intellect, and the rigid and undeviating propriety of his own conduct, how tolerant he was of the defects and errors of other men. He was too indulgent, in truth, and favourable to his friends, and made a kind and liberal allowance for the faults of all mankind; except only faults of baseness or of cruelty, against which he never failed to manifest the most open scorn and detestation. Independently, in short, of his high attainments, Mr Playfair was one of the most amiable and estimable of men; delightful in his manners, inflexible in his principles, and generous in his affections, he had all that could charm in society or attach in private; and whilst his friends enjoyed the free and unstudied conversation of an easy and intelligent associate, they had at all times the proud and inward assurance that he was a being upon whose perfect honour and generosity they might rely with the most implicit confidence, in life and in death,—and of whom it was equally impossible that, under any circumstances, he should ever perform a mean, a selfish, or a *questionable* action, as that his body should cease to gravitate or his soul to live.

“ If we do not greatly deceive ourselves, there is nothing here of exaggeration or partial feeling, and nothing with which an indifferent and honest chronicler would not concur. Nor is it altogether idle to have dwelt so long on the personal character of this distinguished individual. For we are ourselves persuaded, that this personal character has done almost as much for the cause of science and philosophy amongst us as the great talents and attainments with which it was combined; and has contributed in a very eminent degree to give to the better society of Edinburgh that tone of intelligence and liberality by which it is so honourably distinguished. It is not a little advantageous to philosophy that it is in fashion; and it is still more advantageous, perhaps, to the society which is led to confer on it this apparently trivial distinction. It is a great thing for the country at large,—for its happiness, its prosperity, and its renown,—that the upper and influencing part of its population should be made familiar, even in its untasked and social hours, with sound and liberal information, and be taught to know and respect those who have distinguished themselves for great intellectual attainments. Nor is it, after all, a slight or despicable reward for a man of genius to be received with honour in the highest and most elegant society around him, and to receive in his living person that homage and applause which is too often reserved for his memory. Now, those desirable ends can never be effectually accomplished, unless the manners of our leading philosophers are agreeable, and their personal habits and dispositions engaging and amiable. From the time of Hume and Robertson, we have been fortunate in Edinburgh in possessing a succession of distinguished men, who have kept up this salutary connection between the learned and the fashionable world; but there never, perhaps, was any one who contributed so powerfully to confirm and extend it, and that in times when it was peculiarly difficult, as the lamented individual of whom we are now speaking; and they who have had the best opportunity to observe how superior the society of Edinburgh is to that of most other places of the same size, and how much of that superiority is owing to the cordial combination of the two aristocracies of rank and of letters (of both of which it happens to be the chief provincial seat), will be best able to judge of the importance of the service he has thus rendered to its inhabitants, and through them, and by their example, to all the rest of the country." (P. P.)

PLAYHOUSE. The most ancient English playhouses were the Curtain in Shoreditch, and the Theatre. In the time of Shakspeare, who commenced dramatic writer in 1592, there were no less than ten theatres open. Four of these were private houses, namely, that in Blackfriars, the Cockpit or Phœnix in Drury-Lane, a theatre in Whitefriars, and one in Salisbury Court. The other six were called public theatres, namely, the Globe, the Swan, the Rose, and the Hope, on the Bank-side; the Red Bull, at the upper end of St John's Street; and the Fortune in White-Cross Street. The two last were chiefly frequented by citizens. Mr Malone gives a pretty copious account of these playhouses, in a supplement to his last edition of Shakspeare, which account we shall here insert.

"Most, if not all," says he, "of Shakspeare's plays were performed either at the Globe, or at the Theatre in Blackfriars. It appears that they both belonged to the same company of comedians, viz. his majesty's servants, which title they assumed, after a license had been granted to them by King James in 1603, having before that time been called the servants of the lord chamberlain.

"The theatre in Blackfriars was a private house; but the peculiar and distinguishing marks of a private playhouse it is not easy to ascertain. It was very small, and plays were there usually represented by candle-light. The Globe, situated on the southern side of the river Thames, was a hexagonal building, partly open to the weather, partly covered with reeds. It was a public theatre, and of considerable size, and there they always acted by daylight. On the roof of the Globe, and the other public theatres, a pole was erected, to which a flag was affixed. These flags were probably displayed only during the hours of exhibition; and it should seem, from a passage in one of the old comedies, that they were taken down during Lent, in which season no plays were presented. The Globe, though hexagonal at the outside, was probably a rotunda within, and perhaps had its name from its circular form. It might, however, have been denominated only from its sign, which was a figure of Hercules supporting the Globe. This theatre was burnt down in 1613, but it was rebuilt in the following year, and decorated with more ornament than had been originally bestowed upon it. The exhibitions at the Globe seem to have been calculated chiefly for the lower class of people; those at Blackfriars for a more select and judicious audience.

"A writer informs us, that one of these theatres was a winter and the other a summer house. As the Globe was partly exposed to the weather, and they acted there usually by daylight, it was probably the summer theatre. The exhibitions here seem to have been more frequent than at Blackfriars, at least till the year 1604 or 1605, when the Bank-side appears to have become less fashionable and less frequented than it formerly had been. Many of our ancient dramatic pieces were performed in the yards of carriers' inns; in which, in the beginning of Queen Elizabeth's reign, the comedians, who then first united themselves in companies, erected an occasional stage. The form of these temporary playhouses seems to be preserved in our modern theatre. The galleries are in both ranged over each other on three sides of the building. The small rooms under the lowest of these galleries answer to our present boxes; and it is observable that these, even in theatres which were built in a subsequent period expressly for dramatic exhibitions, still retained their old name, and are frequently called rooms by our ancient writers. The yard bears a sufficient resemblance to the pit as at present in use. We may suppose the stage to have been raised in this area, on the fourth side, with its back to the gate-way of the inn, at which the money for admission was taken. Hence, in the middle of the Globe, and I suppose of the other public theatres, in the time of Shakspeare, there was an open yard or area, where the common people stood to see the exhibition; from which circumstance they are called by our author groundlings, and by Ben Johnson 'the understanding gentlemen of the ground.'

"In the ancient playhouses there appears to have been a private box, of which it is not easy to ascertain the situation. It seems to have been placed at the side of the stage, towards the rear, and to have been at a lower price; in this some people sat, either from economy or singularity. The galleries, or scaffolds as they are sometimes called, and that part of the house which in private theatres was named the pit, seem to have been at the same price; and probably in houses of reputation, such as the Globe, and that in Blackfriars, the price of admission into those parts of the theatres was sixpence, while in some meaner playhouses it was only one penny, in others only twopence. The price of admission into the best rooms or boxes was, I believe, in our author's time, one shilling; though afterwards it appears to have risen to two shillings and half-a-crown.

"From several passages in our old plays, we learn, that spectators were admitted on the stage, and that the critics and wits of the time usually sat there. Some were placed on the ground; others sat on stools, of which the price was either sixpence or one shilling, according, I suppose, to the commodiousness of the situation; and they were attended by pages, who furnished them with pipes and tobacco, which was smoked here as well as in other parts of the house; yet it should seem that persons were suffered to sit on the stage only in the private playhouses, such as Blackfriars, &c. where the audience was more select, and of a higher class; and that in the Globe and other public theatres no such licence was permitted.

"The stage was strewed with rushes, which, as we learn from Hentzner and Caius de Ephemera, was, in the time of Shakspeare, the usual covering of floors in England. The curtain which hangs in the front of the present stage, drawn up by lines and pulleys, though not a modern invention, for it was used by Inigo Jones in the masks at court, was yet an apparatus to which the simple mechanism of our ancient theatres had not arrived, for in them the curtains opened in the middle, and were drawn backwards and forwards on an iron rod. In some playhouses they were woollen, in others made of silk. Towards the rear of the stage there appears to have been a balcony, the platform of which was probably eight or ten feet from the ground. I suppose it to have been supported by pillars. From hence, in many of our old plays, part of the dialogue was spoken; and in the front of this balcony curtains likewise were hung.

"A doubt has been entertained whether, in our ancient theatres, there were side and other scenes. The question is involved in so much obscurity, that it is very difficult to form any decided opinion upon it. It is certain, that in the year 1695 Inigo Jones exhibited an entertainment at Oxford, in which moveable scenes were used; but he appears to have introduced several pieces of machinery in the masks at court, with which undoubtedly the public theatres were unacquainted. A passage which has been produced from one of the old comedies proves, it must be owned, that even these were furnished with some pieces of machinery, which were used when it was requisite to exhibit the descent of some god or saint; but, from all the contemporary accounts, I am inclined to believe that the mechanism of our ancient stage seldom went beyond a painted chair or a trap-door, and that few, if any of them, had any moveable scenes. When King Henry VIII. is to be discovered by the Dukes of Suffolk and Norfolk, reading in his study, the scenical direction in the first folio, 1623, which was printed apparently from playhouse copies, is 'the king draws the curtain (*i. e.* draws it open), and sits reading pensively;' for, besides the principal curtains that hung in the front of the stage, they used others as substitutes for scenes. If a bedchamber is to be exhibited, no change of scene is mentioned; but the property-man is simply ordered to thrust forth a bed. When the fable requires the Roman capitol to be exhibited, we find two officers enter, 'to lay cushions, as it were, in the capitol,' &c. On the whole, it appears, that our ancient theatres in general were only furnished with curtains, and a single scene composed of tapestry, which were sometimes, perhaps, ornamented with pictures; and some passages in our old dramas incline one to think, that when tragedies were performed the stage was hung with black.

"In the early part, at least, of our author's (Shakspeare's) acquaintance with the theatre, the want of scenery seems to have been supplied by the simple expedient of writing the names of the different places where the scene was laid in the progress of the play, which were disposed in such a manner as to be visible to the audience. The invention of trap-doors, however, appears not to be modern; for in an old Morality, entitled All for Money, we find a marginal direction which implies that they were very early in use. The covering or internal roof of the stage was anciently termed the heavens. It was probably painted of a sky-blue colour, or perhaps pieces of drapery tinged with blue were suspended across the stage to represent the heavens.

"It is probable that the stage was formerly lighted by two large branches, of a form similar to those now hung in churches. They gave place in a subsequent period to small circular wooden frames, furnished with candles, eight of which were hung on the stage, four at either side; and these within a few years were wholly removed by Mr Garrick, who, on his return from France, first introduced the present commodious method of illuminating the stage by lights not visible to the audience. Many of the companies of players were formerly so thin, that one person played two or three parts; and a battle on which the fate of an empire was supposed to depend was decided by half a dozen combatants. It appears to have been a common practice in their mock engagements to discharge small pieces of ordnance on the stage. Before the exhibition began, three flourishes or pieces of music were played, or, in the ancient language, there were three soundings. Music was likewise played between the acts. The instruments chiefly used were trumpets, cornets, and hautboys. The band, which did not consist of more than five or six performers, sat in an upper balcony, over what is now called the stage-box.

"The person who spoke the prologue was ushered in by trumpets, and usually wore a long black velvet cloak, which, I suppose, was considered as best suited to a supplicatory address. Of this custom, whatever might have been its origin, some traces remained till very lately, a black coat having been, if I mistake not, within these few years the constant stage habiliment of our modern prologue speakers. The dress of the ancient prologue speaker is still retained in the play that is exhibited in Hamlet before the king and court of Denmark. The performers of male characters generally wore periwigs, which in the age of Shakspeare were not in common use. It appears from a passage in Puttenham's Art of English Poesy, 1589, that vizards were on some occasions used by the actors of those days; and it may be inferred, from a scene in one of our author's comedies, that they were sometimes worn in his time by those who performed female characters; but this I imagine was very rare. Some of the female part of the audience likewise appeared in masks. The stage-dresses, it is reasonable to suppose, were much more costly at some theatres than at others; yet the wardrobe of even the king's servants at the Globe and Blackfriars was, we find, but scantily furnished; and our author's dramas derived very little aid from the splendour of exhibition.

"It is well known, that in the time of Shakspeare, and for many years afterwards, female characters were represented by boys or young men. Sir William d'Avenant, in imitation of the foreign theatres, first introduced females in the scene, and Mrs Betterton is said to have been the first woman that appeared on the English stage. Andrew Pennycuike played the part of Matilda in a tragedy of Davenport's, in 1655; and Mr Kynaston acted several female parts after the Restoration. Downes, a contemporary of his, assures us, 'that being then very young, he made a complete stage beauty, performing his parts so well, particularly Arthiope and Aglaura, that it has since been disputable among the judicious whether any woman that succeeded him touched the audience so sensibly as he.'

"Both the prompter, or book-holder as he was sometimes called, and the property-man, appear to have been regular appendages of our ancient theatres. No writer that I have met with intimates, that in the time of Shakspeare it was customary to exhibit more than a single dramatic piece in one day. The Yorkshire tragedy, or All's One, indeed, appears to have been one of four pieces that were represented on the same day; and Fletcher has also a piece called Four Plays in One; but probably these were either exhibited on some particular occasion, or were ineffectual efforts to introduce a new species of amusement; for we do not find any other instances of the same kind. Had any shorter pieces been exhibited after the principal performance, some of them probably would have been printed; but there are none extant of an earlier date than the time of the Restoration. The practice, therefore, of exhibiting two dramas successively in the same evening, we may be assured was not established before that period. But though the audiences in the time of our author were not gratified by the representation of more than one drama in the same day, the entertainment was diversified, and the populace diverted, by vaulting, tumbling, slight of hand, and morris-dancing, a mixture not much more heterogeneous than that with which we are daily presented, a tragedy and a farce.

"The amusements of our ancestors, before the commencement of the play, were of various kinds, such as reading, playing cards, drinking ale, or smoking tobacco. It was a common practice to carry table-books to the theatre, and, either from curiosity or enmity to the author, or some other motive, to write down passages of the play that was represented; and there is reason to believe that the imperfect and mutilated copies of some of Shakspeare's dramas, which are yet extant, were taken down in short-hand during the exhibition. At the end of the piece, the actors, in noblemen's houses and in taverns, where plays were frequently performed, prayed for the health and prosperity of their patrons; and in the public theatres for the king and queen. This prayer sometimes made part of the epilogue. Hence, probably, as Mr Steevens has observed, the addition of *Vivant rex et regina* to the modern play-bills.

"Plays, in the time of our author, began at one o'clock in the afternoon; and the exhibition was usually finished in two hours. Even in 1667 they commenced at three. When Gosson wrote his School of Abuse, in 1579, it seems the dramatic entertainments were usually exhibited on Sundays. Afterwards they were performed on that and other days indiscriminately. It appears from a contemporary writer, that exhibiting plays on Sunday had not been abolished in the third year of King Charles I.

"The modes of conveyance to the theatre, anciently as at present, seem to have been various; some going in coaches, others on horseback, and many by water. To the Globe playhouse the company probably were conveyed by water; to that in Blackfriars the gentry went either in coaches or on horseback, and the common people on foot. In an epigram to Sir John Davis, the practice of riding to the theatre is ridiculed as a piece of affectation or vanity, and therefore we may presume it was not very general.

"The long and whimsical titles that are prefixed to the quarto copies of our author's plays, I suppose to have been transcribed from the play-bills of the time. A contemporary writer has preserved something like a play-bill of those days, which seems to corroborate this observation; for if it were divested of rhime, it would bear no very distant resemblance to the title-pages that stand before some of our author's dramas:

> Prithee, what's the play?
> (The first I visited this twelvemonth day)
> They say, "A new invented play of Purle,
> That jeoparded his neck to steal a girl
> Of twelve; and lying fast inpounded for't,
> Has hither sent his beard to act his part;
> Against all those in open malice bent,
> That would not freely to the theft consent:
> Feigns all to's wish, and in the epilogue
> Goes out applauded for a famous rogue"
> —Now hang me if I did not look at first
> For some such stuff, by the fond people's thrust.

"It is uncertain at what time the usage of giving authors a benefit on the third day of the exhibition of their pieces commenced. Mr Oldys, in one of his manuscripts, intimates that dramatic poets had anciently their benefit on the first day that a new play was represented; a regulation which would have been very favourable to some of the ephemeral productions of modern times. But for this there is not, I believe, any sufficient authority. From D'Avenant, indeed, we learn, that in the latter part of the reign of Queen Elizabeth the poet had his benefit on the second day. As it was a general practice in the time of Shakspeare to sell the copy of the play to the theatre, I imagine in such cases an author derived no other advantage from his piece than what arose from the sale of it. Sometimes, however, he found it more beneficial to retain the copyright in his own hands; and when he did so, I suppose he had a benefit. It is certain that the giving authors the profit of the third exhibition of their play, which seems to have been the usual mode during almost the whole of the last century, was an established custom in the year 1612; for Decker, in the prologue to one of his comedies printed in that year, speaks of the poet's third day. The unfortunate Otway had no more than one benefit on the production of a new play; and this, too, it seems, he was sometimes forced to mortgage before the piece was acted. Southerne was the first dramatic writer who obtained the emoluments arising from two representations; and to Farquhar, in the year 1700, the benefit of a third was granted. When an author sold his piece to the sharers or proprietors of a theatre, it remained for several years unpublished; but when that was not the case, he printed it for sale, to which many seem to have been induced, from an apprehension that an imperfect copy might be issued from the press without their consent. The customary price of the copy of a play in the time of Shakspeare appears to have been twenty nobles, or six pounds thirteen shillings and fourpence. The play when printed was sold for sixpence; and the usual present from a patron in return for a dedication was forty shillings. On the first day of exhibiting a new play, the prices of admission appear to have been raised; and this seems to have been occasionally practised on the benefit-nights of authors to the end of the last century. The custom of passing a final censure on plays at their first exhibition is as ancient as the time of our author, for no less than three plays of his rival Ben Jonson appear to have been damned; and Fletcher's Faithful Shepherdess, and the Knights of the Burning Pestle, written by him and Beaumont, underwent the same fate.

"It is not easy to ascertain what were the emoluments of a successful actor in the time of Shakspeare. They had not then annual benefits, as at present. The performers at each theatre seem to have shared the profits arising either from each day's exhibition, or from the whole season, among them. From Ben Jonson's Poetaster we learn, that one of either the performers or proprietors had seven shares and a half; but of what integral sum is not mentioned. From the prices of admission into our ancient theatres, which have been already mentioned, I imagine the utmost that the shares of the Globe playhouse could have received on any one day was about L.35. So lately as the year 1685, Shadwell received by his third day, on the representation of the Squire of Alsatia, L.130; which, Downes the prompter says, was the greatest receipt that had been ever taken at Drury-Lane playhouse at single prices. It appears from the manuscripts of Lord Stanhope, treasurer of the chambers to King James I. that the customary sum paid to John Heminge and his company for the performance of a play at court was twenty nobles, or six pounds thirteen shillings and fourpence. And Edward Alleyn mentions in his Diary, that he once had so slender an audience in his theatre called the Fortune, that the whole receipts of the house amounted to no more than three pounds and some odd shillings.

"Thus scanty and meagre were the apparatus and accommodations of our ancient theatres, on which those dramas were first exhibited that have since engaged the attention of so many learned men, and delighted so many thousand spectators. Yet even then, we are told by a writer of that age, 'that dramatic poesy was so lively expressed and represented on the public stages and theatres of this city, as Rome in the age of her pomp and glory never saw it better performed; in respect of the action and art, not of the cost and sumptuousness.'"

PLEA, in *Law*, is what either party alleges for himself in court, in a cause there depending; and in a more restricted sense, it is the defendant's answer to the plaintiff's declaration.

Pleas are usually divided into those of the crown and common pleas. Pleas of the crown are all suits in the king's name, or in the name of the attorney-general in behalf of the king, for offences committed against his crown and dignity, and against his peace; as treason, murder, felony, &c.

Common pleas are such suits as are carried on between common persons in civil cases. These pleas are of two sorts; dilatory pleas, and pleas to the action. Dilatory pleas are such as tend merely to delay or put off the suit, by questioning the propriety of the remedy rather than by denying the injury; pleas to the action are such as dispute the very cause of suit.

PLEASURE is a word so universally understood that it needs no explanation. Lexicographers, however, who must attempt to explain every word, call it "the gratification of the mind or senses." It is directly opposed to *pain*, and constitutes the whole of positive happiness, as that does of misery.

The Author of Nature has furnished us with many pleasures, as well as made us liable to many pains; and we are susceptible of both in some degree as soon as we have life and are endowed with the faculty of sensation. A French writer, in a work[1] which once raised high expectations, contends that a child in the womb of its mother feels neither pleasure nor pain. "These sensations," says he, "are not innate; they have their origin from without; and it is at the moment of our birth that the soul receives the first impressions; impressions slight and superficial at the beginning, but which by time and repeated acts leave deeper traces in the sensorium, and become more extensive and more lasting. It is when the child sends forth its first cries that sensibility or the faculty of sensation is produced, which in a short time gathers strength and stability by the impression of exterior objects. Pleasure and pain not being innate, and being only acquired in the same manner as the qualities which we derive from instruction, education, and society, it follows that we learn to suffer and enjoy as we learn any other science."

This is strange reasoning and strange language. That sensations are not innate is universally acknowledged; but it does not therefore follow that the soul receives its first impressions and first sensations at the moment of birth. The child has life, the power of locomotion, and the sense of touch, long before it is born; and every mother will tell this philosopher that an infant unborn exhibits symptoms both of pain and of pleasure. That many of our organs of sense are improved by use is incontrovertible; but it is so far from being true that our sensible pleasures become more exquisite by being often repeated, that the contrary is experienced in far the greater part of them; and though external objects, by making repeated impressions on the senses, certainly leave deeper traces on the memory than an object once perceived can do, it by no means follows that these impressions become the more delightful the more familiar that they are to us. That we learn to suffer and enjoy as we learn any other science, is a most extravagant paradox; for it is self-evident that we cannot live without being capable in some degree both of suffering and enjoyment, though a man may certainly live to old age in profound ignorance of all the sciences.

The same writer assures us, indeed, that sensation is not necessary to human life. "Philosophers," says he, "make mention of a man who had lost every kind of feeling in every member of his body; he was pinched or pricked to no purpose. Meanwhile this man made use of all his members; he walked without pain, he drank, ate, and slept, without perceiving that he did so. Sensible neither to pleasure nor pain, he was a true natural machine."

To the tale of these anonymous philosophers the author before us gives implicit credit, whilst at the same instant he favours us with the following argumentation, which completely proves its falsehood. "It is true that sensation is a relative quality, susceptible of increase and diminution; that it is not necessary to existence, and that one might live without it; but in this case he would live as an automaton, without feeling pleasure or pain; and he would possess neither idea, nor reflection, nor desire, nor passion, nor will, nor sentiment; his existence would be merely passive, he would live without knowing it, and die without apprehension."

But if this man of the philosophers, whom our author calls an automaton, and a true natural machine, had neither idea, nor desire, nor passion, nor will, nor sentiment (and without sensation he certainly could have none of them), what induced him to walk, eat, or drink, or to cease from any of these operations after they were accidentally begun? The instances of the automata which played on the flute and at chess are not to the purpose for which they are produced; for there is no parallel between them and this natural machine, unless the philosophers wound up their man to eat, drink, walk, or sit, as Vacanson and Kempeler wound up their automata to play or cease from playing on the German flute and at chess.

The author having for a while sported with these harmless paradoxes, proceeds to put the credulity of his reader to the test in regard to others of a very contrary tendency. He institutes an inquiry concerning the superiority, in number and degree, of the pleasures enjoyed by the different orders of men in society; and labours, not indeed by argument, but by loose declamation, to propagate the belief that happiness is very unequally distributed. The pleasures of the rich, he says, must be more numerous and exquisite than those of the poor; the nobleman must have more enjoyments than the plebeian of equal wealth; and the king, according to him, must be the happiest of all men. He owns, indeed, that although birth, rank, honours, and dignity add to happiness, a man is not to be considered as miserable because he is born in the lower conditions of life. A man may be happy as a mechanic, a merchant, or a labourer, provided he enters into the spirit of his profession, and has not imbibed, by a misplaced education, those sentiments which make his condition insupportable. Happiness is of easy acquisition in the middling stations of life; and though perhaps we are unable to know or to estimate exactly the pleasure which arises from contentment and mediocrity, yet happiness being a kind of aggregate of delights, of riches, and of advantages more or less great, every person must have a share of it; the division is not exactly made, but, all other things being equal, there will be more in the elevated than in the inferior conditions of society; the enjoyment will be more felt, the means of enjoying more multiplied, and the pleasures more varied. Birth, rank, fortune, talents, wit, genius, and virtue, are then the great sources of happiness; those advantages are so considerable, that we see men contented with any one of them; but their union forms supreme felicity.

"There is so vast a difference, says Voltaire, between a man who has made his fortune and one who has to make it, that they are scarcely to be considered as creatures of the same kind. The same thing may be said of birth, the greatest of all advantages in a large society; of rank, of honours, and of great abilities. How great a difference is made between a person of high birth and a tradesman; between a Newton or Descartes and a simple mathematician! Ten thousand soldiers are killed on the field of battle, and it is scarcely mentioned; but if the general fall, and especially if he be a man of courage and abilities, the court and city are filled with the news of his death, and the mourning is universal.

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[1] *Encyclopédie Méthodique*, articles *Logique*, *Métaphysique*, *et Morale*, tom. iv.

"Frederick the Great, king of Prussia, felt in a more lively manner than perhaps any other man the value of great talents. I would willingly renounce, said he to Voltaire, every thing which is an object of desire and ambition to man; but I am certain if I were not a prince I should be nothing. Your merit alone would gain you the esteem, and envy, and admiration of the world; but to secure respect for me, titles, and armies, and revenues, are absolutely necessary."

For what purpose this account of human happiness was published, it is not for us to say. Its obvious tendency, however, is to make the lower orders of society discontented with their state, and envious of their superiors; and it is not unreasonable to suppose, that it contributed in some degree to excite the ignorant part of the author's countrymen to the commission of those atrocities of which they have since been guilty. That such was his intention, the following extract will not permit us to believe; for though in it the author attempts to support the same false theory of human happiness, he mentions virtuous kings with the respect becoming a loyal subject of the unfortunate Louis, whose character he seems to have intentionally drawn, and whose death by the authority of a savage faction he has in effect foretold.

"Happiness, in a state of society, takes the most variable forms; it is a Proteus susceptible of every kind of metamorphosis; it is different in different men, in different ages, and in different conditions. The pleasures of youth are very different from those of old age; what affords enjoyment to a mechanic, would be supreme misery to a nobleman; and the amusements of the country would appear insipid in the capital. Is there, then, nothing fixed with regard to happiness? Is it of all things the most variable and the most arbitrary? Or, in judging of it, is it impossible to find a standard by which we can determine the limits of the greatest good to which man can arrive in the present state? It is evident that men form the same ideas of the beautiful and sublime in nature, and of right and wrong in morality, provided they have arrived at that degree of improvement and civilization of which human nature is susceptible; and that different opinions on these subjects depend on different degrees of culture, of education, and of improvement. The same thing may be advanced with regard to happiness: all men, if equal with respect to their organs, would form the very same ideas on this subject if they reached the degree of improvement of which we are presently speaking; and, in fact, do we not see in the great circles at Rome, at Vienna, at London, and at Paris, that those who are called people of fashion, who have received the same education, have nearly the same taste, the same desires, and the same spirit for enjoyment? There is doubtless a certain degree of happiness to be enjoyed in every condition of life; but as there are some conditions preferable to others, so are there degrees of happiness greater and less; and if we were to form an idea of the greatest possible in the present state, it perhaps would be that of a sovereign, master of a great empire, enjoying good health and a moderate spirit; endowed with piety and virtue; whose whole life was employed in acts of justice and mercy, and who governed by fixed and immoveable laws. Such a king is the image of the Divinity on earth, and he must be the idol of a wise people. His whole life should present a picture of the most august felicity. Although such sovereigns are rare, yet we are not without examples of them. Ancient history affords us Titus and Marcus Aurelius, and the present age can boast of piety and munificence in the character of some of its kings. This state of the greatest happiness to which man can reach not being ideal, it will serve as a standard of comparison by which happiness and misery can be estimated in all civilized countries. *He is as happy as a king*, is a proverbial expression, because we believe with justice that royalty is the extreme limit of the greatest enjoyments; and, in fact, happiness being the work of man, that condition which comprehends all the degrees of power and of glory, which is the source of honour and of dignity, and which supposes in the person invested with it all means of enjoyment either for himself or others, leaves nothing on this earth to which any reasonable man would give the preference.

"We can find also in this high rank the extreme of the greatest evils to which the condition of nature is exposed. A king condemned to death and perishing on a scaffold, by the authority of a faction, while at the same time he had endeavoured, by every means in his power, to promote the general happiness of his subjects, is the most terrible and striking example of human misery; for if it be true that a crown is the greatest of all blessings, then the loss of it, and at the same time the loss of life by an ignominious and unjust sentence, are of all calamities the most dreadful.

"It is also in the courts of kings that we find the most amiable and perfect characters; and it is there where true grandeur, true politeness, the best tone of manners, the most amiable graces, and the most eminent virtues, are completely established. It is in courts that men seem to have acquired their greatest improvement. Whosoever has seen a court, says La Bruyère, has seen the world in the most beautiful, the most enchanting, and attractive colours. The prejudices of mankind in behalf of the great are so excessive, that if they inclined to be good they would be almost the objects of adoration."

In this passage there are doubtless many just observations. But there is at least an equal number of others both false and dangerous. That a crown is the greatest of all earthly blessings, and that it is in the courts of kings that we meet with the most amiable and perfect characters, are positions which a true philosopher will not admit, except with great limitations. The falsehood of the author's general theory respecting the unequal distribution of happiness in society, we need not waste time in exposing. It is sufficiently refuted in other articles of this work. (See MORAL PHILOSOPHY.) He enters upon other speculations respecting the pleasures and pains of savages, which are ingenious, and worthy of attention; but before we proceed to notice them, it will be proper to consider the connection which subsists between pleasure and pain.

"That the cessation of pain is accompanied by pleasure, is a fact, "says Dr Sayers," which has been repeatedly observed, but perhaps not sufficiently accounted for. Let us suppose a person in a state of indifference as to heat. Upon coming near a fire, he will experience at first an agreeable warmth, that is, pleasure. If the heat be increased, this state of pleasure will, after a time, be converted into one of pain, from the increased action upon the nerves and brain, the undoubted organs of all bodily sensations. Let the heat now be gradually withdrawn; the nervous system must acquire again, during this removal, the state of agreeable warmth or pleasure; and after passing through that state it will arrive at indifference. From this fact then we may conclude that a state of pleasure may be pushed on till it is converted into one of pain; and, on the other hand, that an action which produces pain will, if it go off gradually, induce at a certain period of its decrease a state of pleasure. The same reasoning which has thus been applied to the body may be extended also to the mind. Total languor of mind is not so pleasant as a certain degree of action or emotion; and emotions pleasant at one period may be increased till they become painful at another; whilst painful emotions, as they gradually expire, will, at a certain period of their decrease, induce a state of pleasure. Hence then we are able to explain why pleasure should arise in all cases from the gradual cessation of any action or emotion which produces pain."

The same author maintains, that from the mere removal of pain, whether by degrees or instantaneously, we always experience pleasure; and if the pain removed was exquisite, what he maintains is certainly true. To account for this phenomenon he lays down the following law of nature, which experience abundantly confirms, viz. "that the temporary withdrawing of any action from the body or mind invariably renders them more susceptible of that action when again produced." Thus, after long fasting, the body is more susceptible of the effects of food than if the stomach had been lately satisfied; the action of strong liquors is found to be greater on those who use them seldom than on such as are in the habit of drinking them. Thus, too, with respect to the mind; if a person be deprived for a time of his friend's society, or of a favourite amusement, the next visit of his friend, or the next renewal of his amusement, is attended with much more pleasure than if they had never been withheld from him.

"To apply this law to the case of a person suddenly relieved from acute pain. While he labours with such pain, his mind is so totally occupied by it, that he is unable to attend to his customary pursuits or amusements. He becomes therefore so much more susceptible of their action, that when they are again presented to him, he is raised above his usual indifference to positive pleasure. But all pains do not proceed from an excess of action. Many of them arise from reducing the body or the mind to a state below indifference. Thus, if a person have just sufficient warmth in his body to keep him barely at ease or in a state of indifference, by withdrawing this heat, a state of uneasiness or pain is produced; and if in a calm state of mind one be made acquainted with a melancholy event, his quiet is interrupted, and he sinks below indifference, into a painful state of mind. If, now, without communicating any new source of pleasure, we remove in the former case the cold, and in the latter the grief, the persons from whom they are removed will experience real pleasure. Thus, then, whether pain arises from excess or deficiency of action, the gradual or the sudden removal of it must be in all cases attended with pleasure."[1] It is equally true that the gradual or sudden removal of pleasure is attended with pain.

We are now prepared to examine the French author's account of the pleasures and pains of savages. "Every age," says he, "has its different pleasures; but if we were to imagine that those of childhood are equal to those of confirmed age, we should be much mistaken in our estimation of happiness. The pleasures of philosophy, either natural or moral, are not unfolded to the infant; the most perfect music is a vain noise; the most exquisite perfumes and dishes highly seasoned offend his young organs instead of affording delight; his touch is imperfect; forty days elapse before the child gives any sign of laughter or of weeping; his cries and groans before that period are not accompanied with tears; his countenance expresses no passion; the parts of his face bear no relation to the sentiments of the soul, and are moreover without consistency. Children are but little affected with cold; whether it be that they feel less, or that the interior heat is greater than in adults. In them all the impressions of pleasure and pain are transitory; their memory has scarcely begun to unfold its powers; they enjoy nothing but the present moment; they weep, laugh, and give tones of satisfaction without consciousness, or at least without reflection; their joy is confined to the indulgence of their little whims, and constraint is the greatest of their misfortunes; few things amuse, and nothing satisfies them. In this happy condition of early infancy nature is at the whole expense of happiness; and the only point is not to contradict her. What desires have children? Give them liberty in all their movements, and they have a plenitude of existence, an abundance of that kind of happiness which is confined in some sort to all the objects which surround them; but if all beings were happy on the same conditions, society would be at no expense in procuring the happiness of the different individuals who compose it. Sensation is the foundation of reflection; it is the principal attribute of the soul; it is by this that man is elevated to sublime speculations, and secures his dominion over nature and himself. This quality is not stationary, but susceptible, like all other relative qualities, of increase and decay, of different degrees of strength and intenseness: it is different in different men; and in the same man it increases from infancy to youth, from youth to confirmed manhood: at this period it stops, and gradually declines as we proceed to old age and to second childishness. Considered physically, it varies according to age, constitution, climate, and food; considered in a moral point of view, it takes its different appearances from individual education, and from the habits of society; for man in a state of nature and society, with regard to sensation and the unfolding of his powers, may be considered as two distinct beings; and if one were to make a calculation of pleasure in the course of human life, a man of fortune and capacity enjoys more than ten thousand savages.

"Pleasure and pain being relative qualities, they may be almost annihilated in the moment of vehement passion. In the heat of battle, for example, ardent and animated spirits have not felt the pain of their wounds; and minds strongly penetrated with sentiments of religion, enthusiasm, and humanity, have supported the most cruel torments with courage and fortitude. The sensibility of some persons is so exquisitely alive, that one can scarcely approach them without throwing them into convulsions. Many diseases show the effect of sensibility pushed to an extreme; such as hysteric affections, certain kinds of madness, and some of those which proceed from poison, and from the bite or sting of certain animals, as the viper and the tarantula. Excessive joy or grief, fear and terror, have been known to destroy all sensation, and occasion death."[2]

Having made these preliminary observations on pleasure and pain in infancy, and as they are increased or diminished by education, and the different conditions of body and mind, the same author proceeds to consider the capability of savages to feel pleasure and pain. "By savages he understands all the tribes of men who live by hunting and fishing, and on those things which the earth yields without cultivation. Those tribes who possess herds of cattle, and who derive their subsistence from such possessions, are not to be considered as savages, as they have some idea of property. Some savages are naturally compassionate and humane, others are cruel and sanguinary. Although the physical constitution of man be everywhere the same, yet the varieties of climate, the abundance or scarcity of natural productions, have a powerful influence to determine the inclinations; even the fierceness of the tiger is softened under a mild sky. Now nature forms the manners of savages just as society and civil institutions form the manners of civilized life. In the one case climate and food produce almost the whole effect; in the other they have scarcely any influence. The habits of society every moment contend with nature, and they are almost always victorious. The savage devotes himself to the dominion of his passions; the civilized man is employed in restraining, in directing, and in modifying them: so much influence have government, laws, society, and the fear of censure and punishment, over his soul.

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[1] Disquisitions Metaphysical and Literary.

[2] There are instances of persons who have died in consequence of the noise of thunder, without being touched. A man frightened by the fall of a gallery in which he happened to be, was immediately seized with the black jaundice. M. le Cat mentions a young person on whom the insolence of another made such an impression, that his countenance became at first yellow, and then changed into black, in such a manner that in less than eight days he appeared to wear a mask of black velvet; and he continued in this state for four months, without any other symptom of bad health, or any pain. A sailor was so terrified in a storm, that his face sweated blood, which, like ordinary sweat, returned as it was wiped off. Stahl, whose testimony cannot be called in question, cites a similar case of a girl who had been frightened by soldiers. The excess of fear, according to many physicians, produces madness and epilepsy.

" It is not to be doubted that savages are susceptible both of pleasure and pain; but are the impressions made on their organs as sensible, or do they feel pain in the same degree with the inhabitants of a civilized country?

" Their enjoyments are so limited, that if we confine ourselves to truth, a few lines will be sufficient to describe them: our attention must therefore be confined to pain, because the manner in which they support misfortune, and even torture, presents us with a view of character unequalled in the history of civilized nations. It is not uncommon in civilized countries to see men braving death, meeting it with cheerfulness, and even not uttering complaints under the torture; but they do not insult the executioners of public vengeance, and defy pain in order to augment their torments; and those who are condemned by the laws suffer the punishment with different degrees of fortitude. On those mournful occasions, the common ranks of mankind in general die with less firmness: those, on the other hand, who have received education, and who by a train of unfortunate events are brought to the scaffold, whether it be the fear of being reproached with cowardice, or the consideration that the stroke is inevitable, such men discover the expiring sighs of self-love even in their last moments; and those, especially of high rank, from their manners and sentiments, are expected to meet death with magnanimity: but an American savage in the moment of punishment appears to be more than human; he is a hero of the first order, who braves his tormentors, who provokes them to employ all their art, and who considers it his chief glory to bear the greatest degree of pain without shrinking. The recital of their tortures would appear exaggerated, if it were not attested by the best authority, and if the savage nations among whom those customs are established were not sufficiently known; but the excess of the cruelty is not so astonishing as the courage of the victim. The European exposed to sufferings of the same dreadful nature would rend heaven and earth with his piercing cries and horrible groans; the reward of martyrdom, the prospect of eternal life, could alone give him fortitude to endure such torments; but the savage is not animated with this exalted hope. What supports him, then, in scenes of so exquisite suffering? The feeling of shame, the fear of bringing reproach on his tribe, and giving a stain to his fellows never to be wiped away, are the only sentiments which influence the mind of a savage, and which, always present to his imagination, animate him, support him, and lend him spirit and resolution. At the same time, however powerful those motives may be, they would not be alone sufficient, if the savage felt pain in the same degree with the European. Sensibility, as we have already observed, is increased by education; it is influenced by society, manners, laws, and government; climate and food work it into a hundred different shapes; and all the physical and moral causes contribute to increase and diminish it. The habitual existence of a savage would be a state of suffering to an inhabitant of Europe. You must cut the flesh of the one, and tear it away with your nails, before you can make him feel in an equal degree to a scratch or prick of a needle in the other. The savage, doubtless, suffers under torture, but he suffers much less than an European in the same circumstances: the reason is obvious; the air which the savages breathe is loaded with fog and moist vapours; their rivers not being confined by high banks, are by the winds as well as in floods spread over the level fields, and deposit on them a putrid and pernicious slime; the trees, squeezed one upon another in that rude and uncultivated country, serve rather as a covering to the earth than an ornament. Instead of those fresh and delicious shades, those openings in the woods, and walks crossing each other in all directions, which delight the traveller in the fine forests of France and Germany; those in America serve only to intercept the rays of the sun, and to prevent the benign influence of his beams. The savage participates of this cold humidity; his blood has little heat, his humours are gross, and his constitution phlegmatic. To the powerful influence of climate it is necessary to join the habit of his life. Obliged to traverse vast deserts for subsistence, his body is accustomed to fatigue; food not nourishing, and at the same time in no great plenty, blunts his feelings; and all the hardships of the savage state give a rigidity to his members which makes him almost incapable of suffering. The savage in this state of nature may be compared to our water-women and street-porters, who, though they possess neither great vigour nor strength, are capable of performing daily, and without complaint, that kind of labour which to a man in a different condition of life would be a painful and grievous burden. Feeling, in less perfection with the savage, by the effects of climate and food, and the habits of his life, is still farther restrained by moral considerations. The European is less a man of nature than of society: moral restraints are powerful with him, whilst over the American they have scarcely any influence. This latter, then, is in a double condition of imperfection with regard to us; his senses are blunted, and his moral powers are not disclosed. Now, pleasure and pain depending on the perfection of the senses and the unfolding of the intellectual faculties, it cannot be doubted, that in enjoyments of any kind savages experience less pleasure, and in their suffering less pain, than Europeans in the same circumstances. And, in fact, the savages of America possess a very feeble constitution. They are agile without being strong; and this agility depends more on their habits than on the perfection of their members: they owe it to the necessity of hunting; and they are moreover so weak, that they were unable to bear the toil which their first oppressors imposed on them. Hence a race of men in all respects so imperfect could not endure torment under which the most robust European would sink, if the pain which they feel were really as great as it appears to be. Feeling is, then, and must necessarily be, less in the savage condition; for this faculty disclosing itself by the exercise of all the physical and moral qualities, must be less as they are less exercised. Everything shows the imperfection of this precious quality, this source of all our affections, in the American savages.

" All the improvements in Europe have had a tendency to unfold sensibility; the air is purified that we may breathe more freely; the morasses are drained, the rivers are regulated in their courses, the food is nourishing, and the houses commodious. With the savages, on the contrary, everything tends to curb it; they take pleasure even in hardening the organs of the body, in accustoming themselves to bear by degrees the most acute pain without complaining. Boys and girls among the savages amuse themselves with tying their naked arms together, and laying a kindled coal between them, to try which of them can longest suffer the heat; and the warriors who aspire to the honour of being chief, undergo a course of suffering which exceeds the idea of torture inflicted on the greatest criminals in Europe."

These observations on the pleasures and pains of savages appear to be well founded, and, as the attentive reader will perceive, are perfectly agreeable to the theory of Dr Sayers. If, indeed, that theory be just, as we believe it to be, it will follow, that the few pleasures of sense which the American enjoys, he ought to enjoy more completely than any European, because to him they recur but seldom. This may very possibly be the case, and certainly would be so, were not his fibres, by climate and the habits of his life, rendered more rigid than those of the civilized part of the inhabitants of Europe. But if we agree with this author[1] in what he says of the pains and pleasures of savages, we cannot admit, without many exceptions, his theory of the enjoyments of children. It is so far from being true that few things amuse, and that nothing satisfies them, that the direct contrary must have been observed by every man attentive to the operations of the infant mind, which is amused with everything new, and often completely satisfied with the merest trifle. The pleasures of philosophy are not indeed unfolded to the infant; but it by no means follows that he does not enjoy his rattle and his drum as much as the philosopher enjoys his telescope and his air-pump; and if there be any truth in the science of physiognomy, the happiness of the former is much more pure and exquisite than that of the latter. That the most perfect music is vain noise to an infant, is far from being self-evident, unless the author confines the state of infancy to a very few months; and we are not disposed to believe, without better evidence than we have yet received, that the relish of exquisite perfumes and highly-seasoned dishes adds much to the sum of human felicity.

But however much we disapprove of many of these reflections, the following we cordially approve and adopt. "If we compare," says our author, "the pleasures of sense with those which are purely intellectual, we shall find that the latter are infinitely superior to the former, as they may be enjoyed at all times and in every situation of life. What are the pleasures of the table, says Cicero, of gaming, and of women, compared with the delight of study? This taste increases with age, and no happiness is equal to it. Without knowledge and study, says Cato, life is almost the image of death.[2] The pleasures of the soul are such, that it is frequent enough to see men preserve their gaiety during their whole life, notwithstanding a weak, diseased, and debilitated body. Scaron, who lived in the last century, was an example of this. Balzac, speaking of him, says that Prometheus, Hercules, and Philoctetes, in profane, and Job in sacred history, said many great things while they were afflicted with violent pain; but Scaron alone said pleasant things. I have seen, continues he, in many places of ancient history, constancy, and modesty, and wisdom, and eloquence, accompanying affliction; but he is the only instance wherein I have seen pleasantry.

"There are men whose understandings are constantly on the stretch, and by this very means they are improved; but if the body were as constantly employed in the pursuit of sensual gratification, the constitution would soon be destroyed. The more we employ the mind we are capable of the greater exertion; but the more we employ the body we require the greater repose. There are, besides, but some parts of the body capable of enjoying pleasure; every part of it can experience pain. A toothach occasions more suffering than the most considerable of our pleasures can procure of enjoyment. Great pain may continue for any length of time; excessive pleasures are almost momentary. Pleasure carried to an extreme becomes painful; but pain, either by augmenting or diminishing it, never becomes agreeable. For the moment, the pleasures of the senses are perhaps more satisfactory; but in point of duration, those of the heart and mind are infinitely preferable. All the sentiments of tenderness, of friendship, of gratitude, and of generosity, are sources of enjoyment for man in a state of civilization. The damned are exceedingly unhappy, said St Catherine de Sienna, if they are incapable of loving or being beloved.

"Pleasure, continued for a great length of time, produces languor and fatigue, and excites sleep; the continuation of pain is productive of none of these effects. Many suffer pain for eight days, and even a month, without interruption; an equal duration of excessive pleasure would occasion death.

"Time is a mere relative idea with regard to pleasure and pain; it appears long when we suffer, and short when we enjoy. If there existed no regular and uniform movement in nature, we would not be able from our sensations alone to measure time with any degree of exactness, for pain lengthens and pleasure abridges it. From the languor of unoccupied time has arisen the proverb expressive of our desire to kill it. It is a melancholy reflection, and at the same time true, that there is no enjoyment which can effectually secure us from pain for the remainder of our lives; while there are examples of evils which hold men in constant sorrow and pain during their whole existence. Such, then, is the imperfection of the one and the power of the other.

"Pleasure and pain are the sources of morality; an action is just or unjust, good or otherwise, only as its natural tendency is to produce suffering or enjoyment to mankind. No crime could be committed against a being altogether insensible, nor could any good be bestowed on it. Unless he were endowed with the desire of pleasure and the apprehension of pain, man, like an automaton, would act from necessity, without choice and without determination.

"All our passions are the development of sensibility. If we were not possessed of feeling, we should be destitute of passions; and as sensibility is augmented by civilization, the passions are multiplied; more active and vigorous in an extensive and civilized empire than in a small state; more in the latter than among barbarous nations; and more in these last than among savages. (See PASSION.) There are more passions in France and England than in all the nations of Europe; because everything which serves to excite and foster them is always in those countries in the greatest state of fermentation. The mind is active; the ideas great, extensive, and multiplied. And is it not the soul, the mind, and heart, which are the focus of all the passions?"

But wherever the passions are multiplied, the sources of pleasure and pain are multiplied along with them. This being the case, it is impossible to prescribe a fixed and general rule of happiness suited to every individual. There are objects of pleasure with regard to which all men of a certain education are agreed; but there are perhaps many more, owing to the variety of tempers and education, about which they differ. Every man forms ideas of enjoyment relative to his character; and what pleases one may be utterly detested by another. In proportion as a nation is civilized and extensive, those differences are remarkable. Savages, who are not acquainted with all the variety of European pleasures, amuse themselves with very few objects. Owing to the want of civilization, they have scarcely any choice in the objects of taste. They have few passions; we have many. But even in the nations of Europe, pleasure is infinitely varied in its modification and forms. Those differences arise from manners, from governments, from political and religious customs, and chiefly from education. Meanwhile, however different and variable the ideas of pleasure may be amongst nations and individuals, it still remains a fact, that a certain number of persons in all civilized states, whether distinguished by birth, or rank, or fortune, or talents, as they have nearly the same education, so they form nearly the same ideas of happiness; but, to possess it, a man must give his chief application to the state of his mind; and, notwithstanding all his efforts, it is of uncertain duration. Happiness is the sunshine of life; we enjoy it frequently at great intervals, and it is therefore necessary to know how to use it. All the productions of art perish; the largest fortunes are dissipated; rank, honour, and dignity, pass away like a shadow; the memory is impaired; all the faculties of the soul are extinguished; the body sinks under the infirmities of old age; and scarcely has one reached the boundaries of happiness marked out by his imagination, when he must give place to another, and renounce all his pleasures, all his hopes, all his illusions, the fugitive images of which had given happiness to the mind.

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[1] *Encyclopédie Méthodique*, articles *Logique*, *Métaphysique*, *et Morale*, tom. iv.

[2] "Savages, barbarians, and peasants, enjoy little happiness except that of sensation. The happiness of a civilized and well-informed man consists of sensations, of ideas, and of a great number of affinities, altogether unknown to them. He not only enjoys the present, but the past and the future. He recalls the agreeable idea of pleasures which he has tasted. It is great happiness, says an ancient, to have the recollection of good actions, of an upright intention, and of promises which we have kept."

There are pleasures, however, on which the mind may securely rest, and which elevate man above himself, dignify his nature, fix his attention on spiritual things, and render him worthy of the care of Providence. These are to be found in true religion, which procures for those who practise its duties, inexpressible happiness in a better country, and is in this world the support of the weak and the consolation of the unfortunate.

PLEBEIAN, any person of the rank of the common people. It is chiefly used in speaking of the ancient Romans, who were divided into senators, patricians, and plebeians. The distinction was made by Romulus, the founder of the city, who confined all dignities, civil, military, and sacerdotal, to the rank of patricians. But, to prevent the seditions which such a distinction might produce, through the pride of the higher order and the envy of the lower, he endeavoured to engage them one to another by reciprocal ties and obligations. Every plebeian was allowed to choose, out of the body of the patricians, a protector, who should be obliged to assist him with his interest and substance, and to defend him from oppression. These protectors were called patrons; the protected, clients. It was the duty of the patron to draw up the contracts of the clients, to extricate them out of their difficulties and perplexities, and to guard their ignorance against the artfulness of the crafty. On the other hand, if the patron was poor, his clients were obliged to contribute to the portions of his daughters, the payment of his debts, and the ransom of him and his children if they happened to be taken in war. The client and patron could neither accuse nor bear witness against each other; and if either of them was convicted of having violated this law, the crime was equal to that of treason, and any one might with impunity slay the offender as a victim devoted to Pluto and the infernal gods. For more than six hundred years we find no dissensions or jealousies between the patrons and their clients; not even in the times of the republic, when the people frequently mutinied against the great and powerful.

PLECTRUM, Greek, πλῆκτρον, a small implement of wood, horn, ivory, metal, &c. employed to strike the strings of certain musical instruments used among the ancient Egyptians, Greeks, and Arabians. It was of various shapes, often consisting of a heart-shaped head, and a short handle. In some of the ancient Egyptian paintings at Thebes, are representations of a three-stringed guitar, with an oval body and long neck, having a plectrum attached by a string to the neck, close to its junction with the body. Several foreign stringed instruments are still played with a plectrum, and amongst them the *Tamboora* of Hindustan.

PLEDGE (*plegius*), in common law, a surety or gage, either real or personal, which the plaintiff or demandant is to find for his prosecuting the suit.

To PLEDGE, in drinking, denotes to warrant, or to be surety to one, that he shall receive no harm whilst he is taking his draught. The phrase is referred by antiquaries to the practice of the Danes heretofore in England, who used frequently to stab or cut the throats of the natives whilst they were drinking.

PLEDGERY, or PLEGGERY, in *Law*, suretiship, or an undertaking or answering for another.

PLEIADES, in fabulous history, the seven daughters of Atlas king of Mauritania, and Pleione, who were so called from their mother. They were Maia, Electra, Taygete, Asterope, Merope, Halcyone, and Celœno, who were also called *Atlantides*, from their father Atlas. These princesses were carried off by Busiris king of Egypt; but Hercules, having conquered him, delivered them to their father. Yet they afterwards suffered a new persecution from Orion, who pursued them five years, until Jupiter, being prevailed on by their prayers, took them up into the heavens, where they form the constellation which bears their name.

PLEIADES, in *Astronomy*, an assemblage of seven stars, in the neck of the constellation Taurus.

These stars are so called from the Greek πλειν, *navigare*, to sail; as being terrible to mariners, by reason of the rains and storms which frequently rise with them. The Latins called them *vergiliæ*, from *ver*, spring; because of their rising about the time of the vernal equinox. The largest is of the third magnitude, and is called *lucida Pleiadum*.

PLENARY, something complete or full. Thus we say the pope grants *plenary* indulgences, that is, full and entire remissions of the penalties due to all sins.

PLENIPOTENTIARY, a person vested with full power to do any thing.

PLENITUDE, the quality of a thing that is full, or that fills another. In medicine, it chiefly denotes a redundancy of blood and humours.

PLENUM, in *Physics*, denotes, according to the Cartesians, that state of things in which every part of space is supposed to be full of matter, in opposition to a *vacuum*, which is a space supposed to be devoid of all matter.

PLEONASM, a figure in *Rhetoric*, by which we may use words seemingly superfluous, to express a thought with the greater energy; such as, "I saw it with my own eyes," "I heard it with my own ears," and the like.

PLETHORA, in *Medicine*, from πληθος, *plenitude*. A plethora is, when the vessels are too much loaded with fluids. The plethora may be sanguine or serous. In the former there is too much *crassamentum* in the blood, in the latter too little. In the sanguine plethora, there is danger of a fever, inflammation, apoplexy, rupture of the blood-vessels, and obstructed secretions; in the serous, of a dropsy, and other affections. A rarefaction of the blood produces all the effects of a plethora; it may accompany a plethora, and should therefore be distinguished from it. Mr Bromfield observes, that a sanguine plethora may be known to be present by the pulse. An artery overcharged with blood is as incapable of producing a strong full pulse, as one that contains a deficient quantity; so that in both cases there will be a low and weak pulse. To distinguish rightly, the pulse must not be felt with one or two fingers on the carpal artery; but if three or four fingers cover a considerable length of the artery, and we press hard for some time on it, and then suddenly raise all these fingers except that which is nearest to the patient's hand, the influx of the blood, if there is a plethora, will be so rapid as to raise the other finger, and make us sensible of the fulness. The sanguine plethora is relieved by bleeding; the serous by purging, diuretics, and sweating.

PLEXUS, amongst anatomists, a bundle of small vessels interwoven in the form of network. Thus a congeries of vessels within the brain is called *plexus choroides, reticularis*, or *retiformis*. A plexus of nerves is the union of two or more nerves forming a sort of ganglion or knot.

PLICA POLONICA, or *Plaited Hair*, is a disease peculiar to Poland, and hence the name. Mr Coxe, who gives a short account of it, attempts likewise to assign the physical causes which are supposed to produce it. Many causes of this kind, he tells us, have been supposed to concur in rendering the plica more frequent in those regions than in other parts. It would be an endless task to enumerate the various conjectures by which each person has endeavoured to support his favourite hypothesis. The most probable are those assigned by Dr Vicat. The first cause is the nature of the Polish air, which is rendered insalubrious by numerous woods and morasses, and occasionally derives an uncommon keenness, even in the midst of summer, from the position of the Carpathian Mountains; for the south and south-easterly winds, which usually convey warmth in other regions, are in this chilled in their passage over the snowy summits of this range. The second is unwholesome water; for although Poland is not deficient in good springs, yet the common people usually drink that which is nearest at hand, taken indiscriminately from rivers, lakes, and even stagnant pools. The third cause is the gross inattention of the natives to cleanliness. Indeed experience shows, that those who are not negligent in their persons and habitations, are less liable to be afflicted with the plica than others who are deficient in these particulars. Thus persons of the higher ranks are less subject to this disorder than those of inferior stations, the inhabitants of large towns less than those of small villages, the free peasants less than those in an absolute state of vassalage, the natives of Poland Proper less than those of Lithuania. Whatever we may think as to the possibility of all or any of these causes, by themselves, or in conjunction with others, originally producing the disorder, we may venture to assert, that they all, and particularly the last, assist its propagation, inflame its symptoms, and protract its cure. In a word, the plica polonica appears to be a contagious distemper, which, like the leprosy, still prevails amongst a people ignorant in medicine, and inattentive to check its progress, but is rarely known in those countries where proper precautions are taken to prevent its spreading.

PLINIUS SECUNDUS, C., a celebrated Roman writer, but who is to be distinguished from his nephew, Pliny the younger. He was born A. D. 23, in the tenth year of Tiberius, and died on the 2d of November, A. D. 80, the first year of the Emperor Titus, and the day after the eruption of Mount Vesuvius. Two cities contend for the honour of giving birth to him; but the inhabitants of Novum Comum, now *Como*, seem to have a better claim to him as their fellow-citizen than those of Verona. His earlier years were spent under the profligate reign of Caligula and Claudius, but he does not appear to have mingled in the dissolute scenes of those times. Though he devoted himself to the study of literature, he did not withdraw himself from the active business of life. It appears that he served his first military campaign in Africa, probably about his twenty-third year, and that he afterwards spent some time in Germany, under his friend and commander L. Pomponius Secundus, whom we find in Tacitus to have triumphed over the Catti. It was about this time, A. D. 48, that he published his work entitled *De Jaculatione Equestri;* and as Pomponius died shortly after his triumph, Pliny performed the mournful though pleasing duty of transmitting to posterity the transactions of his friend, in a work entitled *Pomponii Vita*. He next devoted himself to forensic duties, and displayed the same activity and zeal in defending the causes of his fellow-citizens, as he had before done in maintaining the honour of his country by arms. It seems probable that at this time he published his work *Studiorum Tres Libri*, divided into six volumes, which was a manual for the formation of an orator, a subject which was subsequently treated by Quintilian. He also published another work, *Germanica Bella*, in which he gave a detailed account of the wars of Drusus and Germanicus. In the reign of Nero, Pliny was employed in Spain as Procurator Cæsaris; an equestrian dignity, but with the duties of which we are by no means well acquainted. He employed his leisure hours in making a selection of passages from various authors, called *Electorum Commentarii*, which on his death he left, to the number of one hundred and sixty, to his nephew. He also published, about A. D. 67, a grammatical work, *Dubii Sermonis Libri Octo;* and thirty-one books of History, which was a continuation of that of Aufidius Bassus, who seems to have written an account of the civil wars. Pliny became the intimate friend of Vespasian and his son Titus; and it was in the reign of the former, A. D. 77, that he published his celebrated work, *Historia Naturalis*, in thirty-seven books. Two years afterwards, Pliny was stationed at Misenum, in Campania, in command of the fleet; and when the eruption of Vesuvius broke out, he hurried towards it, to assist his friends, and to examine more minutely this wonderful phenomenon of nature. But he fell a victim to his thirst for knowledge; being suffocated by the sulphureous exhalations, as he was approaching the mountain from the side of Stabiæ, now *Castellamare*.

The work for which he is most distinguished is his Natural History, the materials for which he has drawn from upwards of two thousand authors, which have generally disappeared. It was divided into thirty-six books, with a dedication to Titus, and a kind of index of the whole; but these are now considered as the first book. The second book contains introductory remarks on astronomy and meteorology; and from the third to the sixth inclusive we have a description of the earth, the lands and their inhabitants, being a sort of universal geography, though it is frequently nothing more than a simple enumeration of names. Then follows the Natural History, beginning with the animal kingdom, which occupies from the seventh to the eleventh books; then botany from the twelfth to the nineteenth. With the twentieth begins his account of the medicinal qualities of various herbs, which extends to the twenty-seventh; and then of the medicines which may be prepared from animals, to the thirty-second. The remaining books are occupied with the mineral kingdom, in which he takes occasion to introduce much curious information respecting the fine arts, sculpture, painting, &c.; and concludes with an account of the most celebrated artists and their works. Cuvier, who was so well able to judge of the value of such a work, thus expresses himself. "Ce grand ouvrage est le seule de Pline qui soit arrivé jusqu'à nous. Il est en même temps l'un des monumens les plus précieux que l'antiquité nous ait laissés, et la preuve d'une érudition bien étonnante dans un homme de guerre et un homme d'état. Pour apprécier avec justice cette vaste et célèbre composition, il est nécessaire d'y distinguer le plan, les faits, et le style. Le plan en est immense. Pline ne se propose point d'écrire seulement une Histoire Naturelle dans le sens restreint où nous prenons aujourd'hui cette science, c'est-à-dire, un traité, plus ou moins détaillé, des animaux, des plantes, et des mineraux; il embrasse l'astronomie, la physique, la géographie, l'agriculture, le commerce, la médecine, et les arts, aussi bien que l'Histoire Naturelle proprement dite; et il mêle sans cesse à ce qu'il en dit des traits relatif, à la connaissance moralé de l'homme, et à l'histoire des peuples, en sorte qu'à beaucoup d'égards on a pu dire de cet ouvrage qu'il était l'Encyclopédie de son temps........Pline n'a point été un observateur tel qu'Aristote; encore moins un homme de génie, capable, comme ce grand philosophe, de saisir les lois et les rapports d'après lesquels la nature a co-ordonné ses productions. Il n'est en général qu'un compilateur, et même le plus souvent un compilateur qui, n'ayant point par lui-même d'idée des choses sur lesquelles il rassemble les témoignages des autres, n'a pu apprécier la vérité de ces témoignages, ni même toujours comprendre ce qu'ils avaient voulu dire.......Si Pline a pour nous aujourd'hui peu de mérite comme critique et comme naturaliste, il n'en est pas de même de son talent comme écrivain, ni du trésor immense de termes et de locutions Latines dont l'abondance des matières l'a obligé de se servir, et qui ont fait de son ouvrage l'un des plus riches dépôts de la langue des Romains. Malgré les défauts que nous sommes obligés de lui reconnaître quand nous le considérons comme naturaliste, nous ne le regardons pas moins comme l'un des auteurs les plus recommandables et les plus dignes d'être placés au nombre des classiques parmi ceux qui ont écrit après le règne d'Auguste."

The best edition of Pliny is that edited by Cuvier, assisted by other learned men in France, and published by Lemaire, Paris, 1827–1832, ten vols.

PLINIUS Cæcilius Secundus, C., a celebrated Roman orator, was the son of L. Cæcilius, and Plinia, the sister of Pliny the elder, and born in the village of Como, in Cisalpine Gaul, though others have considered Verona as the place of his birth. He was born A. D. 62, in the eighth year of the reign of Nero, the same year in which the poet Persius died; and there seems every reason to believe that he died A. D. 107, in the forty-fifth year of his age, and in the tenth year of the reign of Trajan. Having been left fatherless at an early age, he was adopted by his uncle; and, through his care and that of Virginius Rufus, received the best education that Rome could furnish. Amongst others, he derived much advantage from the talents of Quintilian; and he seems at a very early age to have devoted his attention to poetry. In his fourteenth year he had already written a Greek tragedy, though he does not venture to affirm that it was of much value. He had no sooner finished his youthful studies than we find him in Syria, acting as military tribune; and in his eighteenth year, A. D. 80, he was living with his uncle at Misenum, in Campania, where he was commander of the fleet at the moment of the eruption of Vesuvius, which proved fatal to him. Of the calamity, and the phenomena attendant on it, he gives a very affecting and beautiful account, in two letters to the historian Tacitus. On his return to Rome he commenced his career as an orator, and soon became one of the most distinguished ornaments of the Roman bar. He rose gradually through different ranks till he reached the office of prætor; but towards the end of the reign of Domitian, he drew upon himself the indignation of that monarch, by his able defence of Helvidius, whom Domitian had doomed to destruction; and he was only saved from sharing the fate of many others by the death of the emperor. About the period of Nerva's accession (A. D. 96) he lost his wife, the step-daughter of Vectius Proculus, and the following year married Calpurnia, of an illustrious family, with whom he lived very happily, though by neither of his wives had he any children. Trajan raised him, A. D. 100, to the rank of consul suffectus, upon which occasion he delivered that celebrated panegyric on the emperor which has been preserved to us. The second year after his consulship he was appointed by Trajan to the administration of the province of Bithynia; and it was whilst he was in this office that he wrote that letter to the emperor which bears such honourable testimony to the Christian religion, and which induced Trajan to mitigate the laws which bore so heavily on those who professed that faith. On his return from his province he seems only to have survived a few years, which were probably spent in retirement in his magnificent villas, of which he possessed several in different parts of Italy.

He was of the most amiable disposition, kind to his inferiors, generous and hospitable to his friends, amongst whom he numbered Quintilian, Suetonius, Silius Italicus, Martial, and Tacitus. He was the active and zealous patron of learning, dividing his time between his professional employments and the pursuits of literature. He has been accused of being jealous of the reputation of some of his friends; and there is no doubt that he was vain of his own acquirements. Next to Cicero there is certainly no orator so distinguished; yet of his numerous orations not one has been preserved except his Panegyric on Trajan, in which he returns thanks for having raised him to the consulship. It was received with great applause, and is without doubt one of the most beautiful specimens of Roman eloquence that we possess. He exhibits before us Trajan, invested, not merely with the majesty of a prince and commander, but with all the virtues which dignify a private character. His noble spirit, his integrity, his love of learning, are all beautifully pourtrayed; but in his praise he sometimes exceeds the bounds of propriety, so as to give it the appearance of flattery. He has also too great fondness for antithesis, and too constant a repetition of particular expressions. In his language, also, we have sometimes to regret the simplicity which distinguishes the works of an earlier age.

His epistles are addressed to different persons, upon a variety of occasions, and are divided into ten books, of which the last contains only those to Trajan, with his answers. As Sidonius Apollinaris speaks only of nine books, some have thereby been induced to consider the tenth as not the genuine production of Pliny; and indeed others have also refused to include the ninth. The subject-matter of these letters is of a very pleasing character. The reader is interested not more by the variety of circumstances presented to the mind, than by the agreeable manner in which they are told. They possess also great historical value, from being memorials of a period of which we have only a few unimportant hints. We refer more particularly to the two letters on the life and death of Pliny the elder, and that to Trajan on the character of the Christians. As the letters of Cicero are of great value in elucidating the events of the later years of the republic, and in making us more intimately acquainted with the leading statesmen of that time, so those of Pliny are equally valuable in admitting us to an acquaintance with the very different times of the empire.

The best edition is that of Schöfer, with the notes of Gesner and Ernesti, Leipzig, 1805, two vols. 8vo.

PLINTH, Orle, or *Orlo*, in *Architecture*, a flat square member, in the form of a brick. It is used as the foundation of columns, being that flat square table under the moulding of the base and pedestal at the bottom of the whole order. It seems to have been originally intended to keep the bottom of the original wooden pillars from rotting. Vitruvius also calls the Tuscan abacus *plinth*.

Plinth of a Statue is a base, either flat, round, or square, which serves to support it.

Plinth of a Wall denotes two or three rows of bricks advancing out from a wall; or, in general, any flat high moulding which serves, in a front-wall, to sustain the eaves of a wall, or support the larmier of a chimney.

PLOCK, a province or waiwodschaft of Poland, which has been formed out of the ancient division of that name, and the addition of part of Massovia. It extends in north latitude from 52. 14. to 53. 27., and in east longitude from 18. 39. to 22. 30., and comprehends 6842 square miles. It contains forty-five cities and towns, 3399 villages, with 346,500 inhabitants, of whom 14,000 are Protestants, 24,000 Jews, and the remainder adhere to the Catholic religion. The capital of the province, and of a circle of its name, is the city of Plock. It stands upon the banks of the Vistula, is surrounded with walls, and is the see of a bishop, whose cathedral is here, as well as eleven other churches, and several collegiate and monastic institutions. It contains 960 houses, with 7500 inhabitants, who carry on considerable trade by the river. Long. 19. 42. E. Lat. 52. 33. 3. N.

PLOERMEL, an arrondissement of the department of Morbihan, in France, extending over 682 square miles. It is divided into eight cantons, and these into sixty-one communes, with a population of 84,150 inhabitants. The capital is the city of the same name, situated in a fruitful district, watered by the river Oust. It contains 4720 inhabitants, who carry on manufactures of coarse woollens.

PLOMO, in *Metallurgy*, is a name given by the Spaniards who have the care of the silver mines, to the silver ore when found adhering to the surface of stones, and incrusting their cracks and cavities like small and loose grains of gunpowder. Though these grains be few in number, and the rest of the stone have no silver in it, yet they are always very happy when they find it, as it is a certain token that there is a rich vein somewhere in the neighbourhood. And if in digging forwards they still meet with these grains, or the plomo, in greater quantity, it is a certain sign that they are getting nearer and nearer the good vein.

PLOT, DR ROBERT, a learned antiquary and philosopher, was born at Sutton-Barn, in the parish of Borden, Kent, in the year 1641. He studied in Magdalen Hall, and afterwards in University College, Oxford. In 1682 he was elected secretary of the Royal Society, and published the Philosophical Transactions from No. 143 to No. 166 inclusive. The next year Mr Elias Ashmole appointed him first keeper of his museum, and about the same time the vice-chancellor nominated him primarius professor of chemistry in the university of Oxford. In 1687 he was made secretary to the earl marshal; and the following year received the title of historiographer to James II. In 1690 he resigned his professorship of chemistry, and likewise his place of keeper of the museum, to which he presented a very large collection of natural curiosities, which he had described in his histories of Oxfordshire and Staffordshire; the former published at Oxford in 1677, folio, and reprinted with additions and corrections in 1705, and the latter printed of the same size in 1686. In January 1694–1695, Henry Howard, earl marshal, nominated him Mobray-herald extraordinary; two days after which he was constituted register of the court of honour; and, on the 30th of April 1696, he died of the stone, at his house at Borden.

As Dr Plot delighted in natural history, the above works were designed as essays towards a Natural History of England; and he had actually formed a design of travelling through England and Wales for that purpose. He accordingly drew up a plan of his scheme, in a letter addressed to Bishop Fell, which is inserted at the end of the second volume of Leland's Itinerary, in the edition of 1744. Amongst several manuscripts which he left behind him were large materials for the Natural History of Kent, Middlesex, and the city of London. Besides the above works, he published De Origine Fontium Tentamen Philosophicum, 8vo, and nine papers in the Philosophical Transactions.

PLOTINUS, a Platonic philosopher of the third century. He was born at Lycopolis, a city of Egypt, in 204; and began very early to show a great singularity both in his taste and in his manners. At eight years of age, when he went to school, he used to run to his nurse, and uncover her breast to suck; and would have continued that practice longer if he had not been discouraged by her. At the age of twenty-eight he had a strong desire to study philosophy, on which occasion he was recommended to the most famous professors of Alexandria. He was not satisfied with their lectures; but upon hearing those of Ammonius, he confessed that this was the man he wanted. He studied for eleven years under that excellent master, and then went to hear the Persian and Indian philosophers. In 243, when the Emperor Gordianus intended to wage war against the Persians, he followed the Roman army, but probably repented of it; for it was with difficulty he could save his life by flight after the emperor had been slain. He was then thirty-nine. The year following he went to Rome, and read philosophical lectures in that city; but avoided following the example of Erennius and Origen, his fellow-pupils, who, having like him promised not to reveal some hidden and excellent doctrines which they had received from Ammonius, had nevertheless broken their pledge. Plotinus continued ten years in Rome without writing anything; but in his fiftieth year he obtained as his scholar Porphyry, who, being of an exquisitely fine genius, was not satisfied with superficial answers, but required to have all difficulties thoroughly explained; and therefore Plotinus, to treat things with greater accuracy, was obliged to write more books. He had previously written twenty-one books, and during the six years of Porphyry's sojourn with him he wrote twenty-four, and nine after Porphyry left Rome, making in all fifty-four. The Romans had a high veneration for him; and he passed for a man of such judgment and virtue, that many persons of both sexes, when they found themselves dying, intrusted him, as a kind of guardian angel, with the care of their estates and children. He was the arbiter of numberless lawsuits; and constantly behaved with such humanity and rectitude, that he did not create a single enemy during the twenty-six years he resided in Rome. He did not meet with the same justice, however, from all of his own profession; for Olympias, a philosopher of Alexandria, being envious of his glory, used his utmost endeavours, though in vain, to ruin him. The Emperor Gallienus and the Empress Salonina had a very high regard for him; and if it had not been for the opposition of some jealous courtiers, they would have caused the city of Campania to be rebuilt, and given it to him, with the territory belonging to it, to establish a colony of philosophers, and to govern it according to the ideal laws of Plato's commonwealth. He laboured under various disorders during the last year of his life, which obliged him to leave Rome, when he was carried to Campania, to the heirs of one of his friends, who furnished him with everything necessary; and he died there in the year 270, at the age of sixty-six, in the noblest manner that an heathen philosopher could expire. "I am labouring with all my might," said he, "to return the divine part of me to the Divine Whole which fills the universe."

We have already remarked that the ideas of Plotinus were singular and extraordinary; and we shall now show that they were so. He was ashamed of being lodged in a body, for which reason he did not care to tell the place of his birth or family. The contempt he had for all earthly things was the reason why he would not permit his picture to be drawn; and when his disciple Amelius urged him to do so, "Is it not enough," said he, "to drag after us, whithersoever we go, that image in which nature has shut us up? Do you think that we should likewise transmit to future ages an image of that image, as a sight worthy of their attention?" On the same principle, he refused to attend to his health; for he never made use of preservatives or baths, and did not even eat the flesh of tame animals. He ate but little, and often abstained from bread; which, joined to his intense meditation, prevented him from sleeping. In short, he thought the body altogether below his notice, and had so little respect for it, that he considered it as a prison, from which it would be his supreme happiness to be freed. When Amelius, after his death, inquired of the oracle of Apollo about the state of his soul, he was told that it was gone to the assembly of the blessed, where charity, joy, and a love of the union with God, prevail. And the reason given for this, as related by Porphyry, is, "that Plotinus had been peaceable, gracious, and vigilant; that he had perpetually elevated his spotless soul to God; that he had loved God with his whole heart; that he had disengaged himself, to the utmost of his abilities, from this wretched life; that, elevating himself with all the powers of his soul, and by the several gradations taught by Plato, towards that Supreme Being which fills the universe, he had been enlightened by him, had enjoyed the vision of him without the help or interposition of ideas, and, in short, had often been united to him." This is the account of Porphyry, who also tells us that he himself had once been favoured with the vision. We need scarcely add, however, that little credit is due to such a story, which agrees pretty much with modern enthusiasm and the reveries of Behmenists. Plotinus had his familiar spirit, as well as Socrates; but, according to Porphyry, it was not one of those called *demons*, but of the order of those who are called *gods;* so that he was under the protection of a spirit superior to that of other men. The superiority of his genius puffed him up not a little; or when Amelius desired him to share in the sacrifices which he used to offer up on solemn festivals, "It is their business," replied Plotinus, "to come to me; not mine to go to them."

Porphyry put the fifty-four books of Plotinus in order, and divided them into six nonades. The greater part of them turn on the most high-flown ideas in metaphysics; and this philosopher seems, in certain points, to differ but little from Spinoza. He wrote two books to prove that all being is one and the same; which is, in fact, the very doctrine of Baruc Spinoza. He inquires, in another book, whether there are many souls, or only one. His manner of composing partook of the singularity of his nature. He never read over his compositions after he had written them; he wrote a bad hand, and was not exact in his orthography; he stood in need, therefore, of a faithful friend to revise and correct his writings; and he chose Porphyry for this purpose in preference to Amelius, who had been his disciple twenty-four years, and was very much esteemed by him. Some have accused Plotinus of plagiarism with regard to Numenius; a slander which Amelius refuted. Longinus was once much prejudiced against this philosopher, and wrote against his Treatise of Ideas, and against Porphyry's answer in defence of that treatise. He afterwards conceived a high esteem for Plotinus; sought industriously for all his books; and, in order to have them correct, desired Porphyry to lend him his copy. At the same time he wrote to the latter in the following manner. "I always observed to you, when we were together, when we were at a distance from one another, as well as when you lived at Tyre, that I did not comprehend many of the subjects treated of by Plotinus; but I was extremely fond of his manner of writing, the variety of his knowledge, and the order and disposition of his questions, which are altogether philosophical." This single passage, says Bayle, shows the exalted genius, the exquisite discernment, and judicious penetration of Longinus. It cannot be denied that most subjects which this philosopher examines are incomprehensible; nevertheless, we discover in his works a very elevated, fruitful, and capacious genius, and a close way of reasoning. Had Longinus been an injudicious critic, had he not possessed an exalted and beautiful genius, he would not have been so sensible of Plotinus's obscurity; for no persons complain less of the obscurity of a book, than those whose thoughts are confused, and whose understanding is shallow. Marsilius Ficinus, at the request of Cosmo de' Medici, executed a Latin version of the works of Plotinus, with a summary and analysis of each book; which was printed at Basil, first by itself in 1559, and afterwards with the Greek in 1580, folio. His life was written by Porphyry, the most illustrious of his disciples.

PLOUGH, in *Agriculture*, a machine for turning up the soil by the action of cattle, contrived to save the time, labour, and expense, which must otherwise have been employed in digging the ground, and fitting it for receiving all sorts of seed. See AGRICULTURE.

PLOWDEN, EDMUND, sergeant at law, descended from an ancient family in Shropshire, was born in 1517, and was first a student of the university of Cambridge, where he spent three years in the study of philosophy and medicine. He then removed to Oxford, where, having continued his former studies about four years more, he was in 1552 admitted to the practice of physic and surgery; but probably finding the practice of the healing art less agreeable than the study of physic, he entered himself of the Middle Temple, and began to read law. Wood says, that in 1557 he was summer reader to that society, and Lent reader three years afterwards, being then sergeant and oracle of the law. He died in the year 1584, aged sixty-seven; and was buried in the Temple church. He wrote, 1. Commentaries or Reports of divers Cases in the reigns of Edward VI., Mary, and Elizabeth, London, 1571, 1578, 1599, and 1613, written in the old Norman language; and, 2. Queries, or a Moot-book of Cases, translated, methodized, and enlarged, by H. B. of Lincoln's-Inn, London, 1662, in 8vo.

PLUCHE, ANTONY, a celebrated French writer, was born at Rheims in 1688; and having distinguished himself by his engaging manners and proficiency in the belles lettres, was appointed professor of humanity in the university of that city. Two years afterwards he obtained the chair of rhetoric, and was admitted into holy orders. The Bishop of Leon, informed of his talents, conferred upon him the direction of the college of his episcopal city. By his industry and superior knowledge, a proper order and subordination were soon established in it; but some peculiar opinions respecting the affairs of the time disturbed his tranquillity, and obliged him to resign his office. The intendant of Rouen, at the request of the celebrated Rollin, intrusted him with the education of his son. Abbé Pluche having filled that situation with success and great honour to himself, left Rouen and went to Paris, where, by the patronage of some literary friends, and his own excellent writings, he acquired a distinguished reputation for learning. He published, 1. Le Spectacle de la Nature, in nine volumes 12mo. This work, which is equally instructive and entertaining, is written with perspicuity and elegance; but the form of dialogue which is adopted has rendered it somewhat prolix. The interlocutors are not distinguished by any striking or characteristic features; and though the author has given the conversations a pretty ingenious turn, and even some vivacity, yet now and then they assume the tone of the college. 2. Histoire du Ciel, or History of the Heavens, in two vols. 12mo. In this performance we find two parts almost independent of each other. The first contains some learned inquiries into the origin of the poetical heavens. It is nearly a complete mythology, founded upon ideas which are new and ingenious. The second is the history of the opinions of philosophers respecting the formation of the world. The author shows the inutility, inconsistency, and uncertainty of the most esteemed systems; and concludes with pointing out the excellence and sublime simplicity of the Mosaic account. Voltaire called this work *Fable du Ciel*. 3. De Linguarum Artificio, a work which he translated under the title of Le Mecanique

Plug ‖ Plumbery.

des Langues, in 12mo. In this treatise he proposes a short and easy method of learning languages, which is by the use of translations instead of themes or exercises. 4. Harmony of the Psalms and the Gospel, or a translation of the Psalms and Hymns of the Church, with notes relative to the Vulgate, the Septuagint, and Hebrew Text, printed at Paris in 1764, in 12mo. In 1749, Abbé Pluche retired to Varenne St Maure, where he gave himself up entirely to devotion and study. Having become so deaf that he could not hear without the help of a trumpet, the capital afforded him little enjoyment. It was in this retreat that he died of an apoplexy, on the 20th of November 1761, at the age of seventy-three years. He possessed those qualities which form the scholar, the honest man, and the Christian; temperate in his meals, true to his word, an affectionate parent, a sensible friend, and a humane philosopher, he gave lessons of virtue in his life as well as his writings. His submission to all the dogmas of religion was profound. Some deists having expressed surprise that, in matters of faith, he should think and speak like the vulgar, his answer was, "I glory in doing so; it is infinitely more rational to believe the word of God, than to follow the glimmering lights of a reason which is limited and subject to error."

PLUG, a certain piece of timber, formed like the frustum of a cone, and used to stop a hause-hole, or a breach made in the body of a ship by cannon-balls. Plugs used for the former purpose are therefore called *hause-plugs,* and those for the latter *shot-plugs;* and they are formed of various sizes, in proportion to the holes made by the different sizes of shot which may penetrate the ship's sides or bottom in battle. Accordingly they are always ready for this purpose.

PLUKENET, Leonard, a physician who flourished in the reign of Charles II., was one of the most excellent and laborious botanists of that or any other age. He was author of the Phytographia Plukenetiana, the Almagesticum Britannicum, and other works of a similar kind, on which he spent the greater part of his life and fortune. His Phytography is mentioned with the highest praise in the Philosophical Transactions for February 1696–1697. His Opera Botanica, with cuts, were printed at London, in six vols. folio, in 1720.

PLUMBERY, the art of casting and working lead, and using it in building.

As this metal soon melts, and with little heat, it is easy to cast it into figures of any kind, by running it into moulds of brass, clay, plaster, or other material. But the chief article in plumbery consists of sheets and pipes of lead; and as these form the basis of the plumber's work, we shall here describe the process of making them.

In casting *sheet-lead,* a table or mould is made use of, consisting of large pieces of wood well jointed, and bound with bars of iron at the ends; on the sides of which runs a frame, consisting of a ledge or border of wood, three inches in thickness, and four inches in height from the mould, called the *sharps.* The ordinary width of the mould, within these sharps, is from four to five feet; and its length is sixteen, seventeen, or eighteen feet. This should be something longer than the sheets are intended to be, in order that the end where the metal runs off from the mould may be cut off, because it is commonly thin, or uneven, or ragged, at the end. It must stand very even or level in breadth, and something falling from the end in which the metal is poured in, viz. about an inch or an inch and a half in the length of sixteen or seventeen feet or more, according to the thickness of the sheets wanted; for the thinner the sheet, the more declivity the mould should have. At the upper end of the mould stands the pan, which is a concave triangular prism, composed of two planks nailed together at right angles, and two triangular pieces fitted in between them at the ends. The length of this pan is the whole breadth of the mould in which the sheets are cast. It stands with its bottom, which is a sharp edge, on a form at the end of the mould, leaning with one side against it; on the opposite side is a handle to lift it up by, in order to pour out the melted lead; and on that side of the pan which is next the mould are two iron hooks to take hold of the mould, and prevent the pan from slipping whilst the melted lead is pouring out of it into the mould. This pan is lined on the inside with moistened sand, to prevent it from being fired by the hot metal. The mould is also spread over, about two inches thick, with sand sifted and moistened, which is rendered perfectly level by moving over it a piece of wood called a *strike,* and smoothing it over with a smoothing plane, which is a plate of polished brass about one fourth of an inch thick, and nine inches square, turned up upon all the four edges, and with a handle fitted on to the upper or concave side. The sand being thus smoothed, it is fit for casting sheets of lead. But if they would cast a cistern, they measure out the bigness of the four sides, and having taken the dimensions of the front or fore part, make mouldings by pressing long slips of wood, which contain the same mouldings, into the level sand; and form the figures of birds, beasts, or anything else, by pressing in the same manner leaden figures upon it, and then taking them off, and at the same time smoothing the surface where any of the sand is raised up by making these impressions upon it. The rest of the operation is the same in casting either cisterns or plain sheets of lead. But before we proceed to mention the manner in which that is performed, it will be necessary to give a more particular description of the *strike.*

Plumber

The strike, then, is a piece of board about five inches in breadth, and something longer than the breadth of the mould on the inside; and at each end is cut a notch about two inches deep, so that when it is used it rides upon the sharps with those notches. Before they begin to cast, the strike is made ready by tacking on two pieces of an old hat on the notches, or by slipping a case of leather over each end, in order to raise the under side about one eighth of an inch or something more above the sand, according as they would have the sheet to be in thickness; then the under edge of the strike is tallowed and laid across the mould. The lead being melted, it is put into the pan with ladles, in which, when there is a sufficient quantity for the present purpose, the scum of the metal is swept off with a piece of board to the edge of the pan, letting it settle on the sand, which is by this means prevented from falling into the mould at the pouring out of the metal. When the lead is cool enough, which must be regulated according to the thickness of the sheets wanted, and is known by its beginning to stand with a shell or wall upon the sand round the pan, two men take the pan by the handle, or else one of them lifts it by the bar and chain fixed to a beam in the ceiling, and pour it into the mould, whilst another man stands ready with the strike, and as soon as they have done pouring in the metal, puts on the mould, sweeps the lead forward, and draws the overplus into a trough prepared to receive it. The sheets being thus cast, nothing remains but to roll them up or cut them into any measure wanted. But if it be a cistern, it is bent into four sides, so that the two ends may join the back, where they are soldered together; after which the bottom is soldered up.

We shall next describe the method of casting pipes without soldering. To make these pipes, they have a kind of little mill, with arms or levers to turn it withal. The moulds are of brass, consist of two pieces, which open and shut by means of hooks and hinges, their inward calibre or diameter being, according to the size of the pipe, usually two feet and a half. In the middle is placed a core or round piece of brass or iron, somewhat longer than the mould, and of the thickness of the inward diameter of the pipe. This core is passed through two copper rundles, one at each end of the mould, which they serve to close; and to these is joined a little copper tube about two inches long, and of the thickness the leaden pipe is intended to be of. By means of these tubes the core is retained in the middle of the cavity of the mould. The core being in the mould, with the rundles at its two ends, and the lead melted in the furnace, the latter is taken up in a ladle, and poured into the mould by a little aperture at one end, made in the form of a funnel. When the mould is full, a hook is passed into the end of the core, and, by turning the mill, is drawn out; and after opening the mould, the pipe is also taken out. If they desire to have the pipe lengthened, they put one end of it in the lower end of the mould, and pass the end of the core into it; then shut the mould again, and apply its rundle and tube as before, the pipe just cast serving for a rundle, &c. at the other end. Things being thus replaced, they pour in fresh metal, and repeat the operation till they have got a pipe of the length required.

For making pipes of sheet-lead, the plumbers have wooden cylinders of the length and thickness required; and on these they form their pipes by wrapping the sheet around them, and soldering up the edges all along them.

The lead which lines the Chinese tea-boxes is reduced to a thinness which, we are informed, European plumbers cannot imitate. The following account of the process by which the plates are formed was communicated to a writer in the Gentleman's Magazine, by an intelligent officer of an East Indiaman. The caster sits by a pot containing the melted metal; and has two large stones, the under one fixed, the upper moveable, directly before him. He raises the upper stone by pressing his foot upon the side of it, and with an iron ladle pours in the opening a proper quantity of the fluid metal. He then immediately lets fall the upper stone, and by that means forms the lead into a thin irregular plate, which is afterwards cut into a proper shape. The surfaces of the stones, where they touch each other, are exactly ground together.

PLUMMET, *Plumb-rule*, or *Plumb-line*, an instrument used by carpenters, masons, and others, in order to judge whether walls or beams be upright planes, horizontal, or the like. It is so called from a piece of lead fastened to the end of a cord, which usually constitutes this instrument. Sometimes the string descends along a wooden ruler, raised perpendicularly on another; in which case it becomes a level.

PLUMMING, amongst miners, is the method of using a mine-dial, in order to know the exact place of the work where to sink down an air-shaft, or to bring an adit to the work, or to know which way the lode inclines when any flexure happens in it.

It is performed in this manner. A skilful person, with an assistant, and provided with pen, ink, and paper, a long line, and a mine-dial, after his guess of the place above ground, descends into the adit or work, and there fastens one end of the line to some fixed thing in it; then the incited needle is let to rest, and the exact point where it rests is marked with a pen. The person in question then goes on farther in, the line being still fastened, and at the next flexure of the adit he makes a mark on the line, by a knot or otherwise, and, letting down the dial again, he there likewise notes down that point at which the needle stands in this second position. In this manner he proceeds, from turning to turning, marking down the points, and marking the line, till he comes to the intended place. This being done, he ascends and begins to work on the surface of the earth what he did in the adit, bringing the first knot in the line to such a place where the mark of the place of the needle will again answer its pointing; and continues this till he come to the desired place above ground, which is certain to be perpendicular over the part of the mine into which the air-shaft is to be sunk.

PLUMOSE, something formed in the manner of a feather, with a stem and fibres issuing from it on each side: such are the antennæ of certain moths, butterflies, and other insects.

PLURAL, in *Grammar*, an epithet applied to that number of nouns and verbs which is used when we speak of more than one thing.

PLUS, in *Algebra*, a character marked thus, +, used for the sign of addition. See ALGEBRA.

PLUSH, in commerce, a kind of stuff having a sort of velvet knap or shag on one side, composed regularly of a woof of a single woollen thread and a double warp; the one wool, of two threads twisted, the other goat's or camel's hair; though there are some plushes entirely of worsted, and others composed wholly of hair.

PLUTARCH, one of the most celebrated writers of antiquity, was a native of Chæroneia, in Bœotia. The exact date of his birth and death is unknown; but as he tells us that he studied philosophy under Ammonius at Delphi, when Nero made a tour through Greece, and as we know this circumstance to have taken place A. D. 66, we may place the birth of Plutarch towards the latter years of the reign of Claudius (A. D. 48–53). He was sprung from an honourable family, which had often been invested with the highest offices of the magistracy. He speaks of having seen his great-grandfather Nicarchus, from whom he learned, as from an eye-witness, the miseries which his country had suffered from the oppressions of Antony. His grandfather Lamprias was distinguished for his eloquence and imagination; and his father is praised for his modesty, his acquaintance with the theology of his time, and his knowledge of the works of the poets. Plutarch had two brothers, Timon and Lamprias; of the former of whom he says, that he has no obligations to fortune so great as the enjoyment of his brother Timon's invariable friendship and kindness. Under Ammonius, of whom we know little more than what his pupil has told us, he acquired the doctrines of that humane and rational philosophy for which he was afterwards so distinguished. Upon what occasion he visited Italy is uncertain, but it is supposed to have been on some public business of the Chæroneians. Whilst he remained at Rome, he found his house resorted to by all the principal citizens, and his lectures on philosophy attended by the most illustrious of the Romans. Sossius Senecio, who was four times consul, once under Nerva and thrice under Trajan, was his most intimate friend. To him he addresses his Lives, except that of Aratus, which is inscribed to Polycrates of Sicyon, the grandson of Aratus. Whether he remained in Italy till all philosophers were banished from that country by a decree of Domitian, is a point of which we have no means of determining; but we know that he spent the greater part of his time in his native city. Here he devoted himself to the discharge of such humble duties as the magistrates of Chæroneia were required to perform; and we find that he also joined to his magisterial character the office of priest of Apollo. Suidas states that he was preceptor to Trajan; but he was so nearly contemporary with that emperor, that little credit is due to this assertion. Plutarch was married to a lady of his native city, called Timoxena, and in his matrimonial connection he seems to have been particularly fortunate. By her he had five children, four sons, and a daughter, who died young; and on this occasion he addressed a beautiful letter of consolation to his wife, which is highly honourable to both parties. Two only of his sons survived, Plutarch and Lamprias, the latter of whom appears to have been a philosopher; and it is to him that we are indebted for a catalogue of his father's writings. His nephew Sextus was of considerable eminence, and taught the Greek language to Marcus Antoninus. We have no particular account either as to the manner or the time of his death, only it is evident that he lived to a good old age. The most probable conjecture is that of Fabricius, who says he died in the fifth year of Hadrian, at the age of seventy.

His works have been divided, and they admit of a pretty equal division, into Lives and Morals; the former of which, in his own estimation, were to be preferred, as more noble than the latter. His style has been excepted to with some reason. He has also been criticised for some mistakes in Roman antiquities, and for a partiality to the Greeks. On the other hand, he has been justly praised for the copiousness of his fine sense and learning, for his integrity, and for a certain air of goodness which appears in all he wrote. His business was not to please the ear, but to instruct and charm the mind; and in this none ever excelled him. Of his moral writings it is to be regretted that we have no good English translation. An English version of his Lives, executed with fidelity and spirit, was presented to the public by the Langhornes in 1770. The best edition of his works is that of Reiske, in twelve volumes 8vo, 1774–82.

PLUTO, in Pagan worship, the king of the infernal regions, was the son of Saturn and Ops, and the brother of Jupiter and Neptune. This deity, finding himself childless and unmarried, mounted his chariot to visit the world; and, arriving in Sicily, fell in love with Proserpine, whom he saw gathering flowers with her companions in the valley of Enna, near Mount Ætna; when, forcing her into his chariot, he drove her to the river Chemarus, through which he opened for himself a passage back to the realms of night.

Pluto is usually represented in an ebony chariot drawn by four black horses, sometimes holding a sceptre, to denote his power; at others, a wand, with which he drives away the ghosts; and at others, some keys, to signify that he had the keys of death. Homer observes, that his helmet had the quality of rendering the wearer invisible, and that Minerva borrowed it in order to remain concealed from Mars when she fought against the Trojans. Pluto was greatly revered both by the Greeks and Romans, who erected to him both temples and altars. To this god sacrifices were offered in the night, and it was not lawful to offer them by day.

PLUTUS, in Pagan worship, the god of riches, is frequently confounded with Pluto. He was represented as appearing lame when he approached, but provided with wings at his departure, to show the difficulty of amassing wealth and the uncertainty of its enjoyment. He was also represented blind, to show that he often bestowed his favours on the most unworthy, and left in necessity those who had the greatest merit.

PLUVIUS, a surname of Jupiter. He was invoked by that name amongst the Romans whenever the earth was parched by continual heat, and in want of refreshing rains. He had an altar in the temple on the Capitol.

PLYERS, in fortification, denotes a kind of balance used in raising or letting down a drawbridge. They consist of two timber levers, twice as long as the bridge they lift, joined together by other timbers, framed in the form of a St Andrew's cross, to counterpoise them. They are supported by two upright jambs, on which they swing; and the bridge is raised or let down by means of chains joining the ends of the plyers and bridge.

PLYING, in nautical language, the act of making, or endeavouring to make, a progress against the direction of the wind. Hence a ship that advances well in her course in this manner of sailing, is said to be a good plyer.

PLYMOUTH, a town at the western extremity of the county of Devon, on the southern shore of England. It is a place which has grown to its present importance from the natural advantages of maritime access, and the capability of defence arising from local circumstances, which have been extended by liberal expenditure under the direction of men of the most scientific attainments.

The entrance to the harbour, or more properly harbours, of Plymouth, is not without its dangers, consisting of rocks and shoals. Of the former are the *Mewstone*, the *Shagstone*, and the *Renny*; and of the latter the *Tinker*, the *Shovel*, the *Knap*, and the *Panther*; but their position is so well known, and so accurately pointed out by buoys, that in all but the most tempestuous and foggy weather they are easily avoided, and fewer accidents to ships occur here than in almost any other harbour. The first object deserving notice in the water-access to Plymouth is that part called the *Sound*, a most capacious anchoring place, capable of affording shelter and protection to fifty sail of the line. The Sound has been rendered secure by that prodigious display of human labour known by the name of the *Breakwater*. As a full and scientific description of that work has been given in a former volume (see vol. v. page 219), we refer to it; only adding, that since the trial of the storms of 1816 and 1817, the strength as well as the utility of the work has been proved by a storm which took place on the 23d of November 1824, when the whole southern coast of England was bestrewed with wreck and desolation. The tide then rose to the frightful height of twenty-six feet two inches, whilst the mean rise of its height at spring-tides is usually only eighteen feet. The greater part of the surface of the Breakwater was on that occasion completely overturned, and huge stones of from two to five tons each were carried from the outer and deposited on the inner slope. The centre and western ends suffered most, and the landing-place was destroyed. It is, however, considered that the advantage gained to the work by the shock, causing the blocks to settle down more firmly, will amply compensate for the derangement of the surface. On the whole, therefore, this occurrence may be considered as a most satisfactory proof of the utility and durability of this national barrier. It need scarcely be remarked, that those liabilities to injury to which such a work as the Breakwater is subject whilst in progress, will not exist in an equal degree when the work is completed. Thus, in a hurricane of January 1828 not a single stone of the finished part of the work was removed from its position. The fears entertained by some persons that the erection might ultimately prove detrimental to the Sound and to the harbour within, by causing an increased deposit of mud and silt, are satisfactorily proved to be groundless; no perceptible alteration having taken place in the depth of water in any of those places, or any change in the strength or the set of the tides.

Within the Breakwater there are many indentations, the mouths of which terminate in the *Sound*, and form excellent harbours, some of them adapted for the largest class of ships. The easternmost of these inlets is at first called Catwater, and extends to the Lake of Saltram, being crossed by the Lary Bridge, an elegant work, erected between the years 1824 and 1827, about 500 feet in length. The small river Plym, which gives its name to the town, empties its water into the Lake of Saltram. It is a stream of short course, rising from the Dartmoor Mountains. The next to Catwater is a capacious harbour, called Sutton Pool, which is capable of receiving a thousand sail. It is used chiefly by the largest class of merchant-ships, and by the steam-packets; and it has several yards for repairing or building merchant-vessels. The next harbour is called Mill Bay; it is chiefly used for commercial purposes, and has some good quays, some ship-building yards, and good moorings for steam-boats. Beyond that, at the extreme west, which it separates from Cornwall, is that indentation which is of the most importance to the British navy. It is the harbour of Hamoaze, one of the finest in the world. It is open to the full force of the tide, but receives the stores of fresh water which fall into it from the rivers Tavy, Tamar, Lynher, and St Germains. It is the place where the men of war in ordinary are moored; and on its border are the extensive dock-yard, the gun-wharf, and the powder-magazine, which, with other objects, will hereafter be noticed. In Hamoaze, the admiral commanding the port has the flag displayed on his ship; and when surrounded, as he commonly is, by a hundred sail of vessels, a most impressive spectacle is presented to view afloat, whilst the picturesque objects on the shore tend to increase the effect.

Within the Breakwater is an island, sometimes called Drake's, sometimes St Nicholas'. It is surrounded with rocks, has a strong castle and other fortifications, and is provided with furnaces for heating balls, and with other means of defence; and it is of great importance, as commanding the entrance into Hamoaze, Catwater, and the other harbours.

Little is known of Plymouth prior to the time of the Norman conquest, when it was called South Town or Sutton. In the reign of Edward I. it was called Sutton Prior and Sutton Valletort, the northern parts being situated on the lands of the prior of Plympton, and the southern parts on the estates of the Valletorts. At that period it was chiefly inhabited by fishermen. Under the fostering care of the priors the place made considerable advances, and the more appropriate name of Plym-mouth was given to it. The growing prosperity of the town excited the jealousy of France; and in 1389 a force from thence landed and attempted to burn it. They succeeded in burning a portion, but were ultimately repulsed, with the loss of 500 men, by Hugh Courtenay. Similar attempts were subsequently made at various times, but with no great result; and after each, the fortifications were extended and strengthened. During the civil war between Charles I. and the parliament, Plymouth was held by the troops of the latter party, who, though besieged, and almost reduced by famine, resisted for three years every effort of the royalists. After the restoration, the citadel was erected; and in the reign of William III. the dock-yard and the naval arsenal were established towards the west, upon the eastern shore of Hamoaze. Since that time it has gone on increasing; but the greatest progress has been made during the present century, in which it has assumed a new character, in the intelligence and wealth of the inhabitants, as well as in the architectural style of its buildings both public and private. The buildings collectively called Plymouth are comprehended in three divisions, now known, the first by that name, the second by that of Stonehouse, and the third by that of Devonport. The name of the latter was till August 1824 Plymouth-Dock, when, on an application from the inhabitants, the present name was given by royal authority, on which occasion a column of 125 feet in height was erected to commemorate the introduction of the new name.

The population of the three ports, at the respective decennial enumerations, has been as follows:

	1801.	1811.	1821.	1831.
Plymouth.........	16,040	20,803	21,591	31,080
Stonehouse......	3,407	5,174	6,043	9,571
Devonport.......	23,747	30,083	33,578	34,883
	43,194	56,060	61,212	75,534

Presuming, as we fairly may, that the increase between 1831 and the present time (1838) has been at the same rate as in the preceding periods, the actual population will be upwards of 85,000, or nearly double of what it was thirty-six years ago.

Plymouth was incorporated as a borough in the year 1439, and by that charter, and subsequent alterations of a trifling nature, was governed till 1835, when, by the law made to reform municipal corporations, it was divided into six wards, each choosing six councillors, who elect twelve aldermen, out of which one is appointed mayor; and, besides the mayor, it has six justices of the peace, who are nominated by the king. Two members for this borough are returned to the House of Commons. The town is in the hundred of Roborough, and consists of two parishes, which are within the deanery of Plympton and the archdeaconry of Totness, in the diocese of Exeter. The church of the parish of St Andrews is interesting to the admirers of ancient architecture. It formerly belonged to a monastery; and many alterations having been made since its erection in 1440, various styles are exhibited in the building, which thus as a whole appears incongruous; and, though handsome in parts, it wants, as regards the body of the church, that altitude which is the most essential ingredient of Gothic architecture. The windows are of the pointed style. The tower, containing a fine peal of eight bells, must be admitted to be of good general proportions, and it is crowned by a pinnacled compartment of remarkable beauty.

The other church, of the parish of Charles, was built in the reign of the first king of that name. The tower and spire have an agreeable outline, but otherwise the exterior of the building can only be described as in the debased Gothic style of a degenerate period. Each of these churches has a chapel attached to it, under the respective clergymen, which together contain sittings for 2700 persons. There are two other episcopal chapels, one in the citadel and the other on the Hoe, which afford sittings for about 3000 persons. The several sects of Methodists, Baptists, Independents, Quakers, Roman Catholics, and Unitarians, have their respective places of religious worship; but the first mentioned have by far the most numerous body of adherents. The Hoe or Howe at Plymouth is an eminence on the south side of the town. It is a healthful and pleasing promenade, stretching from Catwater to Mill Bay, on the eastern extremity of which is built the principal defence of this most important place, called the Citadel. The entrance to this work, on the side of the town, is through two gateways of a bad specimen of architecture. The buildings consist of houses for the governor and other officers, of barracks, an hospital, a magazine, an armoury, and a chapel. The fortification consists of three regular and two irregular bastions; the curtains of the regular bastions being strengthened by two ravelins and horn-works; on the east, north, and west sides are a deep ditch, counterscarp, and covered way, palisadoed, and the parapets are pierced for 120 cannon. The lower fort is connected with the Citadel, and is chiefly intended to defend the Sound.

Amongst the public buildings of Plymouth, the most imposing is a noble pile, which comprehends the royal hotel, the assembly-rooms, and the theatre. The foundation was laid in September 1811; and the expense of the erection, amounting to L.60,000, was defrayed partly by the corporation and partly by the institution of a tontine.

The theatre is constructed with not less regard to the safety than to the accommodation of the audience. The roof and entire frame-work of the boxes are of iron, and the auditorium is of a magnitude fully equal to the purpose of the legitimate drama.

The Athenæum is a fine building erected by the Philosophical Institution, and completed in the year 1819. The portico exhibits four columns appropriate to the character of a building devoted to literature and art. In connection with the institution a public library has been established, the building of which exhibits great taste and judgment.

The custom-house, a recent building, is worthy of the town, and convenient for its commerce. It exhibits a front of granite, suitable, solid, and well proportioned. The interior is well arranged for business. On the ground floor are the offices of the principal surveyor, the tide-surveyor, the landing waiter, the searchers, and others. A granite staircase leads to the long room, which is fifty-four feet in length, twenty-six in width, and twenty-two in height. This building was completed in 1820, at an expense of L.8000.

The royal baths is a pile of building between Plymouth and Stonehouse, the appearance of which excites much admiration. It is most appropriately furnished with hot and cold baths of fresh or of sea water, of hot air, of sulphur, and of vapour. The front is in the Doric style of architecture. It has within it a pump-room, where a medicinal water is supplied from a spring, which is chiefly composed of chloride of sodium, muriate of magnesia, and muriate of lime, combined with small proportions of sulphate and carbonate of lime, and a very minute portion of carbonate of iron. It is perhaps the best arranged institution of the kind in England; and the luxuries it provides are administered at very low rates. It belongs to a joint-stock company, incorporated by charter in 1828.

A new public edifice, begun in 1835, for the benevolent purpose of establishing a hospital and dispensary for South Devon and East Cornwall, is approaching to its completion. At present the central part only is erecting; but in the plan it is contemplated to erect two wings, as soon as sufficient funds flow in for the purpose. These would double the capacity of the building as to beds, and supply other conveniences. There are in the centre part a theatre for operations and lectures, and wards for forty beds, with appropriate rooms for nurses and other attendants. Few towns have advanced so much within the last twenty years, in respect to its public buildings, as Plymouth. That advance is still progressive, and new erections are now constructing, one intended as a guild-hall, instead of the old building, another as a new prison, and also one by a society for horticultural and other exhibitions. With all the improvements here noticed, it must be observed, that the principal thoroughfares are irregular in their disposition, and that the most bustling street is the narrowest of the town; and though there are excellent shops of every description, some of them exhibiting fronts of chaste architectural character, yet near them are houses of very antique date and style. The northern part of the town consists of small but neat houses; but the best masses of buildings are at the west end, and they are chiefly occupied by legal, medical, and other professional persons.

Plymouth is, upon the whole, a healthy place. The climate is mild but rainy: whilst frosts are gentle, and snow rarely remains on the ground. It is well supplied with fresh water, which is brought by pipes from a stream on Dartmoor, at twenty-four miles distance, and from a reservoir distributed in the several streets; the annual charge for the supply of water is sixteen shillings for each house. Provisions are uncommonly cheap, and of the best quality. The market for fish is very remarkable, both for the variety, the excellence, and the cheapness of that description of food. The market-days are Mondays, Thursdays, and Saturdays, and the market-place is spacious, comprehending nearly three acres.

The maritime commerce of Plymouth is extensive. A great trade in timber is carried on with the Baltic, with America, and the Mediterranean, and there is a direct intercourse with the West Indies and Mauritius, which secures a good supply of tropical commodities. It is a bonding port for many articles, and especially for tobacco. There are also large importations of timber, hemp, tallow, and other articles, for the use of the dock-yard. The coasting trade is carried on principally with London, Newcastle, Newport in Monmouthshire, and Bristol. Great quantities of manganese are shipped to Scotland, lead to Bristol, and some wool to Hull. The amount of duties paid at the custom-house was, in the year ending 5th January 1836, L.93,462. 3s. 11d., and at 5th January 1837, L.103,423. 7s. 4d. The ships and their tonnage that entered the port in the year ending January 1837, were, British two hundred and nineteen ships, 20,890 tons; and foreign thirty-seven ships, 4779 tons. The whole number of ships owned by Plymouth are three hundred and fifty, the tonnage of which amounts to 30,000 tons. Besides these, there are more than fifty decked boats, called *trawlers*, employed in the extensive fishery at sea, which take such quantities of fish as to enable the captors to send them to Exeter, Bath, and even London. The building and repairing of ships gives occupation to a great number of persons.

Plymouth was in 1834 constituted a stannary town. The neighbouring tin and other mines are numerous and productive. The vicinity also abounds in quarries of granite, slate, and marble; the latter being highly esteemed for its veining and susceptibility of polish. The export of granite and the other stone is much facilitated by the railroad, twenty-four miles in length, which extends from the interior of Dartmoor to the quays of Catwater and Sutton Pool harbours. By the same means coal, lime, and manure are conveyed from the port to the interior. This railroad was executed by a joint-stock company formed in the year 1818, and was completed in 1820. The Exchange for the merchants, erected in 1813, is near the custom-house; and, amongst other institutions, it has a chamber of commerce, a marine insurance office, a steam-packet office, the oil-gas company's office, and an appropriate reading-room.

Plymouth abounds with benevolent institutions, both of ancient and modern foundation, which, from the great number of them, can only be but slightly noticed. The workhouse, a corporate establishment, founded by several acts of parliament, provides for a great number of paupers of both sexes and of all ages. Charles's alms-houses, Joy's alms-houses, the Household of Faith, the new alms-houses, the Mendicity Society, the Female Benevolent Society, and some others, are supported either by bequests, or by voluntary contributions, or by annual subscriptions. Most of the places of worship have schools attached to them; and there are a few endowed schools, and one grammar-school, from whose funds exhibitions are given to students at Oxford. Besides the hospital already noticed, there is a large public dispensary, and an infirmary for diseases of the eye. There is a medical society, with a professional library for the members of the healing art, embracing the entire field of medical literature. In 1815, a law library was established, the members of which consist exclusively of barristers and attorneys. The books are open to the reference of any subscriber to the general library, to whose collection they have been recently united. The amusements of Plymouth are the stage, music, balls, annual races, and, what is more appropriate to the situation, regatta or marine races, in which the assistance of the Naval Yacht Club is afforded.

Stonehous

Stonehouse, the centre town of the group, received the name from Joel de Stonehouse, the lord of this domain in the reign of Henry III. before which it was called Hippeston. It is now descended to the Earl of Mount Edgecumbe, who, by granting leases on liberal terms, has assisted in that great increase of the town which the state of the population at four periods has manifested. These leases are granted on lives, renewable for ever at a fixed fine, and subject to an annual conventional rent. The town is joined with Plymouth by a thoroughfare street, and it occupies nearly the same level. The southern part is most on the increase, and is almost entirely occupied by genteel families, chiefly those of naval and military officers, and other persons holding situations under the government.

Stonehouse was constituted a township by the reform act, and exercises the elective franchise in connection with the borough of Devonport. It is divided into two wards, the east and the west, by the line of Brownlow Street. It is under the jurisdiction of a bench of magistrates, who sit weekly at a town-hall. The poor are under the management of a governor, visitors, and guardians, in a workhouse, attached to which is a prison for vagrants and petty offenders, who are detained till they can be removed by the orders of the magistrates. The chief trade by water is in coals and timber; and the vessels discharge their cargoes on quays in the Pool, in which are accommodations for building ships.

There are two parochial chapels, St George's and St Paul's, besides one in the Royal Naval Hospital, which together provide sittings for 2500 persons, and maintain a large national school. The Roman Catholics, Independents, both kinds of Methodists, and the Baptists, have also places of worship; and most of them have schools for the instruction of those attending the public services of them.

An object that strikes every one in passing from Plymouth into Stonehouse is the establishment of the United Gas Company, at Mill Bay, by which the three towns in a direct line of nearly four miles are supplied with light.

The edifices belonging to the government are the most prominent objects in Stonehouse. One of these, the Marine Barracks, is on the western shore of Mill Bay, where there is a convenient landing-place. The buildings form an oblong square, in front of which are the apartments for the privates, whilst those of the officers are on the two sides. On the west side are the entrance gate and a newly erected guard-house. These barracks are handsomely and regularly built, have an hospital, and accommodate about 1000 men. The mess apartments are spacious and well furnished, and the officers have a very good library.

The Royal Naval Hospital is situated in the north-east part of Stonehouse. This important institution for the reception of sick and wounded marines and seamen was founded in 1762. It occupies a rising ground, and the area of the whole is about twenty-four acres, of which thirteen are formed into a delightful place of exercise-ground for the convalescent patients. It consists of ten buildings, surrounding an extensive quadrangle, each containing six wards calculated to receive sixteen patients; but in cases of emergency the number can be extended to twenty. Thus as many as twelve hundred patients can be accommodated at one time. The vast importance of this establishment may be seen by an authentic account, which shows, that in ten years from 1805 to 1815 no less than 48,452 seamen and marines were received into the hospital, and a very great proportion of them returned again to the service as effective men. The superior officer is of the rank of post-captain in the navy, and has under him two lieutenants. The other officers are a physician, a surgeon, a steward, a dispenser, four hospital-mates, several extra mates, and a chaplain.

The most remarkable object at Stonehouse is one only finished during the last reign, and hence bearing the name of the Royal William Victualling Yard. It is situated close to the shore, upon which a most extensive marine terrace has been constructed, fifty feet broad and nearly 1500 feet in length. It is entered from the land side by a magnificent gateway, under an arch surmounted by a statue of his majesty, and two lateral ways. The whole of the building is of beautiful granite; and the shafts of the columns forming the internal avenue are each of one stone thirty-six feet high. After passing the gateway on the left are the neat granite-fronted residences of the two principal resident officers. On the right is the baking-establishment, comprising a quadrangular range of buildings 250 by 200 feet, enclosing an architectural chimney-shaft of granite 150 feet in height. Further on is the Melville quadrangle, 240 feet square, with its rusticated granite archway (twenty-eight feet high), and the clock-chamber, of the same material, making together an elevation of ninety-five feet, and forming a magnificent centre-piece sixty-one feet in width. Opposite to this is the basin, 250 by 200 feet in extent, surrounded by quays of granite, save where an iron swing-bridge vaults over an opening of forty-five feet into Stonehouse Pool. Answering the great bake-house, on the opposite of the basin, is the brew-house, similar in dimensions and in external character to the former, and having a corresponding chimney-shaft. Passing onwards in a direct line from the entrance, the irregular quadrangle of the cooperage is on the left, and beyond that the Clarence stores, which run along the quay of that name 340 feet. There is also a reservoir for fresh water, elevated above most of the buildings, being fifty feet in height, neatly finished with granite and an iron railing, which contains 7000 tons. The Melville quadrangle includes the offices of the establishment, and, with the Clarence stores, are used as dépôts for wet and dry provisions, and for slops for the seamen. In the brew-house a steam-engine is used in the operation of grinding malt, in mashing, and pumping. A similar engine is employed in the bake-house, where there are twenty-five pair of millstones, affording the means of grinding a thousand bushels of meal in ten hours. In the same period flour is converted in the bake-house into ship-biscuit, to the extent of 2450 pounds weight. The entire premises of this establishment occupy an extent of about thirteen acres, of which one half have been recovered from the sea, and the remainder excavated from the rock, the stone taken from which has been made use of to build a strong wall to defend the whole against the sea.

Devonport.

Devonport, the third town of the group, is divided from Stonehouse by an arm of the sea, or inlet, over which there is now a bridge. It is the most populous of the three; but within the last thirty years there has not been so rapid an increase of the inhabitants of this division as of the other two. It is in the parish of Stoke Damerel; and the ground on which it stands is for the most part the property of the St Aubyn family, whose steward holds a court-leet and a court-baron annually at Michaelmas, when a jury is sworn in, to prevent nuisances, and to appoint and swear in constables. Having been constituted a borough by the reform act, it now returns two members to parliament; but the right of voting for them is also extended to the householders of Stonehouse. The town has neither mayor nor aldermen, but is governed by a board of 150 commissioners, elected chiefly from the inhabitants, vacancies being filled once a year; amongst them are the lord and steward of the manor, the commissioner of the dock-yard, the port-admiral, and some other official men. The act of parliament by which this body is constituted has vested in it the management of the watching, lighting, and cleaning the streets, of the poor, and the power of granting licenses to porters and watermen. The mayor, aldermen, and recorder of the borough of Plymouth and Saltash are also qualified to act on the licensing commission. A bench of resident magistrates hold petty sessions at the town-hall on every Wednesday.

The town of Devonport is supplied with water by a company established by act of parliament 33 George III., which, by means of pipes, have brought a stream of water from the Dartmoor Hills, which winds amongst the hills for thirty-seven miles, when it reaches a reservoir on the higher part of the town, whence it is distributed to the several streets and houses. The streets of the town are clean, and the whole has an appearance of great neatness; and two or three of these streets are of very handsome architecture. Several of the public buildings, though upon a small scale, are distinguished for the classical elegance of their architectural designs. The town-hall is distinguished by a Doric portico, in which the depth of the pronaos, and the elevation of the entrance-door upon a second internal landing, are features exciting great admiration. The columns are twenty-seven feet six inches in height, and the lower diameters five feet six inches. The hall is seventy-five feet in length, forty feet in width, and thirty-one feet in height. Within the building are cells for prisoners, offices for parochial business, and apartments occupied by the Mechanics' Institute. The library is an elegant erection, like the town-hall, of recent construction, having been executed in 1823. The celebrated Denon, on seeing the design for this *façade*, pronounced it the best attempt to appropriate Egyptian architecture to domestic purposes that had ever come under his notice. The institution is designated the Civil and Military Library. It has a news-room, committee-room, and spacious library already containing between 4000 and 5000 volumes, constantly augmenting; and, besides, it possesses a comprehensive and valuable collection of minerals, presented by Sir John St Aubyn.

When the name of Devonport was given to this town, a column was erected to commemorate the grant, which now forms one of its chief architectural ornaments. This noble monument is of granite, fluted, and of Doric proportions; not quite six diameters in height; measuring sixty-five feet four inches from the bottom of the shaft to the top of the capital; and making, with its inferior and crowning pedestals a total altitude of 101 feet. Its height above the street, including the rock on which it stands, is 124 feet. A staircase of 140 steps leads to the gallery, the prospect from which will well repay any one for the labour of ascending to it.

The church of Stoke Damerel, the mother church of this very populous parish, being small, several chapels of ease have been erected. Mount Zion chapel exhibits an ingenious adaptation of Mahommedan architecture to Christian purposes. Though it has a strange, it has also a picturesque appearance; and the interior is capacious and commodious. St Aubyn's chapel is distinguished by its stone spire. It was built by subscription, under an act of parliament, in 1771. St John's chapel was built in the same way, eight years later, at a cost of L.7700. The arrangement of the interior is curiously amphitheatrical. The roof embraces a clear span of seventy feet, the length of the chapel being ninety feet. Besides these episcopal chapels, a large one was built in the dock-yard by government in 1821. It was chiefly intended for the accommodation of the officers, civil, naval, and military, together with the operatives and soldiers belonging to the yard; but it is also open to the public. Besides the established churches, the Calvinist and Arminian Methodists, and the Independents and Baptists, have their places of worship, as well as the smaller sects of the Moravians and the Unitarians or Socinians.

The government-house, on Mount Wise, near the grand parade, commands a southern view, of much beauty. It contains every accommodation for carrying on the military government, and for the family of the governor. The front extends 200 feet. A large brass cannon, at the principal entrance, was taken from the Turks in the engagement of the Dardanelles. The port-admiral's house is near to it, on the north-west side, and comprises all the offices for the transaction of naval business, except that of courts-martial, which are always held on board the flag-ship in Hamoaze. At a short distance from it, on the top of the hill, is the *semaphore*, by which a constant communication is maintained between the office and the flag-ship, and which forms the first of a chain of telegraphs communicating with the Admiralty in London. To illustrate the perfection of the telegraphic system, it will be sufficient to state, that a message has been sent to, and an answer received from London, in fifteen minutes. The parade with its martial pomp and music, and Mount Wise with its charming walks and prospects, form a great source of pleasure to the inhabitants. To these may be added Richmond Walk at the foot of Mount Wise, which leads to the public baths constructed at the joint expense of the navy and ordnance departments, and to the king's stairs, erected for access to the shore in 1820.

The most important object in Plymouth and its vicinity is the dock-yard. In the eighth volume of this work, under the article Docks, is a general description of this establishment, to which the reader is referred. To what is there stated, we may add, that the whole dock-yard extends over seventy-five acres of land, of which about one sixth is the property of the crown, and the remainder of Sir John St Aubyn, under a lease for twenty-one years, renewable every seven years with a fine of L.534. 4s. 6d., and an annual ground-rent of thirty shillings per acre.

The operations carried on within the yard give employment to upwards of 4000 men in time of war, and 1500 in time of peace; and in the latter case the number of individuals depending on it for subsistence exceeds 7000. The chapel of the dock-yard is a fine building, the foundation of which was laid in 1814. The interior is elegantly fitted up. It is one hundred feet in length and seventy-five in breadth, and has a tower with a set of bells. The erection is said to have cost L.24,000. In the year 1834 a police force was established as a civil guard to the dock-yard, consisting of a director, three inspectors, three sergeants, and forty constables.

The gun-wharf is an important part of this naval arsenal, on the north side of the dock-yard. It covers five acres of land. It contains storehouses filled with the various instruments of destruction; vast quantities of muskets, pistols, and cutlasses are deposited in chests or arranged in racks, or on the walls in the form of stars, circles, and crescents. Near these storehouses is the blacksmith's shop, and other buildings used as depositories for gun-carriages, and the implements of the field-train. The intervals between the different edifices are occupied by piles of ordnance belonging to the ships in the harbour, with their respective names painted on the cannon. There are also large quantities of shot arrayed in pyramidical heaps, marked with the number contained in each pile. The vast portion of stores seen here, together with the armoury, form a sight worthy of attention.

Access is granted to the national depositories, on an application to the presiding officer, with the name, residence, and profession of the applicant. (G.)

Plymouth. See New England.

PLYMPTON EARLS, or Plympton Maurice, a borough and market-town of the county of Devon, in the hundred of the same name, 217 miles from London and five from Plymouth. It is one of the stannary towns for stamping tin. It is governed by a mayor, recorder, and seven aldermen, and returned two members to parliament till 1832, when it was disfranchised. The population amounted in 1801 to 604, in 1811 to 715, in 1821 to 762, and in 1831 to 804.

PLYNTERIA, a Grecian festival in honour of Aglauros, or rather of Minerva, who received from the daughter of Cecrops the name of Aglauros. The word is derived from πλυνειν, *lavare*, because during the solemnity they undressed the statue of the goddess and washed it. The day on which it was observed the people looked upon as unfortunate and inauspicious; and therefore no person was permitted to appear in the temples, which were purposely surrounded with ropes. The arrival of Alcibiades in Athens on that day was thought very unfortunate, but the success which ever afterwards attended him proved it to be otherwise. It was customary at this festival to bear in procession a cluster of figs, thus intimating the progress of civilization amongst the primitive inhabitants of the earth, as figs served them for food after they had contracted a dislike for acorns.

PNEUMATICS.

Definition.

According to the present usage of our language, this term is restricted to that part of natural philosophy which treats of mechanical properties of elastic fluids. The word, in its original meaning, expresses a quality of air, or more properly of breath. Under the article Physics we observed, that in a great number of languages the term employed to express breath was also one of the terms used to express the animating principle, nay, the intellectual substance, the soul.

Extent of the science

We have extended the term Pneumatics to the study of the mechanical properties of all elastic or sensibly compressible fluids, that is, of fluids whose elasticity and compressibility become an interesting object of our attention; as the term Hydrostatics is applied to the study of the mechanical properties of such bodies as interest us by their fluidity or liquidity only, or whose elasticity and compressibility are not familiar or interesting, though not less real or general than in the case of air and all vapours.

No precise limit to the different classes of bodies.

There is no precise limit to the different classes of natural bodies with respect to their mechanical properties. There is no such thing as a body perfectly hard, perfectly soft, perfectly elastic, or perfectly incompressible. All bodies have some degree of elasticity intermixed with some degree of ductility. Water, mercury, oil, are compressible; but their compressibility need not be attended to in order perfectly to understand the phenomena consequent on their materiality, fluidity, and gravity. But if we neglect the compressibility of air, we remain ignorant of the cause and nature of its most interesting phenomena, and are but imperfectly informed with respect to those in which its elasticity has no share; and it is convenient to attend to this distinction in our researches, in order to understand those phenomena which depend solely or chiefly on compressibility and elasticity. This observation is important; for here elasticity appears in its most simple form, unaccompanied with any other mechanical affection of matter (if we except gravity), and lies most open to our observation, whether employed for investigating the nature of this very property of bodies, or for explaining its mode of action. We shall even find that the constitution of an avowedly elastic fluid, whose compressibility is so very sensible, will give us the distinctest notions of fluidity in general, and enable us to understand its *characteristic appearances*, by which it is distinguished from solidity, namely, the *equable* distribution of pressure through all its parts in every direction, and the horizontality which its surface assumes by the action of gravity: phenomena which have been assumed as equivalent to the definition of a perfect fluid, and from which all the laws of hydrostatics and hydraulics have been derived. And these laws have been applied to the explanation of the phenomena around us; and water, mercury, oil, &c. have been denominated fluid only because their appearances have been found to tally exactly with these consequences of this definition, while the definition itself remains in the form of an assumption, unsupported by any other proof of its obtaining in nature.

Air the
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Of all the sensible compressible fluids air is the most familiar, was the first studied, and has been the most minutely examined. It has therefore been generally taken as the example of their mechanical properties, whilst those mechanical properties which are peculiar to any of them, and therefore characteristic, have usually been treated as an appendix to the general science of pneumatics.

Different
roperties
f air.

But although the mechanical properties are the proper subjects of our consideration, it will be impossible to avoid considering occasionally properties which are more of a chemical nature; because they occasion such modifications of the mechanical properties as would frequently be unintelligible without considering them in conjunction with the other; and, on the other hand, the mechanical properties produce such modifications of the properties merely chemical, and of very interesting phenomena consequent on them, that these would often pass unexplained unless we give an account of them in this place.

Mechanical properties.

By mechanical properties we mean such as produce, or are connected with, sensible changes of motion, and which indicate the presence and agency of moving or mechanical powers. They are therefore the subject of mathematical discussion; admitting of measure, number, and direction. We shall therefore begin with the consideration of air.

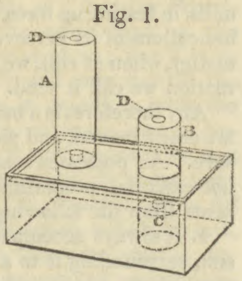
What is air?

It is by no means an idle question to put, What is this air of which so much is said and written? We see nothing, we feel nothing of it. We find ourselves at liberty to move about in any direction without any obstacle or hinderance. Whence, then, the assertion, that we are surrounded with a matter called air? A few very simple observations and experiments will show us that this assertion is well founded.

Proofs that it is matter

We are accustomed to say, that a vessel is empty when we have poured out of it the water which it contained. Take a cylindrical glass jar, having a small hole in its bottom; and having stopped this hole, fill the jar with water, and then pour out the water, leaving the glass empty, in the common acceptation of the word. Now, throw a bit of cork, or any light body, on the surface of water in a cistern; cover this with the glass jar A held in the hand with its bottom upwards, and move it downwards, as at B, keeping it all the while in an upright position. The cork will continue to float on the surface of the water in the inside of the glass, and will most distinctly show whereabouts that surface is. It will thus be seen, that the water within the glass has its surface considerably lower at C than that of the surrounding water; and however deep we immerge the glass, we shall find that the water will never rise in the inside of it so as to fill it. If plunged to the depth of 32 feet, the water will only half fill it; and yet the acknowledged laws of hydrostatics tell us, that the water would fill the glass if there were nothing to hinder it. There is therefore something already within the glass which prevents the water from getting into it; manifesting in this manner the most distinctive property of matter, viz. the hindering other matter from occupying the same place at the same time.

Fig. 1.



Possessed of impulsive force,

While things are in this condition, pull the stopper D out of the hole in the bottom of the jar, and the water will instantly rise in the inside of the jar, and stand at an equal height within and without. This is justly ascribed to the escape through the hole of the matter which formerly obstructed the entry of the water; for if the hand be held before the hole, a puff will be distinctly felt, or a feather held there will be blown aside; indicating in this manner that what prevented the entry of the water, and now escapes, possesses another characteristic property of matter, *impulsive force*. The materiality is concluded from this appearance, in the same manner that the materiality of water is concluded from the impulse of a jet from a pipe. We also see the mobility of the formerly pent up, and now liberated substance, in consequence of external pressure, viz. the pressure of the surrounding water.

Impenetrability,

Also, if we take a smooth cylindrical tube, shut at one end, and fit a plug or cork to its open end, so as to slide along it, but so tightly as to prevent all passage by its sides; and if the plug be well soaked in grease, we shall find that no force whatever can push it to the bottom of the tube. There is therefore something within the tube preventing by its impenetrability the entry of the plug, and therefore possessing this characteristic of matter.

Elasticity,

In like manner, if, after having opened a pair of common bellows, we shut up the nozzle and valve hole. and try to bring the boards together, we find it impossible There is something included which prevents this, in the same manner as if the bellows were filled with wool; but on opening the nozzle we can easily shut them, viz. by expelling this something; and if the compression be forcible, the something will issue with considerable force, and very sensibly impel any thing in its way.

Inertia, and mobility.

It is not accurate to say, that we move about without *any* obstruction: for we find, that if we endeavour to move a large fan with rapidity, a very sensible hinderance is perceived, and a sensible wind is produced, which will agitate the neighbouring bodies. It is therefore justly concluded that the motion is possible only in consequence of having driven this obstructing substance out of the way; and that this impenetrable, resisting, moveable, impelling substance, is matter. We perceive the perseverance of this matter in its state of rest when we wave a fan, in the same manner that we perceive the inertia of water when we move a paddle through it. The effects of wind in impelling our ships and mills, in tearing up trees, and overturning buildings, are equal indications of its perseverance in a state of motion. To this matter, when at rest, we give the name air; and when it is in motion we call it wind.

Air a material fluid.

Air, therefore, is a material fluid; a fluid, because its parts are easily moved, and yield to the smallest inequality of pressure. Air possesses some others of the very general, though not essential, properties of matter. It is heavy. This appears from the following facts.

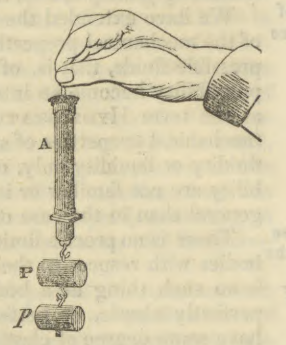
1. It always accompanies this globe in its orbit round the sun, surrounding it to a certain distance, under the name of atmosphere, which indicates the being connected with the earth by its general force of gravity. It is chiefly in consequence of this that it is continually moving round the earth from east to west; forming what is called the trade-wind, to be more particularly considered afterwards. All that is to be observed on this subject at present is, that, in consequence of the disturbing force of the sun and moon, there is an accumulation of the air of the atmosphere, in the same manner as of the waters of the ocean, in those parts of the globe which have the moon near their zenith or nadir: and as this happens successively, going from the east to the west, by the rotation of the earth round its axis in the opposite direction, the accumulated air must gradually flow along to form the elevation. This is chiefly to be observed in the torrid zone; and the generality and regularity of this motion are greatly disturbed by the changes which are continually taking place in different parts of the atmosphere from causes which are not mechanical.

2. It is in like manner owing to the gravity of the air that it supports the clouds and vapours which we see constantly floating in it. We have even seen bodies of no inconsiderable weight float, and even rise, in the air. Soap bubbles, and balloons filled with inflammable gas, (hydrogen or gas obtained from oil or coal,) rise and float in the same manner as a cork rises in water. This phenomenon proves the weight of the air, in the same manner that the swimming of a piece of wood indicates the weight of the water which supports it.

Familiar proofs of its weight.

3. But we are not left to these refined observations for the proof of the air's gravity. We observe many familiar phenomena, which must be immediate consequences of the supposition that air is a heavy fluid, and, like other heavy fluids, presses on the outsides of all bodies immersed in or surrounded by it. Thus, for instance, if we shut the nozzle and valve hole of a pair of bellows after having squeezed the air out of them, we shall find that even some hundred pounds, are necessary for separating the boards. They are kept together by the pressure of the heavy air which surrounds them in the same manner as if they were immersed in water. In like manner, if we stop the end of a syringe after its piston has been pressed down to the bottom, and then attempt to draw up the piston, we shall find a considerable force necessary, viz. about fifteen or sixteen pounds for every square inch of the section of the syringe. Exerting this force, we can draw up the piston to the top, and we can hold it there; but the moment we cease acting, the piston rushes down and strikes the bottom. It is called a suction, as we feel something as it were drawing in the piston; but it is really the weight of the incumbent air pressing it in. And this obtains in every position of the syringe; because the air is a fluid, and presses in every direction. Nay, it presses on the syringe as well as on the piston; and if the piston be hung by its ring on a nail, the syringe requires force to draw it down, just as much as to draw the piston up; and if it be let go, it will spring up unless loaded with at least fifteen pounds for every square inch of its transverse section. See fig. 2.

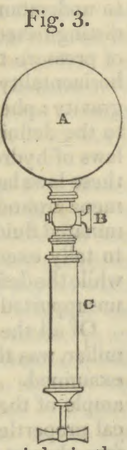
Fig. 2.



It may even be weighed.

4. But the most direct proof of the weight of the air is had by weighing a vessel empty of air, and then weighing it again when the air has been admitted; and this, as it is the most obvious consequence of its weight, has been asserted as long ago as the days of Aristotle. If we take a very large and limber bladder, and squeeze out the air very carefully, and weigh it, and then fill it till the wrinkles just begin to disappear, and weigh it again, we shall find no difference in the weight. But this is not Aristotle's meaning: because the bladder, considered as a vessel, is equally full in both cases, its dimensions being changed. We cannot take the air out of a bladder without its immediately collapsing. But what would be true of a bladder would be equally true of any vessel. Therefore, take a round vessel A, (fig. 3,) fitted with a stopcock B, and syringe C. Fill the whole with water, and press the piston to the bottom of the syringe. Then keeping the cock open, and holding the vessel upright, with the syringe undermost, draw down the piston. The water will follow it by its weight, and leave part of the vessel empty. Now shut the cock, and again push up the piston to the bottom of the syringe, the water escapes through the piston valve, as will be explained afterwards; then opening the cock, and again drawing down the piston, more water will come out of the vessel. Repeat this operation till all the water have come out. Shut the cock, unscrew the syringe, and weigh the vessel very accurately. Now open the cock, and admit the air, and weigh the vessel again, it will be found heavier than before, and this additional weight is the weight of the air which fills it; and it will be found to be 523 grains, about an ounce and a fifth avoirdupois, for every cubic foot that the vessel contains. Now since a cubic foot of water would weigh 1000 ounces, this experiment would show that water is about 840 times heavier than

Fig. 3.



air. The most accurate judgment of this kind of which we have met with an account, is that recorded by Sir George Shuckburgh, in the sixty-seventh volume of the Philosophical Transactions, (p.560.) From this it follows, that when the air is of the temperature 53, and the barometer stands at 29¼ inches, the air is 836 times lighter than water. But the experiment is not susceptible of sufficient accuracy for determining the exact weight of a cubic foot of air. Its weight is very small; and the vessel must be strong and heavy, so as to overload any balance that is sufficiently nice for the experiment.[1]

The most convenient method of doing this.

To avoid this inconvenience, the whole may be weighed in water, first loading the vessel so as to make it preponderate an ounce or two in the water. By this means the balance will be loaded only with this small preponderancy. But even in this case there are considerable sources of error, arising from changes in the specific gravity of the water and other causes. The experiment has often been repeated with this view, and the air has been found at a medium to be about 840 times as light as water, but with great variations, as may be expected from its very heterogeneous nature, in consequence of its being the menstruum of almost every fluid, of all vapours, and even of most solid bodies; all which it holds in solution, forming a fluid perfectly transparent, and of very different density according to its composition. It is found, for instance, that perfectly pure air of the temperature of our ordinary summer is considerably denser than when it has dissolved about half as much water as it can hold in that temperature; and that with this quantity of water the difference of density increases in proportion as the mass grows warmer, for damp air is more expansible by heat than dry air. We have had occasion to consider this subject when treating of the connection of the mechanical properties of air with the state of the weather.

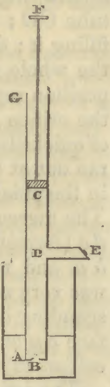
This property of air denied by the Peripatetics.

Such is the result of the experiment suggested by Aristotle, evidently proving the weight of the air; and yet the Peripatetics uniformly refused it this property. It was a matter long debated among the philosophers of the last century. The reason was, that Aristotle assigns a different cause to many phenomena which any man led by common observation would ascribe to the weight of the air. Of this kind is the rise of water in pumps and syphons. Aristotle had asserted that all nature was full of being, and that nature abhorred a void. He adduces many facts, in which it appears, that if not absolutely impossible, it is very difficult, and requires great force, to produce a space void of matter. When the operation of pumps and syphons came to be known, the philosophers of Europe, found in this fancied horror a ready solution of the phenomena. We shall state the facts that every reader may see what kind of reasoning was received not two centuries ago.

Construction of pumps in the last century.

Pumps were then constructed in the following manner: A long pipe GB was set in the water of the well A. This was fitted with a sucker or piston C, having a long rod CF, and was furnished with a valve B at the bottom, and a lateral pipe DE at the place of delivery, also furnished with a valve. The fact is, that if the piston be thrust down to the bottom, and then drawn up, the water will follow it; and upon the piston being again pushed down, the water shuts the valve B by its weight, and escapes or is expelled at the valve E; and on drawing up the piston again the valve E is shut, the water again rises after the piston, and is again expelled at its next descent.

Fig. 4.



The Peripatetics explain all this by saying, that if the water did not follow the piston there would be a void between them. But nature abhors a void; therefore the water follows the piston; this reasoning is overturned by one observation. Suppose the pipe shut at the bottom, the piston can be drawn up, and thus a void produced.

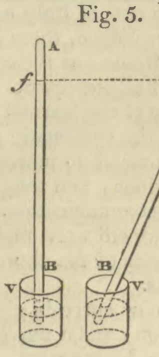
Galileo first predicted the height to which water would rise.

Galileo seems to have been the first who seriously ascribed this to the weight of the air. Many had supposed air heavy; and thus explained the difficulty of raising the board of bellows, or the piston of a syringe, &c. But he distinctly applies to this allowed weight of the air all the consequences of hydrostatical laws; and he reasons as follows. The heavy air rests on the water in the cistern, and presses it with its weight. It does the same with the water in the pipe, and therefore both are on a level: but if the piston, after being in contact with the surface of the water, be drawn up, there is no longer any pressure on the surface of the water within the pipe; for the air now rests on the piston only, and thus occasions a difficulty in drawing it up. The water in the pipe, therefore, is in the same situation as if more water were poured into the cistern, that is, as much as would exert the same pressure on its surface as the air does. In this case we are certain that the water will be pressed into the pipe, and will raise up the water in it, and follow it till it is equally high within and without. The same pressure of the air shuts the valve E during the descent of the piston. He did not wait for the very obvious objection, that if the rise of the water was the effect of the air's pressure, it would also be its measure, and would be raised and supported only to a certain height. He directly said so, and adduced this as a decisive experiment. If the horror of a void be the cause, says he, the water must rise to any extent however great; but if it be owing to the pressure of the air, it will only rise till the weight of the water in the pipe is in equilibrio with the pressure of the air, according to the common laws of hydrostatics. And he adds, that this is well known; for it is a fact, that pumps will not *draw* water much above forty palms, although they may be made to *propel* it, or to *lift it* to any height. He then makes an assertion, which, he says, if true, will be decisive. Let a very long pipe, shut at one end, be filled with water, and let it be erected perpendicularly with the close end uppermost, and a stopper in the other end, and then its lower orifice immersed into a vessel of water; the water will subside in the pipe upon removing the stopper, till the remaining column is in equilibrio with the pressure of the external air. This experiment he proposes to the curious; saying, however, that he thought it unnecessary, there being already such abundant proofs of the air's pressure.

His prediction verified.

It is probable that the cumbersomeness of the necessary apparatus protracted the making of this experiment. Another equally conclusive, and much easier, was made in 1642 after Galileo's death, by his zealous and learned disciple Toricelli. He filled a glass tube, close at one end, with mercury; judging, that if the support of the water was owing to the pressure of the air, and was the measure of this pressure, mercury would in like manner be supported by it, and this at a height which was also the measure of the air's pressure, and therefore thirteen times less than water. He had the pleasure of seeing his expectation verified in the completest manner; the mercury descending in the tube AB, and finally settling at the height

Fig. 5.



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[1] This method as here stated requires a strong vessel, and consequently overloads a delicate balance; but the objection does not apply when water is not used, and the flask weighed, first when full of air, and again when the air has been exhausted by the air-pump to a known amount; in this way the specific gravity of any gas may be determined.

fB of 29¾ Roman inches: and he found, that when the tube was inclined, the point f was in the same horizontal plane with f in the upright tube, according to the received laws of hydrostatical pressure. The experiment was often repeated, and soon became famous. About three years afterwards the same experiment was published, at Warsaw in Poland, by Valerianus Magnus, as his own discovery: but it appears from the letters of Roberval, not only that Toricelli was prior, and that his experiment was the general topic of discussion among the curious; but also highly probable that Valerianus Magnus was informed of it when at Rome, and daily conversant with those who had seen it. He denies, however, even having heard of the name of Toricelli.

Origin of the Royal Society.

This was the era of philosophical ardour; and we think that it was Galileo's invention and immediate application of the telescope which gave it vigour. Discoveries of the most wonderful kind in the heavens, and which required no extent of previous knowledge to understand them, were thus put into the hands of every person who could purchase a spy-glass; whilst the high degree of credibility which some of the discoveries, such as the phases of Venus and the rotation and satellites of Jupiter, gave to the Copernican system, immediately set the whole body of the learned in motion. About the years 1642 and 1644 we find clubs of gentlemen associated in Oxford and London for the cultivation of knowledge by experiment; and before 1655 all the doctrines of hydrostatics and pneumatics were familiar there, and established by experiment. Mr. Boyle procured a coalition of these clubs under the name of the Invisible and Philosophical Society. In May 1658 Mr. Hooke finished for Mr. Boyle an air-pump, which had employed him a long time, and occasioned him several journeys to London for things which the workmen of Oxford could not execute. He speaks of this as a great improvement on Mr. Boyle's own pump, which he had been using some time before. Boyle therefore must have invented his air-pump, and was not indebted for it to Schottus's account of Otto Guerické's, published in the *Mechanica Hydraulo-pneumatica* of Schottus in 1657, as he asserts *Technica Curiosa.* The Royal Society of London arose in 1656 from the coalition of these clubs, after fifteen years' co-operation and correspondence. The Montmorine Society at Paris had subsisted nearly about the same time; for we find Pascal in 1648 speaking of the meetings in the Sorbonne College, from which we know that society originated. Nuremberg, in Germany, was also a distinguished seminary of experimental philosophy. The magistrates, sensible of its valuable influence in many manufactures, the source of the opulence and prosperity of their city, and many of them philosophers, gave philosophy a professed and munificent patronage, furnishing the philosophers with a copious apparatus, a place of assembly, and a fund for the expence of their experiments; so that this was the first academy of sciences out of Italy under the patronage of government. In Italy, indeed, there had long existed institutions of this kind. Rome was the centre of church-government, and the resort of all expectants for preferment. The clergy was the majority of the learned in all Christian nations, and particularly of the systematic philosophers. Each, eager to recommend himself to notice, brought forward every thing that was curious; and they were the willing vehicles of philosophical communication. Thus the experiments of Galileo and Toricelli were rapidly diffused by persons of rank, the dignitaries of the church, or by the monks their obsequious servants.

Toricellian experiment, repeated in various forms.

All now agree in giving Toricelli the honour of the first invention; and it universally passes by the name of the Toricellian Experiment. The tube is called the Toricellian tube; and the space left by the mercury is called the Toricellian Vacuum, to distinguish it from the Boylean Vacuum, which is only an extreme rarefaction. The experiment was repeated in various forms, and with apparatus which enabled philosophers to examine several effects which the vacuum produced on bodies exposed to it. This was done by making the upper part of the tube terminate in a vessel of some capacity, or communicate with such a vessel, in which were included along with the mercury bodies on which the experiments were to be made. When the mercury had run out, the phenomena of these bodies were carefully observed.

An objection to the conclusion drawn from it obviated.

An objection was made to the conclusion drawn from Toricelli's experiment, which appears formidable. If the Toricellian tube be suspended on the arm of a balance, it is found that the counterpoise must be equal to the weight both of the tube and of the mercury it contains. This could not be, say the objectors, if the mercury were supported by the air. It is evidently supported by the balance; and this gave rise to another notion of the cause different from the Peripatetic *fuga vacui.* A suspensive force, or rather attraction, was assigned to the upper part of the tube.

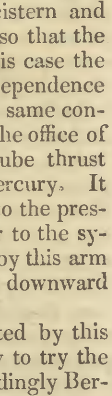
But the true explanation of the phenomena is most easy and satisfactory. Suppose the mercury in the cistern and tube to freeze, but without adhering to the tube, so that the tube could be freely drawn up and down. In this case the mercury is supported by the base, without any dependence on the pressure of the air; and the tube is in the same condition as before, and the solid mercury performs the office of a piston to this kind of syringe. Suppose the tube thrust down till the top of it touches the top of the mercury. It is evident that it must be drawn up in opposition to the pressure of the external air, and it is precisely similar to the syringe in fig. 2. The weight sustained therefore by this arm of the balance is the weight of the tube and the downward pressure of the atmosphere on its top.

Galileo's original experiment performed.

The curiosity of philosophers being thus excited by this very manageable experiment, it was natural now to try the original experiment proposed by Galileo. Accordingly Berti in Italy, Pascal in France, and many others in different places, made the experiment with a tube filled with water, wine, oil, &c., and all with the success which might be expected in so simple a matter: and hence the doctrine of the weight and pressure of the air was established beyond contradiction or doubt. All this was done before the year 1648. A very beautiful experiment was exhibited by Auzout, which completely satisfied all who had any remaining doubts.

A decisive experiment by Auzout.

Fig. 6.



A small box or vial EFGH, had two glass tubes, AB, CD, three feet long, inserted into it in such a manner as to be firmly fixed in one end, and to reach nearly to the other end. AB was open at both ends, and CD was close at D. This apparatus was completely filled with mercury, by unscrewing the tube AB, filling the box and the tube CD; then screwing in the tube AB, and filling it; then holding a finger on the orifice A, the whole was inverted and set upright in the position represented in the figure β, immersing the orifice A (now a of fig. β,) in a small vessel of quicksilver. The result was, that the mercury ran out at the orifice a, till its surface $m\,n$ within the phial descended to the top of the tube $b\,a$. The mercury also began to descend in the tube $d\,c$ (formerly DC,) and run over into the tube $b\,a$, and run out at a, till the mercury in $d\,c$ was very near equal in a level with $m\,n$. The mercury descending in $b\,a$ till it stood at k, 29½ inches above the surface $o\,p$ of the mercury in the cistern, just as in the Toricellian tube.

The rationale of this experiment is very easy. The whole apparatus may first be considered as a Toricellian tube of an uncommon shape, and the mercury would flow out at a. But as soon as a drop of mercury comes out, leaving a space above $m\,n$, there is nothing to keep up the mercury in the tube *d c*. Its mercury, therefore, descends also; and running over into *b a*, continues to supply its expence till the tube *d c* is almost empty, or can no longer supply the waste of *b a*. The inner surface therefore falls as low as it can, till it is level with *b*. No more mercury can enter *b a*, yet its column is too heavy to be supported by the pressure of the air on the cistern below; it therefore descends in *b a*, and finally settles at the height *ko*, equal to that of the mercury in the Toricellian tube.

The prettiest circumstance of the experiment remains. Make a small hole *g* in the upper cap of the box. The external air immediately rushes in by its weight, and now presses on the mercury in the box. This immediately raises the mercury in the tube *d c* to *l*, $29\frac{1}{2}$ inches above *m n*. It presses on the mercury at *k* in the tube *b a*, balancing the pressure of the air in the cistern. The mercury in this tube therefore is left to the influence of its own weight, and it descends to the bottom. Nothing can be more apposite or decisive.

The gravity of the air a statical principle.

And thus the doctrine of the gravity and pressure of the air is established by the most unexceptionable evidence; and we are entitled to assume it as a statical principle, and to affirm *a priori* all its legitimate consequences.

And in the first place, we obtain an exact measure of the pressure of the atmosphere. It is precisely equal to the weight of the column of mercury, of water, of oil, &c. which it can support; and the Toricellian tube, or others fitted up upon the same principle, are justly termed *baroscopes* and *barometers* with respect to the air. Now it is observed that water is supported at the height of 32 feet nearly: the weight of the column is exactly 2000 avoirdupois pounds on every square foot of base, or $13\frac{9}{10}$ on every square inch. The same conclusion very nearly may be drawn from the column of mercury, which is nearly $29\frac{1}{2}$ inches high when in equilibrium with the pressure of the air. We may here observe, that the measure taken from the height of a column of water, wine, spirits, and the other fluids of considerable volatility, as chemists term it, is not so exact as that taken from mercury, oil, and the like. For it is observed, that the volatile fluids are converted by the ordinary heat of our climates into vapour when the confining pressure of the air is removed; and this vapour, by its elasticity, exerts a small pressure on the surface of the water, &c. in the pipe, and thus counteracts a small part of the external pressure; and therefore the column supported by the remaining pressure must be lighter, that is, shorter. Thus it is found, that rectified spirits will not stand much higher than is competent to a weight of 13 pounds on an inch, the elasticity of its vapour balancing about $\frac{1}{13}$ of the pressure of the air. We shall afterwards have occasion to consider this matter more particularly.

A difficulty solved.

As the medium height of the mercury in the barometer is $29\frac{1}{2}$ inches, we see that the whole globe sustains a pressure equal to the whole weight of a body of mercury of this height; and that all bodies on its surface sustain a part of this in proportion to their surfaces. An ordinary sized man sustains a pressure of several thousand pounds. How comes it then that we are not sensible of a pressure which one should think enough to crush us together? This has been considered as a strong objection to the pressure of the air; for when a man is plunged a few feet under water, he is very sensible of the pressure. The answer is by no means so easy as is commonly imagined. We feel very distinctly the effects of removing this pressure from any part of the body. If any one will apply the open end of a syringe to his hand, and then draw up the piston, he will find his hand sucked into the syringe with great force, and it will give pain; and the soft part of the hand will swell into it, being pressed in by the neighbouring parts, which are subject to the action of the external air. If one lays his hand on the top of a long perpendicular pipe, such as a pump filled to the brim with water, which is at first prevented from running out by the valve below; and if the valve be then opened, so that the water descends, he will then find his hand so hard pressed to the top of the pipe, that he cannot draw it away. But why do we only feel the *inequality* of pressure? There is a similar instance wherein we do not feel it, although we cannot doubt of its existence. When a man goes slowly to a great depth under water in a diving-bell, we know unquestionably that he is exposed to a new and very great pressure, yet he does not feel it. But those facts are not sufficiently familiar for general argument. The human body is a bundle of solids, hard or soft, filled or mixed with fluids, and there are few or no parts of it which are empty. All communicate either by vessels or pores; and the whole surface is a sieve through which the insensible perspiration is performed. The whole extended surface of the lungs is open to the pressure of the atmosphere; every thing is therefore in equilibrio; and if free or speedy access be given to every part, the body will not be damaged by the pressure, however great, any more than a wet sponge would be deranged by plunging it any depth in water. The pressure is instantaneously diffused by means of the incompressible fluids with which the parts are filled; and if any parts are filled with air or other compressible fluids, these are compressed till their elasticity again balances the pressure. Besides, all our fluids are acquired slowly, and gradually mixed with that proportion of air which they can dissolve or contain. The whole animal has grown up in this manner from the first vital atom of the embryo. For such reasons the pressure can occasion no change of shape by squeezing together the flexible parts; nor any obstruction by compressing the vessels or pores. We cannot say what would be felt by a man, were it possible that he could have been produced and grown up *in vacuo*, and then subjected to the compression. We even know that any sudden and considerable change of general pressure is very severely felt. Persons in a diving-bell have been almost killed by letting them down or drawing them up too suddenly. In drawing up, the elastic matters within have suddenly swelled, and not finding an immediate escape, have burst the vessels. Dr. Halley experienced this, the blood gushing out from his ears by the expansion of air contained in the internal cavities of this organ, from which there are but very slender passages.

The weather-glass.

A very important observation recurs here. The pressure of the atmosphere is variable. This was observed almost as soon as philosophers began to attend to the barometer. Pascal observed it in France, and Descartes observed it in Sweden in 1650. Mr. Boyle and others observed it in England in 1656. And before this, observers, who took notice of the concomitancy of these changes of aerial pressure with the state of the atmosphere, remarked, that it was generally greatest in winter and in the night; and certainly most variable during winter and in the northern regions. Familiar now with the weight of the air, and considering it as the vehicle of the clouds and vapours, they noted with care the connection between the weather and the pressure of the air, and found that a great pressure of the air was generally accompanied with fair weather, and a diminution of it with rain and mists. Hence the barometer came to be considered as an index not only of the present state of the air's weight, but also as indicating by its variations changes of weather.

The pressure of the air in proportion to the elevation

In the next place, we may conclude that the pressure of the air will be different in different places, according to their elevation above the surface of the ocean; for if air be a heavy fluid, it must press in some proportion according to its perpendicular height. If it be a homogeneous fluid of equal density and weight in all its parts, the mercury in the cistern of a barometer must be pressed precisely in proportion to the depth to which that cistern is immersed in it; and as this pressure is exactly measured by the height of the mercury in the tube, the height of the mercury in the Toricellian tube must be exactly proportional to the depth of the place of observation under the surface of the atmosphere.

This proved by experiments.

The celebrated Descartes first entertained this thought, (Epist. 67. of Pr. III.) and soon after him Pascal. His occupation in Paris not permitting him to try the justness of his conjecture, he requested Mr. Perrier, a gentleman of Clermont in Auvergne, to make the experiment, by observing the height of the mercury at one and the same time at Clermont and on the top of a very high mountain in the neighbourhood. His letters to Mr. Perrier in 1647 are still extant. Accordingly, Mr. Perrier, in September 1648, filled two equal tubes with mercury, and observed the heights of both to be the same, viz. $26\frac{7}{24}$ inches, in the garden of the convent of the Friars Minims, situated in the lowest part of Clermont. Leaving one of them there, and one of the fathers to observe it, he took the other to the top of Puy de Dome, which was elevated nearly 500 French fathoms above the garden. He found its height to be $23\frac{2}{24}$ inches. On his return to the town, in a place called *Font de l'Arbre*, 150 fathoms above the garden, he found it 25 inches; when he returned to the garden it was again $26\frac{7}{24}$, and the person set to watch the tube which had been left, said that it had not varied the whole day. Thus a difference of elevation of 3000 French feet had occasioned a depression of $3\frac{1}{8}$ inches; from which it may be concluded, that $3\frac{1}{8}$ inches of mercury weighs as much as 3000 feet of air, and one-tenth of an inch of mercury as much as 96 feet of air. The next day he found, that taking the tube to the top of a steeple 120 feet high, made a fall of one-sixth of an inch. This gives 72 feet of air for one-tenth of an inch of mercury; but ill agreeing with the former experiment. But it is to be observed, that a very small error of observation of the barometer would correspond to a great difference of elevation, and also that the height of the mountain had not been measured with any precision. This has been since done (Mem. Acad. par. 1703,) and found to be 529 French toises.

Pascal published an account of this great experiment,[1] and it was quickly repeated in many places of the world. In 1653, it was repeated in England by Dr. Power (Power's Exper. Phil.) and in Scotland in 1661, by Mr. Sinclair, professor of philosophy in the university of Glasgow, who observed the barometer at Lanark, on the top of mount Tinto in Clydesdale, and on the top of Arthur's seat at Edinburgh. He found a depression of two inches between Glasgow and the top of Tinto, three quarters of an inch between the bottom and top of Arthur's seat, and $\frac{5}{32}$ of an inch at the cathedral of Glasgow on a height of 126 feet.[2]

Hence a method of measuring heights.

Hence we may derive a method of measuring the heights of mountains. Having ascertained with great precision the elevation corresponding to a fall of one-tenth of an inch of mercury, which is nearly 90 feet, we have only to observe the length of the mercurial column at the top and bottom of the mountain, and to allow 90 feet for every tenth of an inch. Accordingly this method has been practised with great success; but it requires an attention to many things not yet considered; such as the change of density of the mercury by heat and cold; the changes of density of air from its compressibility; a change immediately connected with or dependent on the very elevation we wish to measure.

Also a measure of the density of the air.

These observations give us the most accurate measure of the density of air and its specific gravity. This is but vaguely though directly measured by weighing air in a bladder or vessel. The weight of a manageable quantity is so small, that a balance sufficiently ticklish to indicate even very sensible fractions of it is overloaded by the weight of the vessel which contains it, and ceases to be exact; and when we take Bernouilli's ingenious method of suspending it in water, we expose ourselves to great risk of error by the variation of the water's density. Also it must necessarily be humid air which we can examine in this way: but the proportion of an elevation in the atmosphere to the depression of the column of mercury or other fluid, by which we measure its pressure, gives us at once the proportion of this weight or their specific gravity. Thus since it is found that in such a state of pressure the barometer stands at 30 inches, and the thermometer at 32°, 87 feet of rise produces one-tenth of an inch of fall in the barometer, the air and the mercury being both of the freezing temperature, we must conclude that mercury is 10,440 times heavier or denser than air. Then, by comparing mercury and water, we get $\frac{1}{800}$ nearly for the density of air relative to water; but this varies so much by heat and moisture, that it is useless to retain any thing more than a general notion of it; nor is it easy to determine whether this method or that by actual weighing be preferable. It is extremely difficult to observe the height of the mercury in the barometer nearer than $\frac{1}{200}$ of an inch; and this will produce a difference of even five feet, or $\frac{1}{26}$ of the whole. Perhaps this is a greater proportion than the error in weighing.[3]

Height of the atmosphere.

From the same experiments we also derive some knowledge of the height of the aerial covering which surrounds our globe. When we raise our barometer 87 feet above the surface of the sea, the mercury falls about one-tenth of an inch in the barometer; therefore if the barometer shows 30 inches at the sea-shore, we may expect that, by raising it 300 times 87 feet or five miles, the mercury in the tube will descend to the level of the cistern, and that this is the height of our atmosphere. But other appearances lead us to suppose a much greater height. Meteors are seen with us much higher than this, and which yet give undoubted indication of being supported by our air. There can be little doubt, too, that the visibility of the expanse above us is owing to the reflection of the sun's light by our air. Were the heavenly spaces perfectly transparent, we should no more see them than the purest water through which we see other objects; and we see them as we see water tinged with milk or other fæculæ. Now it is easy to show, that the light which gives us what is called twilight must be reflected from the height of at least 50 miles; for we have it when the sun is depressed 18 degrees below our horizon.

Why this knowledge is not accurate.

A little attention to the constitution of our air will convince us, that the atmosphere must extend to a much greater height than 300 times 87 feet. We see from the most familiar facts that it is compressible; we can squeeze it in an ox-bladder. It is also heavy; pressing on the air in this bladder with a very great force, not less than 1500 pounds. We must therefore consider it as in a state of compression, existing in smaller room than it would assume if it were not compressed by the incumbent air. It must therefore be in a condition something resembling that of a quantity of fine carded wool thrown loosely into a deep pit; the lower strata carrying the weight of the upper strata, and being compressed by them; and so much the more compressed as they are further down, and only the upper stratum in its unconstrained and most expanded state. If we shall suppose this wool thrown in by a hundred weight at a time, it will be divided into strata of equal weights, but of unequal thickness; the lowest being the thinnest, and the superior strata gradually increasing in thickness. Now, suppose the pit filled with air, and reaching to the top of the atmosphere, the weights of all the strata above any horizontal plane in it is measured by the height of the mercury in the Toricellian tube placed in that plane; and one-tenth of an inch of mercury is just equal to the weight of the lowest stratum 87 feet thick; for on raising the tube 87 feet from the sea, the surface of the mercury will descend one-tenth of an inch. Raise the tube till the mercury fall another tenth. This stratum must be more than 87 feet thick: how much more we cannot tell, being ignorant of the law of the air's expansion. In order to make it fall a third tenth, we must raise it through a stratum still thicker; and so on continually.

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[1] *Grande Expérience sur la Pésanteur de l'Air.*

[2] See Sinclair's *Ars Nova et Magna Gravitatis et Levitatis;* Sturmii *Collegium Experimentale, and* Schotti *Technica Curiosa.*

[3] Barometers are now made by which accurate observations may be made to the $\frac{1}{1000}$th part of an inch.

All this is abundantly confirmed by the very first experiment made by the order and directions of Pascal. For by carrying the tube from the garden of the convent to a place 150 fathoms higher, the mercury fell $\frac{7}{24}$ inches, or 1.2916; which gives about 69 feet eight inches of aerial stratum for $\frac{1}{10}$ of an inch of mercury; and by carrying it from thence to a place 350 fathoms higher, the mercury fell $1\frac{22}{24}$, or 1.9167 inches, which gives 109 feet seven inches for $\frac{1}{10}$ of an inch of mercury. These experiments were not accurately made. It is evident, however, from the whole tenor of them, that the strata of air decrease in density as we ascend through the atmosphere; but it remained to be discovered what is the force of this decrease, that is, the law of the air's expansion. Till this be done we can say nothing about the constitution of our atmosphere; we cannot tell in what manner it is fittest for raising and supporting the exhalations and vapours which are continually arising from the inhabited regions; not as an excrementitious waste, but to be supported, perhaps manufactured, in that vast laboratory of nature, and to be returned to us in beneficent showers. We cannot use our knowledge for the curious, and frequently useful, purpose of measuring the heights of mountains and taking the levels of extensive regions; in short, without an accurate knowledge of this, we can hardly acquire any acquaintance with those mechanical properties which distinguish air from those liquids which circulate here below.

Compressibility of the air.

Having therefore considered at some length the leading consequences of the air's fluidity and gravity, let us consider its compressibility with the same care; and then, combining the agency of both, we shall answer all the purposes of philosophy, discover the laws, explain the phenomena of nature, and improve art. We proceed therefore to consider a little the phenomena which indicate and characterise this other property of the air. All fluids are elastic and compressible as well as air; but in them the compressibility makes no figure, or does not interest us while we are considering their pressures, motions, and impulsions. But in air the compressibility and expansion draw our chief attention, and make it a proper representative of this class of fluids.

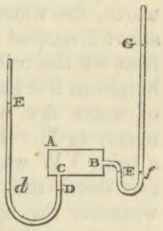
A familiar phenomenon.

Nothing is more familiar than the compressibility of air. It is seen in a bladder filled with it, which we can forcibly squeeze into less room; it is seen in a syringe, of which we can push the plug farther and farther as we increase the pressure. But these appearances bring into view another, and the most interesting, property of air, viz. its *elasticity*. When we have squeezed the air in the bladder or syringe into less room, we find that the force with which we *compressed* it is necessary to *keep it in this bulk;* and that if we cease to press it together, it will swell out and regain its natural dimensions. This distinguishes it essentially from such a body as a mass of flour, salt, or such like, which remain in the compressed state to which we reduce them. There is something therefore which opposes the compression different from the simple impenetrability of the air: there is something that opposes mechanical force: there is something too which produces motion, not only resisting compression, but pushing back the compressing body, and communicating motion to it. As an arrow is gradually accelerated by the bow-string pressing it forward, and at the moment of its discharge is brought to a state of rapid motion; so the ball from a pop-gun or wind-gun is gradually accelerated along the barrel by the pressure of the air during its expansion from its compressed state, and finally quits it with an accumulated velocity. These two motions are indications perfectly similar of the elasticity of the bow and of the air.

Fluidity of the air experimentally proved

Thus it appears that air is heavy and elastic. It needs little consideration to convince us in a vague manner that it is fluid. The ease with which it is penetrated, and driven about in every direction, and the motion of its pipes and channels, however crooked and intricate, entitle it to this character. But before we can proceed to deduce consequences from its fluidity, and to offer them as a true account of what will happen in these circumstances, it is necessary to exhibit some distinct and simple case, in which the characteristic mechanical property of a fluid is clearly and unequivocally observed in it. That property of fluids is, that any pressure applied to any part of them is propagated through the whole mass in every direction; and that in consequence of this diffusion of pressure, any two external forces can be put in equilibrio by the interposition of a fluid, in the same way as they can be put in equilibrio by the intervention of any mechanical engine.

Fig. 7.



Let a close vessel ABC (fig. 7.), of any form, have two upright pipes EDC, GFB, inserted into any parts of its top, sides, or bottom, and let water be poured into them, so as to stand in equilibrio with the horizontal surfaces at E, D, G, F, and let D *d*, F *f*, be horizontal lines, *it will be found* that the height of the column E *d* is sensibly equal to that of the column G *f*. This is a fact universally observed in whatever way the pipes are inserted. Now the surface of the water at D is undoubtedly pressed upwards with a force equal to a column of water, having its surface for its base, and E *d* for its height; it is therefore prevented from rising by some opposite force. This can be nothing but the elasticity of the confined air pressing it down. The very same thing must be said of the surface at F; and thus there are two external pressures at D and F set in equilibrio by the interposition of air. The force exerted on the surface D, by the pressure of the column E *d*, is therefore propagated to the surface at F; and thus air has this characteristic mark of fluidity.

In this experiment the weight of the air is insensible when the vessel is of small size, and has no sensible share in the pressure reaching at D and F. But if the elevation of the point F above D is very great, the column E *d will be observed* sensibly to exceed the column G *f*. Thus if F be 70 feet higher than D, E *d* will be an inch longer than the column G *f*: for in this case there is reacting at D, not only the pressure propagated from F, but also the weight of a column of air, having the surface at D for its base and 70 feet high. This is equal to the weight of a column of water one inch high.

It is by this propagation of pressure, this *fluidity*, that the pellet is discharged from a child's pop-gun. It sticks fast in the muzzle; and he forces in another pellet at the other end, which he presses forward with the rammer, condensing the air between them, and thus propagating to the other pellet the pressure which he exerts, till the friction is overcome, and the pellet is discharged by the air expanding and following it.

Hero's fountain.

There is a philosophical toy which illustrates this property of air, and which we shall have occasion to consider as converted into a useful hydraulic machine. This is what is usually called *Hero's fountain*. It consists of two vessels KLMN (fig. 8.), OPQR, which are close on all sides. The tube AB, having a funnel a-top, passes through the uppermost vessel without communicating with it, being soldered into its top and bottom. It also passes through the top of the under-vessel, where it is also soldered, and reaches almost to its bottom. This tube is open at both ends. There is another open tube ST, which is soldered into the top of the under vessel and the bottom of the upper vessel, and reaches almost to its top. These two tubes serve also to support the upper vessel. A third tube GF is soldered into the top of the upper vessel, and reaches almost to its bottom. This tube is open at both ends, but the orifice G is very small. Now suppose the uppermost vessel filled with water to the height EN, E *e* being its surface a little below T. Stop the orifice G with the finger, and pour in water at A. This will descend through AB, and compress the air in OPQR into less room. Suppose the water in the under vessel to have acquired the surface C *c*, the air which formerly occupied the whole of the spaces OPQR, and KL*e*E will now be contained in the spaces *o* P *c* C and KL *e* E; and its elasticity will be in equilibrio with the weight of the column of water, whose base is the surface E *e*, and whose height is A *c*. As this pressure is exerted in every part of the air, it will be exerted on the surface E *e* of the water of the upper vessel; and if the pipe FG were continued upwards, the water would be supported in it to an height *e*H above E *e*, equal to A *c*. Therefore if the finger be now taken from off the orifice G, the water will spout up to the same height as if it had been immediately forced out by a column of water A *c* without the intervention of the air, that is, nearly to H. If instead of the funnel at A, the vessel have a brim VW which will cause the water discharged at G to run down the pipe AB, this fountain will play till all the water in the upper vessel is expended. The operation of this second fountain will be better understood from fig. 9, which an intelligent reader will see is perfectly equivalent to fig. 8. A very powerful engine for raising water upon this principle has long been employed in the Hungarian mines; where the pipe AB is about 200 feet high, and the pipe FG about 120; and the condensation is made in the upper vessel, and communicated to the lower at the bottom of the mine, by a long pipe.

Fig. 8.

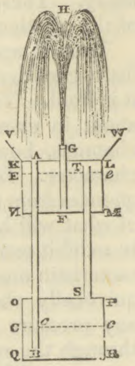
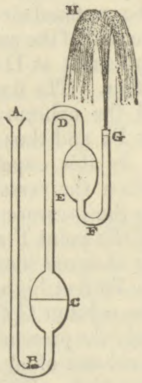


Fig. 9.



Laws of hydrostatics applicable to air.

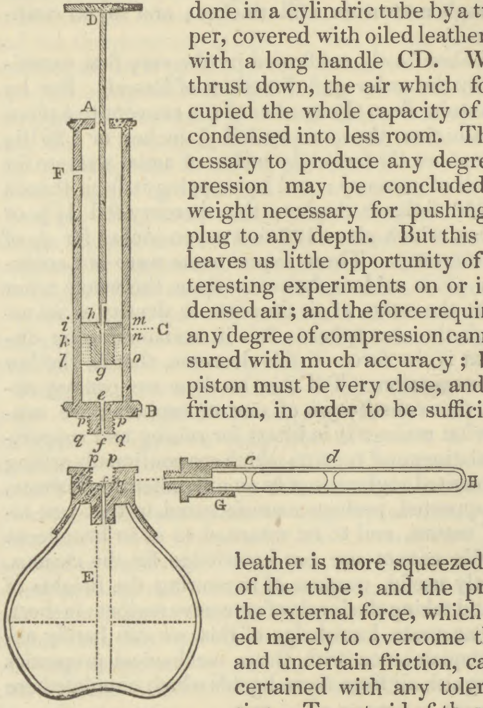
We may now then apply to air the laws of hydrostatics and hydraulics, in perfect confidence that their legitimate consequences will be observed in all its situations. We shall in future substitute, in place of any force acting on a surface of air, a column of water, mercury, or any other fluid whose weight is equal to this force; and as we know distinctly from theory what will be the consequences of this hydrostatic pressure, we shall determine *a priori* the phenomena in air; and in cases where theory does not enable us to say with precision what is the effect of this pressure, experience informs us in the case of water, and analogy enables us to transfer this to air.

More refined experiments

From such familiar and simple observations and experiments, the fluidity, the heaviness, and elasticity, are discovered of the substance with which we are surrounded, and which we call *air*. But to understand these properties, and completely to explain their numerous and important consequences, we must call in the aid of more refined observations and experiments, which even this scanty knowledge of them enables us to make; we must contrive some methods of producing with precision, any degree of condensation or rarefaction, of employing or excluding the gravitating pressure of air, and of modifying at pleasure the action of all its mechanical properties.

Nothing can be more obvious than a method of compressing a quantity of air to any degree. Take a cylinder or prismatic tube AB (fig. 10.) shut at one end, and fit it with a piston or plug C, so nicely that no air can pass by its sides. This will be best done in a cylindric tube by a turned stopper, covered with oiled leather, and fitted with a long handle CD. When this is thrust down, the air which formerly occupied the whole capacity of the tube is condensed into less room. The force necessary to produce any degree of compression may be concluded from the weight necessary for pushing down the plug to any depth. But this instrument leaves us little opportunity of making interesting experiments on or in this condensed air; and the force required to make any degree of compression cannot be measured with much accuracy; because the piston must be very close, and have great friction, in order to be sufficiently tight. And as the compression is increased, the leather is more squeezed to the side of the tube; and the proportion of the external force, which is employed merely to overcome this variable and uncertain friction, cannot be ascertained with any tolerable precision. To get rid of these imperfections, the following addition may be made to the instrument, which then becomes what is called the condensing syringe.

Fig. 10.



The end of the syringe is perforated with a very small hole *e f*, and being externally turned to a small cylinder, a narrow slip of bladder, or of waxed silk, must be tied over the hole at *f*. Now let us suppose the piston pushed down to the bottom of the barrel, to which it applies close; when it is drawn up to the top, it leaves a void behind, and the weight of the external air presses on the slip of bladder, which therefore clasps close to the brass, and thus performs the part of a valve, and keeps it close, so that no air can enter. But the piston having reached the top of the barrel, a hole F in the side of it is just below the piston, and the air rushes through this hole, and fills the barrel. Now push the piston down again, it immediately passes the hole F, and no air escapes through it; it therefore forces open the valve at *f*, and escapes while the piston moves to the bottom.

Now let E be any vessel, such as a glass bottle, having its mouth furnished with a brass cap firmly cemented to it, having a hollow screw which fits a solid screw *p p*, turned to the cylindric nozzle of the syringe. Screw the syringe into this cap, and it is evident that the air forced out of the syringe will be accumulated in this vessel; for upon drawing up the piston, the valve *f* always shuts by the elasticity or expanding force of the air in E; and on pushing it down again, the valve will open as soon as the piston has got so far down that the air in the lower part of the barrel is more powerful than the air already in the vessel. Thus at every stroke an additional barrelful of air will be forced into the vessel E; and it will be found, that after every stroke the piston must be farther pushed down before the valve will open. It cannot open till the pressure arising from the elasticity of the air condensed in the barrel, is superior to the elasticity of the air condensed in the vessel; that is, till the condensation of the first, or its density, is *somewhat* greater than that of the last, in order to overcome the straining of the valve on the hole, and the sticking occasioned by the clammy matter employed to make it air-tight.

Sometimes the syringe is constructed with a valve in the piston. This piston, instead of being of one piece, and solid, consists of two pieces perforated. The upper part *i k n m*, is connected with the rod or handle, and has its lower part turned down to a small cylinder, which is screwed into the lower part *k l o n*, and as a perforation *g h* going up in the axis, and terminating in a hole *h* in one side of the rod, over this hole at *g* there is a valve similar to the valve at *f*. When the piston is drawn up, and a void left below it, the weight of the external air forces it through the hole *g h*, opens the valve *g*, and fills the barrel. Then, on pushing down the piston, the air being squeezed into less room, presses on the valve *g*, shuts it; and none escaping through the piston, it is gradually condensed as the piston descends, till it opens the valve *f*, and is added to that already accumulated in the vessel E.

Elasticity of the air increased by condensation.

Having in this manner forced a quantity of air into the vessel E, we can make many experiments in it in this state of condensation. We are chiefly concerned at present, with the effect which this produces on its elasticity. We see this to be greatly increased; for we find more and more force required for introducing every successive barrelful. When the syringe is unscrewed, we see the air rush out with great violence, and every indication of great expanding force. If the syringe be connected with the vessel E, in the same manner as the syringe in No. 17, viz. by interposing a stopcock B between them (see fig. 3.) and if this stopcock have a pipe at its extremity, reaching near to the bottom of the vessel, which is previously half filled with water, we can observe distinctly when the elasticity of the air in the syringe exceeds that of the air in the receiver; for the piston must be pushed down a certain length before the air from the syringe bubbles up through the water, and the piston must be farther down at each successive stroke before this appearance is observed. When the air has thus been accumulated in the receiver, it presses the sides of it outward, and will burst it if not strong enough. It also presses on the surface of the water; and if we now shut the cock, unscrew the syringe, and open the cock again, the air will force the water through the pipe with great velocity, causing it to rise in a beautiful jet. When a metal-receiver is used, the condensation may be pushed to a great length, and the jet will then rise to a great height; which gradually diminishes as the water is expended, and room given to the air to expand itself.

Methods of judging of the condensation, &c.

We judge of the condensation of air in the vessel E, by the number of strokes, and the proportion of the capacity of the syringe to that of the vessel. Suppose the first to be one-tenth of the last; then we know, that after ten strokes the quantity of air in the vessel is doubled, and therefore its density double, and so on after any number of strokes. Let the capacity of the syringe (when the piston is drawn to the top) be a, and that of the vessel be b, and the number of strokes be n, the density of air in the vessel will be $\frac{b+na}{b}$, or $1+\frac{na}{b}$.

But this is on the supposition that the piston accurately fills the barrel, the bottom of the one applying close to that of the other, and that no force is necessary for opening either of the valves; but the first cannot be insured, and the last is very far from being true. In the construction now described, it will require at least one-twentieth part of the ordinary pressure of the air to open the piston valve; therefore the air which gets in will want at least this proportion of its complete elasticity; and there is always a similar part of the elasticity employed in opening the nozzle valve. The condensation therefore is never nearly equal to what is here determined.

It is accurately enough measured by a gage fitted to the instrument. A glass tube GH of a cylindric bore, and close at the end, is screwed into the side of the cap on the mouth of the vessel E. A small drop of mercury is taken into this tube by warming it a little in the hand, which expands the contained air, so that when the open end is dipped into mercury, and the whole allowed to cool, the mercury advances a little into the tube. The tube is furnished with a scale divided into small equal parts, numbered from the close end of the tube. Since this tube communicates with the vessel, it is evident that the condensation will force the mercury along the tube, acting like a piston on the air beyond it, and the air in the tube and vessel will always be of one density. Suppose the number at which the drop stands before the condensation is made to be c, and that it stands at d when the condensation has attained the degree required, the density of the air in the remote end of the gage, and consequently in the vessel, will be $\frac{c}{d}$.

Sometimes there is used any bit of tube close at one end, having a drop of mercury in it, simply laid into the vessel E, and furnished with a scale; but this can only be used with glass vessels, and these are with difficulty made strong enough to resist the pressure arising from great condensation. In such experiments metalline vessels are generally used, fitted with a variety of apparatus for different experiments.

Syringes for great condensations.

It must be observed in this place, that very great condensations require great force, and therefore small syringes. It is therefore convenient to have them of various sizes, and to begin with those of a larger diameter, which operate more quickly; and when the condensation becomes fatiguing, to change the syringe for a smaller.

For this reason, and in general to make the condensing apparatus more convenient, it is proper to have a stop-cock interposed between the syringe and the vessel, or, as it is usually called, the receiver. This consists of a brass pipe, which has a well-ground cock in its middle, and has a hollow screw at one end, which receives the nozzle screw of the syringe, and a solid screw at the other end, which fits the screw of the receiver. (See fig. 3.)

Instances of great condensation.

By these gages, or contrivances similar to them, we have been able to ascertain very great degrees of condensation in the course of some experiments. Dr. Hales found, that when dry wood was put into a strong vessel, which it almost filled, and the remainder was filled with water, the swelling of the wood, occasioned by its imbibition of water, condensed the air of his gage into the thousandth of its original bulk. He found that pease, treated in the same way, generated elastic air, which, pressing on the air in the gage, condensed it into the fifteen-hundreth part of its bulk. This is the greatest condensation that has been ascertained with precision, although in other experiments it has certainly been carried much farther; but the precise degree could not be ascertained.

Some opinions respecting elasticity, &c.

Another important observation is, that in every state of density in which we find it, it retains its perfect fluidity, transmitting all pressures which are applied to it with undiminished force, as appears by the equality constantly observed between the opposing columns of water or other fluid by which it is compressed, and by the facility with which all motions are performed in it in the most compressed states in which we can make observations of this kind. This fact is totally incompatible with the opinion of those who ascribe the elasticity of air to the springy ramified structure of its particles, touching each other like so many pieces of sponge or foot-balls. A collection of such particles might indeed be pervaded by solid bodies with considerable ease, if they were merely touching each other, and not subjected to any external pressure. But the moment such pressure is exerted, and the assemblage squeezed into a smaller space, each presses on its adjoining particles: they are individually compressed, flattened in their touching surfaces, and before the density is doubled they are squeezed into the form of perfect tubes, and compose a mass, which may indeed propagate pressure from one place to another in an imperfect manner, and with great diminution of its intensity, but will no more be fluid than a mass of soft clay.

Consequences of the air's elasticity.

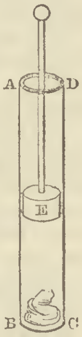
We have seen the air is heavy and compressible, and might now proceed to deduce in order the explanation of the appearances consequent on each of these properties. But, as has been already observed, the elasticity of air modifies the effects of its gravity so remarkably, that they would be imperfectly understood if both qualities were not combined in our consideration of either. At any rate, some farther consequences of its elasticity must be considered, before we understand the means of varying at pleasure the effects of its gravity.

Its great expansibility proved by experiment.

Since air is heavy, the lower strata of a mass of air must support the upper; and, being compressible, they must be condensed by their weight. In this state of compression the elasticity of the lower strata of air acts in opposition to the weight of the incumbent air, and balances it. There is no reason which should make us suppose that its expanding force belongs to it only when in such a state of compression. It is more probable that, if we could free it from this pressure, the air would expand itself into still greater bulk. This is most distinctly seen in the following experiment.

Into the cylindric jar ABCD, (fig. 11,) which has a small hole in its bottom, and is furnished with an air-tight piston E, put a small flaccid bladder, having its mouth tied tight with a string. Having pushed the piston near to the bottom, and noticed the state of the bladder, stop up the hole in the bottom of the jar with the finger, and draw up the piston, which will require a considerable force. You will observe the bladder swell out, as if air had been blown into it; and it will again collapse on allowing the piston to descend. Nothing can be more unexceptionable than the conclusion from this experiment, that ordinary air is in a state of compression, and that its elasticity is not limited to this state. The bladder being flaccid, shews that the included air is in the same state with the air which surrounds it; and the same must be affirmed of it while it swells but still remains flaccid. We must conclude that the whole air within the vessel expands, and continues to fill it, when its capacity has been enlarged. And since this is observed to go on as long as we give it more room, we conclude, that by such experiments we have not yet given it so much room as it can occupy.

Fig. 11.

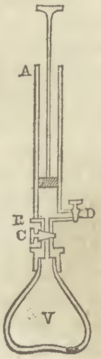


Attempts to discover the limits of this expansion.

It was a natural object of curiosity to discover the limits of this expansion; to know what was the natural unconstrained bulk of a quantity of air, beyond which it would not expand though all external compressing force were removed. Accordingly philosophers constructed instruments for *rarefying* the air. The common water-pump had been long familiar, and appeared very proper for this purpose. The most obvious is the following.

Let the barrel of the syringe AB communicate with the vessel V, with a stopcock C between them. Let it communicate with the external air by another orifice D, in any convenient situation, also furnished with a stopcock. Let this syringe have a piston very accurately fitted to it so as to touch the bottom all over when pushed down, and have no vacancy about the sides.

Fig. 12.



Now, suppose the piston at the bottom, the cock C open, and the cock D shut, draw the piston to the top. The air which filled the vessel V will expand so as to fill both that vessel and the barrel AB; and, as no reason can be given to the contrary, we must suppose that the air will be uniformly diffused through both. Calling V and B the capacity of the vessel and barrel, it is plain that the bulk of the air will now be V+B; and since the quantity of matter remains the same, and the density of a fluid is as its quantity of matter directly and its bulk inversely, the density of the expanded air will be $\frac{V}{V+B}$, the density of common air being 1; for V+B; V=1; $\frac{V}{V+B}$.

The piston requires force to raise it, and it is raised in opposition to the pressure of the incumbent atmosphere; for this had formerly been balanced by the elasticity of the common air; and we conclude from the fact, *that force is required to raise the piston*, that the elasticity of the expanded air is less than that of air in its ordinary state; and an accurate observation of the force necessary to raise it would shew how much the elasticity is diminished. When therefore the piston is let go, it will descend as long as the pressure of the atmosphere exceeds the elasticity of the air in the barrel; that is, till the air in the barrel is in a state of ordinary density. To put it further down will require force, because the air must be compressed in the barrel; but if we open the cock D, the air will be expelled through it, and the piston will reach the bottom.

Now shut the *discharging cock* D, and open the cock C, and draw the piston. The air which occupied the space V, with the density $\frac{V}{V+B}$, will now occupy the space V+B, if it expands so far. To have its density D, say, As its present bulk V+B is to its former bulk V, so its former density $\frac{V}{V+B}$ to its new density; which will therefore be $\frac{V+V}{\overline{V+B+V+B}}$, or $\overline{\frac{V}{V+B}}\Big|^{2}$.

It is evident, that if the air continues to expand, the density of the air in the vessel after the third drawing up of the piston will be $\overline{\frac{V}{V+B}}\Big|^{2}$, after the fourth it will be $\overline{\frac{V}{V+B}}\Big|^{4}$, and after any number of strokes n will be $\overline{\frac{V}{V+B}}\Big|^{n}$. Thus, if the vessel is four times as large as the barrel, the density after the fifth stroke will be $\frac{1024}{3125}$, nearly $\frac{1}{3}$ of its ordinary density.

On the other hand, the number n of strokes necessary for reducing air to the density D is $\frac{\log D}{\log V-\log (V+B)}$.

Some inconveniences of this instrument.

Thus we see that this instrument can never abstract the whole air in consequence of its expansion, but only rarefy it continually as long as it continues to expand; nay, there is a limit beyond which the rarefaction cannot go. When the piston has reached the bottom, there remains a small space between it and the cock C filled with common air. When the piston is drawn up, this small quantity of air expands, and also a similar quantity in the neck of the other cock; and no air will come out of the receiver V till the expanded air in the barrel is or a smaller density than the air in the receiver. This circumstance evidently directs us to make these two spaces as small as possible, or by some contrivance to fill them up altogether. Perhaps this may be done effectually in the following manner.

Fig. 13.

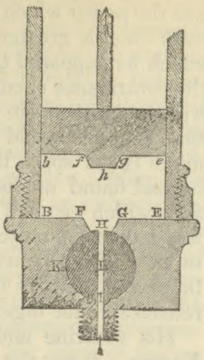
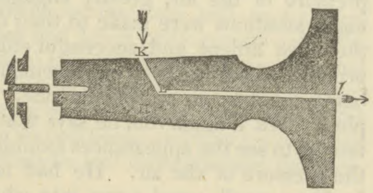


Fig. 14.



Let BE represent the bottom of the barrel, and let the circle HKI be the section of the key of the cock, of a large diameter, and place it as near to the barrel as can be. Let this communicate with the barrel by means of a hole FG widening upwards, as the frustum of a hollow obtuse cone. Let the bottom of the piston *b f h g e* be shaped so as to fit the bottom of the barrel and this hole exactly. Let the cock be pierced with two holes. One of them, HI, passes perpendicularly through its axis, and forms the communication between the receiver and barrel. The other hole, KL, has one extremity K on the same circumference with H, so that when the key is turned a fourth part round, K will come into the place of H: but this hole is pierced obliquely into the key, and thus keeps clear of the hole HI. It goes no further than the axis, where it communicates with a hole bored along the axis and terminating at its extremity. This hole forms the communication with the external air, and serves for discharging the air in the barrel. (A side view of the key is seen in fig. 14.) Fig. 13 shows the position of the cock while the piston is moving upwards, and fig. 14 shows its position while the piston is moving downwards. When the piston has reached the bottom, the conical piece *f h g* of the piston, which may be of firm leather, fills the hole FHG, and therefore completely expels the air from the barrel. The canal KL *l* of the cock contains air of the common density; but this is turned aside into the position KL (fig. 13), while the piston is still touching the cock. It cannot extend into the barrel during the ascent of the piston. In place of it the perforation HLI comes under the piston, filled with air that had been turned aside with it when the piston was at the top of the barrel, and therefore of the same density with the air of the receiver. It appears therefore that there is no limit to the rarefaction as long as the air will expand.

This instrument is called an Exhausting Syringe. It is more generally made in another form, which is much less expensive, and more convenient in its use. Instead of being furnished with *cocks* for establishing the communications and shutting them, as is necessary, it has *valves* like those of the condensing syringe, but opening in the opposite direction from those in fig. 10.

This syringe is evidently more easy in its use, requiring no attention to the cocks to open and shut them at the proper times. On this account this construction of an exhausting syringe is much more generally used.

But it is greatly inferior to the syringe with cocks, with respect to its power of rarefaction. It is evident that no air will come out of the receiver unless its elasticity *exceed* that of the air in the barrel by a difference able to lift up the valve fig. 10. A piece of waxed silk tied across this hole can hardly be made tight and certain of clapping to the hole without some small straining, which must therefore be overcome. It must be very gentle indeed not to require a force equal to the weight of two inches of water, and this is equal to about the 200th part of the whole elasticity of the ordinary air; and therefore this syringe, for this reason alone, cannot rarefy air above 200 times, even though air were capable of an indefinite expansion. In like manner the valve in the piston cannot be raised without a similar prevalence of the elasticity of the air in the barrel above the weight of the atmosphere. These causes united, make it difficult to rarefy the air more than 100 times, and very few such syringes will rarefy it more than 50 times; whereas the syringe with cocks, when new and in good order, will rarefy it 1000 times.

But, on the other hand, syringes with cocks are much more expensive, especially when furnished with apparatus for opening and shutting the cocks. They are more difficult to make equally tight, and (which is the greatest objection) do not remain long in good order. The cocks, by so frequently opening and shutting, grow loose, and allow the air to escape. No method has been found of preventing this. They must be ground tight by means of emery or other cutting powders. Some of these unavoidably stick in the metal, and continue to wear it down. For this reason philosophers, and the makers of philosophical instruments, have turned their chief attention to the improvement of the syringe with valves.

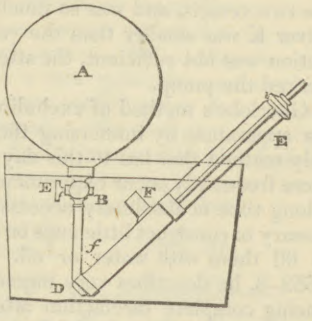
OF THE AIR-PUMP.

Invention of the air-pump by Guericke.

An Air-Pump is nothing but an exhausting syringe accommodated to a variety of experiments. It was first invented by Otto Guericke, a gentleman of Magdeburgh in Germany, about the year 1654. We trust that it will not be unacceptable to our readers to see this instrument in its first form, and to trace it through its successive steps to its present state of improvement.

Guericke gave a minute description of all his pneumatic apparatus to Gaspar Schottus, professor of mathematics at Wirtemberg, who immediately published it with the author's consent, with an account of some of his performances, first in 1657, in his *Mechanica Hydraulico-pneumatica;* and then in his *Technica Curiosa*, in 1664.

Fig. 16.



Construction of his pump.

Otto Guericke's air-pump consists of a glass receiver A of a form nearly spherical, fitted up with a brass cap and cock B. The nozzle of the cap was fixed to a syringe DE, also of brass, bent at D into half a right angle. This had a valve at D, opening from the receiver into the syringe, and shutting when pressed in the opposite direction. In the upper side of the syringe there is another valve F, opening from the syringe into the external air, and shutting when pressed inwards. The piston had no valve. The syringe, the cock B, and the joint of the tube, were immersed in a cistern filled with water. From this description, it is easy to understand the operation of the instrument. When the piston was drawn up from the bottom of the syringe, the valve F was kept shut by the pressure of the external air, and the valve D opened by the elasticity of the air in the receiver. When it was pushed down again, the valve D immediately shut by the superior elasticity of the air in the syringe; and when this was sufficiently compressed, it opened the valve F, and was discharged. It was immersed in water, that no air might find its way through the joints or cocks.

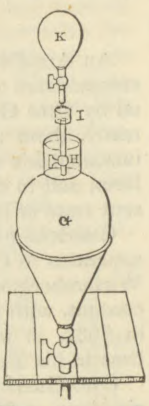
Its imperfections.

It would seem that this machine was not very perfect; for Guericke says, that it took several hours to produce an evacuation of a moderate-sized vessel; but he says, that when it was in good order, the rarefaction was so great, that when the cock was opened, and water admitted, it filled the receiver so as sometimes to leave no more than the bulk of a pea filled with air. This is a little surprising; for if the valve F be placed as far from the bottom of the syringe as in Schottus' figure,[1] it would appear that the rarefaction could not be greater than what must arise from the air in DF, expanding till it filled the whole syringe: because, as soon as the piston in its descent passes F, it can discharge no more air, but must compress it between F and the bottom, to be expanded again when the piston is drawn up. It is probable that the piston was not very tight, but that on pressing it down, it allowed the air to pass it; and the water in which the whole was immersed prevented the return of the air when it was drawn up again; and this accounts for the great time necessary for producing the desired rarefaction.

His improvement of it.

Guericke added a part to the machine, which saved his numerous visitants the trouble of hours' attendance, before they could see the curious experiments with rarefied air. He made a large copper vessel G (fig. 17.), having a pipe and cock below, which passed through the floor of the chamber into an under apartment, where it was joined to the syringe immersed in the cistern of water, and worked by a lever. The upper part of the vessel terminated in a pipe, furnished with a stopcock H, surrounded with a small brim to hold water for preventing the ingress of air. On the top was another cap I, also filled with water, to protect the junction of the pipes with the receiver K. This great vessel was always kept exhausted, and workmen attended below. When experiments were to be performed in the receiver K, it was set on the top of the great vessel, and the cock H was opened. The air in K immediately diffused itself equally between the two vessels, and was so much more rarefied as the receiver K was smaller than the vessel G. When this rarefaction was not sufficient, the attendants below immediately worked the pump.

Fig. 17.



Guericke's method of excluding air from all the joints of his apparatus, by immersing these joints in water, is the only method that has to this day been found effectual; and there frequently occur experiments where this exclusion for a long time is absolutely necessary. In such cases it is necessary to construct little cups or cisterns at every joint, and to fill them with water or oil. In a letter to Schottus, 1662–3, he describes very ingenious contrivances for producing complete rarefaction after the elasticity of the remaining air has been so far diminished that it is not able to open the valves. He opens the exhausting valves by a plug, which is pushed in by the hand; and the discharging valve is opened by a small pump placed on its outside, so that it opens into a void instead of opening against the pressure of the atmosphere.[2] These contrivances have been lately added to air-pumps by Haas and Hurter as new inventions.

Merits of Guericke.

It must be acknowledged, that the application of the pump or syringe to the exhaustion of air was a very obvious thought on the principle exhibited in fig. 3; and in this way it was also employed by Guericke, who first filled the receiver with water, and then applied the syringe. But this was by no means either his object or his principle. His object was not solely to procure a vessel void of air, but to exhaust the air which was already in it; and his principle was the power which he suspected to be in air of expanding itself into a greater space when the force was removed which he supposed to compress it. He expressly says,[3] that the contrivance occurred to him accidentally when occupied with experiments in the Toricellian tube, in which he found that the air would really expand, and completely fill a much larger space than what it usually occupied, and that he had found no limits to the expansion, evincing this by facts which we shall perfectly understand by and bye. This was a doctrine quite new, and required a philosophical mind to view it in a general and systematic manner; and it must be owned, that his manner of treating the subject is equally remarkable for ingenuity and for modesty.

Progress of experimental philosophy.

His doctrine and his machine were soon spread over Europe. It was the age of literary ardour and philosophical curiosity; and it is most pleasant to us, who, standing on the shoulders of our predecessors, can see far around us, to observe the eagerness with which every new, and to us frivolous, experiment was repeated and canvassed.

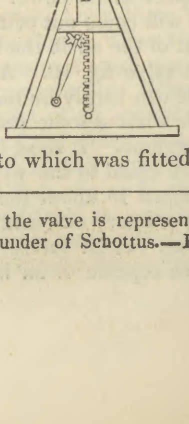
Ardour of Mr. Boyle.

About this time the foundations of the Royal Society of London were laid. Mr. Boyle, Mr. Wren, Lord Brounker, Dr. Wallis, and others, held meetings at Oxford, in which were received accounts of whatever was doing in the study of nature; and many experiments were exhibited. The researches of Galileo, Toricelli, and Pascal, concerning the pressure of the air, greatly engaged their attention, and many additions were made to their discoveries. Mr. Boyle, the most ardent and successful studier of nature, had the principal share in these improvements, his inquisitive mind being aided by an opulent fortune. In a letter to his nephew Lord Dungarvon, he says that he had made many attempts to see the appearances exhibited by bodies freed from the pressure of the air. He had made Toricellian tubes, having a small vessel a-top, into which he put some bodies before filling the tubes with mercury; so that when the tube was set upright, and the mercury run out, the bodies were *in vacuo*. He had also abstracted the water from a vessel by a small pump, by means of its weight, in the manner shewn in fig. 3, having previously put bodies into the vessel along with the water. But all these ways were very troublesome and imperfect. He was delighted when he learned from Schottus' first publication, that Guericke had effected this by the expansive power of the air; and immediately set about constructing a machine from his own ideas, no description of Guericke's being then published.

His air-pump.

It consisted of a receiver A, (fig. 18.) furnished with a stopcock B, and syringe CD placed in a vertical position below the receiver. Its valve C was in its bottom, close adjoining to the entry of the pipe of communication; and the hole by which the air issued was farther secured by a plug which could be removed. The piston was moved by a wheel and rack-work. The receiver of Guericke's pump was but ill adapted for any considerable variety of experiments; and accordingly very few were made in it. Mr. Boyle's receiver had a large opening EF, with a strong glass margin. To this was fitted a strong brass cap, pierced with a hole G in its middle, to which was fitted a

Fig. 18.



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[1] In Guericke's own account of these discoveries, published in 1672, eight years after the *Technica Curiosa*, the valve is represented at *f*, close to the bottom of the syringe; hence it would appear that the representing it in the middle at F was a blunder of Schottus.—Ed.

[2] See Schotti *Technica Curiosa*, p. 68—70.

[3] *Tractatus de Experimentis Magdeburgicis, et Epistolæ ad Schottum.*

plug ground into it, and shaped like the key of a cock. The extremity of this key was furnished with a screw, to which could be affixed a hook, or a variety of pieces for supporting what was to be examined in the receiver, or for producing various motions within it, without admitting the air. This was farther guarded against by means of oil poured round the key, where it was retained by the hollow cup-like form of the cover. With all these precautions, however, Mr. Boyle ingenuously confesses, that it was but seldom, and with great difficulty, that he could produce an extreme degree of rarefaction; and it appears by Guericke's letter to Schottus that in this respect the Magdeburgh machine had the advantage. But most of Boyle's very interesting experiments did not require this extreme rarefaction; and the variety of them, and their philosophic importance, compensated for this defect, and soon eclipsed the fame of the inventor to such a degree, that the state of air in the receiver was generally denominated the *vacuum Boyleanum*, and the air-pump was called *machina Boyleana*.

His contrivances to make air-vessels tight.

Mr. Boyle found, that to make a vessel air-tight, it was sufficient to place a piece of wet or oiled leather on its brim, and to lay a flat plate of metal on this. The pressure of the external air squeezed the two solid bodies so hard together, that the soft leather effectually excluded it. This enabled him to render the whole machine incomparably more convenient for a variety of experiments. He caused the conduit-pipe to terminate in a flat plate which he covered with leather, and on this he set the glass ball or receiver, which had both its upper and lower brim ground flat. He covered the upper orifice in like manner with a piece of oiled leather and a flat plate, having cocks and a variety of other perforations and contrivances suited to his purposes. This he found infinitely more expeditious, and also tighter than the clammy cements which he had formerly used for securing the joints.

Dr Hooke's improvement of Boyle's air-pump.

Fig. 19.

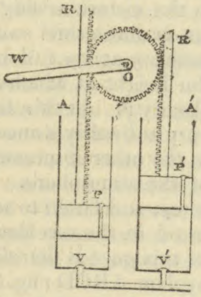
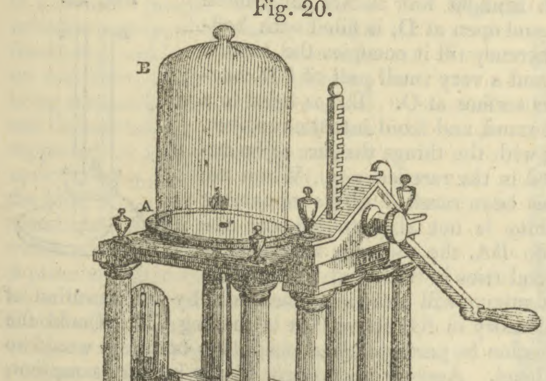


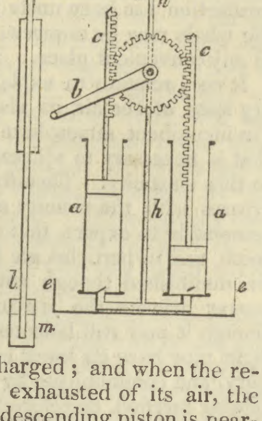
Fig. 20.



He was now assisted by Dr. Hooke, the most ingenious and inventive mechanic that the world has ever seen. This person made a great improvement on the air-pump, by applying two syringes AA, (fig. 19), whose pistons P and P′ are both worked by one wheel, O pitching in the racks or piston rods R and R′, the pistons being thus raised and depressed alternately by turning the winch W backwards and forwards. In the bottom of each of the barrels there is an opening communicating with the receiver or bell glass B, placed on the plate A, (fig. 20). Over these openings valves of oiled silk are so placed as to admit of the passage of the air from the receiver to the syringe or barrel, but to oppose its passage from the barrel to the receiver. Now, suppose either of the pistons to be at the bottom of its barrel, it is obvious, that on drawing it up a vacuum will be found in the lower portion of the barrel, until the air in the receiver, by its elastic force, opening the valve V or V′, rushes in, distributing itself equally betwixt the barrel and receiver, but as the pistons are furnished with valves P and P′ similar to and opening in the same direction as VV′; on the descent of the piston the air which occupies the space betwixt the piston and bottom of the barrel being prevented from returning to the receiver by the valve V or V′, opens the valve in the piston and escapes into the apartment, with the air of which the piston valve communicates. This evidently doubled the expedition of the pump's operation; but it also greatly diminished the labour of pumping; for it must be observed, that the piston P must be drawn up against the pressure of the external air, and when the rarefaction is nearly perfect, this requires a force of nearly fifteen pounds for every inch of the area of the piston. Now when one piston P is at the bottom of the barrel, the other P′ is at the top of the barrel, and the air below P′ is equally rare with that in the receiver. Therefore the pressure of the external air on the piston P′ is *nearly* equal to that on the piston P. Both, therefore, are acting in opposite directions on the wheel which gave them motion; and the force necessary for raising P is only the difference between the elasticity of the air in the barrel P, and that of the air in the barrel P′. This is very small in the beginning of the stroke, but gradually increases as the piston P′ descends, and becomes equal to the whole excess of the air's pressure above the elasticity of the remaining air of the receiver, when the air at P of the natural density begins to open the piston valves. An accurate attention to the circumstances will show us that the force requisite for working the pump is greatest at first, and gradually diminishes as the rarefaction advances; and when this is nearly complete, hardly any more force is required than what is necessary for overcoming the friction of the pistons, except during the discharge of the air at the end of each stroke. This is therefore the form of the air-pump which is most generally used over all Europe; though in the various modifications some traces of national prepossession remain. We shall give a description of Boyle's air-pump as finally improved by Hawkesbee, which, with some small accommodations to particular views, continued for many years the most approved form.

Hawkesbee's improvements

Fig. 21.



It consists of two brass barrels *a a*, (fig. 21.) twelve inches high, and two wide. The pistons are raised and depressed by turning the winch *b*. This is fastened to an axis passing through a strong toothed wheel, which lays hold of the teeth of the racks *c c*. Then the one is raised while the other is depressed; by which means the valves, which are made of limber bladder, fixed in the upper part of each piston, as well as in the openings into the bottom of the barrels, perform their office of discharging the air from the barrels, and admitting into them the air from the receiver to be afterwards discharged; and when the receiver comes to be pretty well exhausted of its air, the pressure of the atmosphere in the descending piston is nearly so great, that the power required to raise the other is little more than is necessary for overcoming the friction of the piston, which renders this pump preferable to all others, which require more force to work them as the rarefaction of the air in the receiver advances.

The barrels are set in a brass dish about two inches deep, filled with water or oil to prevent the insinuation of air. The barrels are screwed tight down by the nuts *e e*, which force the frontispiece *f f* down on them, through which the two pillars *g g* pass; for the sake of distinctness these are omitted in the figure.

From between the barrels rises a slender brass pipe *h h*, communicating with each by a perforation in the transverse piece of brass on which they stand. The upper end of this pipe communicates with another perforated piece of brass, which screws on underneath the plate *i i*, of ten inches diameter, and surrounded with a brass rim to prevent the shedding of water used in some experiments. This piece of brass has three branches. 1st, An horizontal one communicating with the conduit pipe *h h*. 2d, An upright one, screwed into the middle of the pump plate, and terminating in a small pipe *k*, rising about an inch above it. 3d, A perpendicular one, looking downwards in the continuation of the pipe *k*, and having a hollow screw in its end receiving the brass cap of the gage-pipe *l l*, which is of glass, thirty-four inches long, and immersed in a glass cistern *m* filled with mercury. This is covered a-top with a cork float, carrying the weight of a light wooden scale divided into inches, which are numbered from the surface of the mercury in the cistern. This scale will therefore rise and fall with the mercury in the cistern, and indicate the true elevation of that in the tube.

There is a stop-cock immediately above the insertion of the gage-pipe, by which its communication may be cut off. There is another at *n*, by which a communication is opened with the external air, for allowing its readmission; and there is sometimes another immediately within the insertion of the conduit-pipe for cutting off the communication between the receiver and the pump. This is particularly useful when the rarefaction is to be continued long, as there are by these means fewer chances of the insinuation of air by the many joints.

The receivers are made tight by simply setting them on the pump-plate, with a piece of wet or oiled leather between; and the receivers, which are open a-top, have a brass cover set on them in the same manner. In these covers there are various perforations and contrivances for various purposes. The one in the figure has a slip wire passing through a collar of oiled leather, having a hook or a screw in its lower end, for hanging any thing on, or producing a variety of motions.

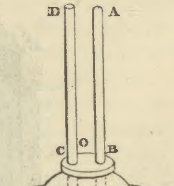
Sometimes the receivers are set on another plate, which has a pipe screwed into its middle, furnished with a stop-cock and a screw, which fits the middle pipe *k*. When the rarefaction has been made in it, the cock is shut, and then the whole may be unscrewed from the pump, and removed to any convenient place. This is called a *transporter plate.*

It only remains to explain the gage *ll*. In the ordinary state of the air, its elasticity balances the pressure of the incumbent atmosphere. We find this from the force that is necessary to squeeze it into less bulk in opposition to this elasticity. Therefore the elasticity of the air increases with the vicinity of its particles. It is therefore reasonable to expect, that when we allow it to occupy more room, and its particles are further asunder, its elasticity will be diminished though not annihilated; that is, it will no longer balance the WHOLE pressure of the atmosphere, though it may still balance part of it. If therefore an upright pipe have its lower end immersed in a vessel of mercury, and communicate by its upper end with a vessel containing rarefied, therefore less elastic air, we should expect that the pressure of the air will prevail, and force the mercury into the tube, and cause it to rise to such a height that the weight of the mercury, joined to the elasticity of the rarefied air acting on its upper surface, shall be exactly equal to the whole pressure of the atmosphere. The height of the mercury is the exact measure of that part of the whole pressure which is not balanced by the elasticity of the rarefied air, and its deficiency from the height of the mercury in the Toricellian tube is the exact measure of this remaining elasticity.

It is evident, therefore, that the pipe will be a scale of the elasticity of the remaining air, and will indicate in some sort the degree of rarefaction; for there must be some analogy between the density of the air and its elasticity; and we have no reason to imagine that they do not increase and diminish together, although we may be ignorant of the law, that is, of the change of elasticity corresponding to a known change of density. This is to be discovered by experiment; and the air-pump itself furnishes us with the best experiments for this purpose. After rarefying till the mercury in the gage has attained half the height of that in the Toricellian tube, shut the communication with the barrels and gage, and admit the water into the receiver. It will go in till all is again in equilibrio with the pressure of the atmosphere; that is, till the air in the receiver has collapsed into its natural bulk. This we can accurately measure, and compare with the whole capacity of the receiver; and thus obtain the precise degree of rarefaction corresponding to half the natural elasticity. We can do the same thing with the elasticity reduced to one-third, one-fourth, &c. and thus discover the whole law.

This gage must be considered as one of the most ingenious and convenient parts of Hawkesbee's pump; and it is well disposed, being in a situation protected against accidents; but it necessarily increases greatly the size of the machine, and cannot be applied to the table-pump represented in fig. 20. When it is wanted here, a small plate is added behind, or between the barrels and receiver; and on this is set a small tubulated (as it is termed) receiver, covering a common weather-glass tube. This receiver being rarefied along with the other, the pressure on the mercury in the cistern arising from the elasticity of the remaining air, is diminished so as to be no longer able to support the mercury at its full height; and it therefore descends till the height at which it stands puts it in equilibrio with the elasticity. In this form, therefore, the height of the mercury is directly a measure of the remaining elasticity; while in the other it measures the remaining unbalanced pressure of the atmosphere. But this gage is extremely cumbersome, and liable to accidents. We are seldom much interested in the rarefaction till it is great; a contracted form of this gage is therefore very useful, and was early used. A syphon ABCD (fig. 22.) each branch of which is about four inches long, close at A and open at D, is filled with boiling mercury till it occupies the branch AB, and a very small part of CD, having its surface at O. This is fixed to a small stand, and fixed into the receiver, along with the things that are to be exhibited in the rarefied air. When the air has been rarefied till its remaining elasticity is not able to support the column BA, the mercury descends in AB, and rises in CD, and the remaining elasticity will always be measured by the elevation of the mercury in AB above that in the leg CD. Could the exhaustion be perfected, the surfaces in both legs would be on a level. Another gage might be put into the same foot, having a small bubble of air at A. This would move from the beginning of the rarefaction; but our ignorance of the analogy between the density and elasticity hinders us from using it as a measure of either.

Fig. 22.



A complete exhaustion not effected by the air-pump.

It is enough for our present purpose to observe, that the barometer gage is a perfect indication and measure of the performance of an air-pump, and that a pump is, *cæteris paribus*, so much the more perfect, as it is able to raise the mercury higher in the gage. It is in this way that we discover that none can produce a complete exhaustion, and that their operation is only a very great rarefaction: for none can raise the mercury to that height at which it stands in the Toricellian tube, well purged of air. Few pumps will bring it within one-tenth of an inch. Hawkesbee's, fitted up according to his instructions, will seldom bring it within one-fifth. Pumps with cocks, when constructed according to the principles mentioned when speaking of the exhausting syringe, and new and in fine order, will in favourable circumstances bring it within one-fortieth. None with valves fitted up with wet leather, or when water or volatile fluids are allowed access into any part, will bring it nearer than one-fifth. Nay, a pump of the best kind, and in the finest order, will have its rarefying power reduced to the lowest standard, as measured by this gage, if we put into the receiver the tenth part of a square inch of white sheep-skin, fresh from the shops, or of any substance equally damp. This is a discovery made by means of the improved air-pump, and leads to very extensive and important consequences in general physics, some of which will be treated of under this article; and the observation is made thus early, that our readers may better understand the improvements which have been made on this celebrated machine.

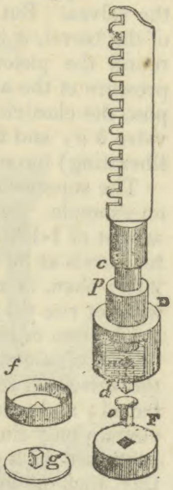
Various improvements of this machine.

It would require a volume to describe all the changes which have been made on it. An instrument of such multifarious use, and in the hands of curious men, each diving into the secrets of nature in his favourite line, must have received many alterations and real improvements in many particular respects. But these are beside our present purpose; which is to consider it merely as a machine for rarefying elastic or expansive fluids. We must therefore confine ourselves to this view of it; and shall carefully state to our readers every improvement founded on principle, and on pneumatical laws. All who used it perceived the limit set to the rarefaction by the resistance of the valves, and tried to perfect the construction of the cocks. The Abbé Nollet and s'Gravesande, two of the most eminent experimental philosophers in Europe, were the most successful.

s'Gravesande's improvement.

Mr. s'Gravesande justly preferred Hooke's plan of a double pump, and contrived an apparatus for turning the cocks by the motion of the pump's handle. This is far from either being simple or easy in working; and occasions great jerks and concussions in the whole machine. This, however, is not necessarily connected with the truly pneumatical improvement. His piston has no valve, and the rod is connected with it by a stirrup D (fig. 23), as in a common pump. The rod has a cylindric part *c p*, which passes through the stirrup, and has a stiff motion in it up and down of about half an inch; being stopped by the shoulder *c* above and the nut below. The round plate supported by this stirrup has a short square tube *n d*, which fits tight into the hole of a piece of cork F. The round plate E has a square shank *g*, which goes into the square tube *n d* A piece of thin leather *f*, soaked in oil, is put between the cork and the plate E, and another between the cork and the plate which forms the sole of the stirrup. All these pieces are screwed together to form the piston by the nail *e*, whose flat head covers the hole *n*. Suppose, therefore, the piston touching the bottom of the barrel, and the winch turning to raise it again, the friction of the piston on the barrel keeps it in its place, and the rod is drawn up through the stirrup D. Thus the wheel has liberty to turn about an inch; and this is sufficient for turning the cock, so as to cut off the communication with the external air, and to open the communication with the receiver. This being done, and the motion of the winch continued, the piston is raised to the top of the barrel. When the winch is turned in the opposite direction, the piston remains fixed till the cock is turned, so as to shut the communication with the receiver, and open that with the external air.

Fig. 23.



This is a pretty contrivance, and does not at first appear necessary; because the cocks might be made to turn at the beginning and end of the stroke without it. But this is just possible; and the smallest error of adjustment, or wearing of the apparatus, will cause them to be open at improper times. Besides, the cocks are not turned in an instant, and are improperly open during some very small time; but this contrivance completely obviates the difficulty.

The cock is precisely similar to that formerly described, having one perforation diametrically through it, and another entering at right angles to this, and after reaching the centre, it passes along the axis of the cock, and comes out to the open air.

Its inconveniences remedied.

It is evident, that by this construction of the cock, the ingenious improvement of Dr. Hooke, by which the pressure of the atmosphere on one piston is made to balance, in great part, the pressure on the other, is given up: for, whenever the communication with the air is opened, it rushes in, and immediately balances the pressure on the upper side of the piston in this barrel; so that the whole pressure in the other must be overcome by the person working the pump. Gravesande, aware of this, put a valve on the orifice of the cock; that is, tied a slip of wet bladder or oiled leather across it; and now the piston is pressed down, as long as the air in the barrel is rarer than the outward air, in the same manner as when the valve is in the piston itself.

This is all that is necessary to be described in Mr. s'Gravesande's air pump. Its performance is highly extolled by him, as far exceeding his former pumps with valves. The same preference was given to it by his successor Muschenbrock. But, while they both prepared the pistons and valves and leathers of the pump, by steeping them in oil, and then in a mixture of water and spirits of wine, we are certain that no just estimate could be made of its performance. For with this preparation it could not bring the gage within one-fifth of an inch of the barometer. We even see other limits to its rarefaction: from its construction, it is plain that a very considerable space is left between the piston and cock, not less than an inch, from which the air is never expelled; and if this be made extremely small, it is plain that the pump must be worked very slow, otherwise there will not be time for the air to diffuse itself from the receiver into the barrel, especially towards the end, when the expelling force, viz. the elasticity of the remaining air, is very small. There is also the same limit to the rarefaction, as in Hooke's or Hawkesbee's pump, opposed by the valve, which will not open till the air below the piston is considerably denser than the external air; and this pump soon lost any advantages it possessed when fresh from the workman's hands, by the cock's growing loose and admitting air. It is surprising that Gravesande omitted Hawkesbee's security against this, by placing the barrels in a dish filled with oil; which would effectually have prevented this inconvenience.

Advantage of short barrels.

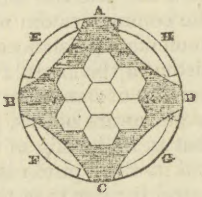
We must not omit a seemingly paradoxical observation of s'Gravesande, that in a pump constructed with valves, and worked with a determined uniform velocity, the required degree of rarefaction is sooner produced by short barrels than by long ones. It would require too much time to give a general demonstration of this, but it will easily be seen by an example. Suppose the long barrel to have equal capacity with the receiver, then at the end of the first stroke the air in the receiver will have one-half its natural density. Now, let the short barrrels have half this capacity: at the end of the first stroke the density of the air in the receiver is two-thirds, and at the end of the second stroke it is four-ninths, which is less than one-half, and the two strokes of the short barrel are supposed to be made in the same time with one of longest, &c.

The valve pump improved by Smeaton

Hawkesbee's pump maintained its pre-eminence without rival in Britain, till about the year 1750, when it engaged the attention of Mr. John Smeaton. He was then a maker of philosophical instruments, and made many attempts to perfect the pumps with cocks, but found, that whatever perfection he could bring them to, he could not enable them to preserve it; and he never would sell one of this construction. He therefore attached himself solely to the valve pumps.

The first thing was to diminish the resistance to the entry of the air from the receiver into the barrels; and this he rendered almost nothing, by enlarging the surface on which this feebly elastic air was to press. Instead of making these valves to open by its pressure on a circle of one-twentieth of an inch in diameter, he made the valve-hole one inch in diameter, enlarging the surface 400 times; and, to prevent this piece of thin leather from being burst by the great pressure on it, when the piston in its descent was approaching the bottom of the barrel, he supported it by a delicate but strong grating, dividing the valve-hole like the section of a honey-comb, as represented in fig. 24; and the ribs of this grating are seen edgewise in fig. 25, at *a b c*.

Fig. 24.



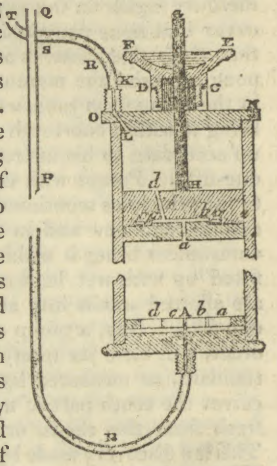
The valve was a piece of thin membrane or oiled silk, gently strained over the mouth of the valve-hole, and tied on by a fine silk thread wound round it in the same manner that the narrow slips had been tied on formerly. This done, he cut with a pointed knife the leather round the edge, nearly four quadrantal arcs, leaving a small tongue between each, as in fig. 24. The strained valve immediately shrinks inwards, as represented by the shaded parts; and the strain by which it is kept down is now greatly diminished, taking place only at the corners. The gratings being reduced nearly to an edge (but not quite, lest they should cut), there is very little pressure to produce adhesion by the clammy oil. Thus it appears, that a very small elasticity of the air in the receiver will be sufficient to raise the valve; and Mr. Smeaton found, that when it was not able to do this at first, when only about $\frac{1}{600}$ of the natural elasticity, it would do it after keeping the piston up eight or ten seconds, the air having been all the while undermining the valve, and gradually detaching it from the grating.

Unfortunately he could not follow this method with the piston valve. There was not room round the rod for such an expanded valve; and it would have obliged him to have a great space below the valve, from which he could not expel the air by the descent of the piston. His ingenuity hit on a way of increasing the expelling force through the common valve. He inclosed the rod of the piston in a collar of leather D C (fig. 25,) through which it moved freely without allowing any air to get past its sides. For greater security, the collar of leather was contained in a box terminating in a cup filled with oil. As this makes a material change in the principle of construction of the air-pump, and indeed of pneumatic engines in general, and as it has been adopted in all the subsequent attempts to improve them, it merits a particular consideration.

Structure of his piston.

The piston itself consists of two pieces of brass fastened by screws from below. The uppermost, which is of one solid piece with the rod GH (fig. 25), is of a diameter somewhat less than the barrel; so that when they are screwed together, a piece of leather soaked in a mixture of boiled oil and tallow, is put between them; and when the piston is thrust into the barrel from above, the leather comes up around the side of the piston, and fills the barrel, making the piston perfectly air-tight. The lower half of the piston projects upwards into the upper, which has a hollow *g b c d* to receive it. There is a small hole through the lower half at *a* to admit the air; and a hole *c d* in the upper half to let it through, and there is a slip of oiled silk strained across the hole *a* by way of valve, and there is room enough left at *b c* for this valve to rise a little when pressed from below. The rod GH passes through the piece of brass which forms the top of the barrel so as to move freely, but without any sensible shake: this top is formed into a hollow box, consisting of two pieces ECDF and CNOD, which screw together at CD. This box is filled with rings of oiled leather exactly fitted to its diameter, each having a hole in it for the rod to pass through. When the piece ECDF is screwed down, it compresses the leathers; squeezing them to the rod, so that no air can pass between them; and, to secure us against all ingress of air, the upper part is formed into a cup EF, which is kept filled with oil.

Fig. 25.



The top of the barrel is also pierced with a hole LK, which rises above the flat surface NO, and has a slip of oiled silk tied over it to act as a valve; opening when pressed from below, but shutting when pressed from above.

The communication between the barrel and receiver is made by means of the pipe ABPQ; and there goes from the hole K in the top of the barrel a pipe KRST, which either communicates with the open air or with the receiver, by means of the cock at its extremity T. The conduit pipe ABPQ has also a cock at Q, by which it is made to communicate either with the receiver or with the open air. These channels of communication are variously conducted and terminated, according to the views of the maker. The sketch in this figure is sufficient for explaining the principle, and is suited to the general form of the pump, as it has been frequently made by Nairne and other artists in London.

Superiority of this construction.

Let us now suppose the piston at the top of the barrel, that it applies to it all over, and that the air in the barrel is very much rarefied: In the common pump the piston valve is pressed hard down by the atmosphere, and continues shut till the piston gets far down, condenses the air below it beyond its natural state, and enables it to force up the valves. But here, as soon as the piston quits the top of the barrel, it leaves a void behind it; for no air gets in round the piston rod, and the valve at K is shut by the pressure of the atmosphere. There is nothing now to oppose the elasticity of the air below but the stiffness of the valve *b c*; and thus the expelling (or more accurately the liberating) force is prodigiously increased.

The superiority of this construction will be best seen by an example. Suppose the stiffness of the valve equal to the weight of 1-10th of an inch of mercury, when the barometer stands at 30 inches, and that the pump-gage stands at 29·9; then, in an ordinary pump, the valve in the piston will not rise till the piston has got within the 300th part of the bottom of the barrel, and it will leave the valve-hole filled with air of the ordinary density. But in this pump the valve will rise as soon as the piston quits the top of the barrel; and when it is quite down, the valve-hole *a* will contain only the 300th part of the air which it would have contained in a pump of the ordinary form. Suppose, farther, that the barrel is of equal capacity with the receiver.

and that both pumps are so badly constructed, that the space left below the piston is the 300th part of the barrel. In the common pump the piston valve will rise no more, and the rarefaction can be carried no farther, however delicate the barrel valve may be; but in this pump the next stroke will raise the gage to 29·95, and the piston valve will again rise as soon as the piston gets half way down the barrel.

The limit to the rarefaction by this pump depends chiefly on the space contained in the hole LK, and in the space *b c d* of the piston. When the piston is brought up to the top, and applied close to it, those spaces remain filled with air of the ordinary density, which will expand as the piston descends, and thus will retard the opening of the piston valve. The rarefaction will stop when the elasticity of this small quantity of air, expanded so as to fill the whole barrel (by the descent of the piston to the bottom), is just equal to the force requisite for opening the piston valve.

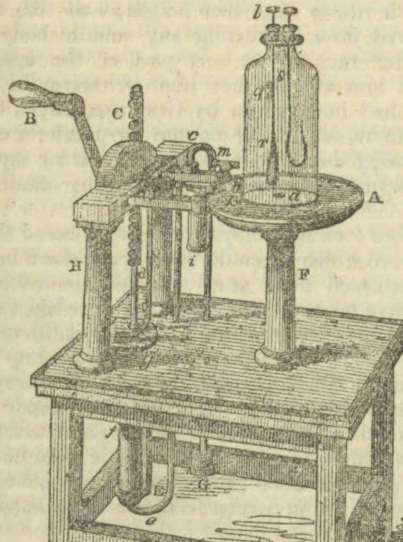
Another advantage attending this construction is, that in drawing up the piston, we are not resisted by the whole pressure of the air; because the air is rarefied above this piston as well as below it, and the piston is in precisely the same state of pressure as if connected with another piston in a double pump. The resistance to the ascent of the piston is the excess of the elasticity of the air above it over the elasticity of the air below; this, toward the end of the rarefaction, is very small, while the piston is near the bottom of the barrel, but gradually increases as the piston rises, and reduces the air above it into smaller dimensions, and becomes equal to the pressure of the atmosphere, when the air above the piston is of the common density. If we should raise the piston still farther, we must condense the air above it; but Mr. Smeaton has here made an issue for the air by a small hole in the top of the barrel, covered with a delicate valve. This allows the air to escape, and shuts again as soon as the piston begins to descend, leaving almost a perfect void behind it as before.

This pump has another advantage. It may be changed in a moment from a rarefying to a condensing engine, by simply turning the cocks at Q and T. Whilst T communicates with the open air and Q with the receiver, it is a rarefying engine or air-pump; but when T communicates with the receiver, and Q with the open air, it is a condensing engine.

Description of Smeaton's pump.

Fig. 26 represents Mr. Smeaton's air-pump as it was usually made by Nairne. Upon a solid base or table are set up three pillars F, H, H; the pillar F supports the pump-plate A, and the pillars H, H, support the front or head, containing a brass cog-wheel, which is turned by the handle B, and works in the rack C fastened to the upper end of the piston rod. The whole is still farther steadied by two pieces of brass *n* and *h*, which connect the pump-plate with the front, and have perforations communicating between the hole *a* in the middle of the plate and the barrel, as will be described immediately. DE is the barrel of the pump, firmly fixed to the table by screws through its upper flanch; *e f d c* is a slender brass tube screwed to the bottom of the barrel, and to the under side of the horizontal canal *n*. In this canal there is a cock *m*, which opens a communication between the barrel and the receiver, when the key is in the position represented here; but when the key is at right angles with this position, this communication is cut off. If that side of the key which is here drawn next to the pump-plate be turned outward, the external air is admitted into the receiver; but if turned inwards, the air is admitted into the barrel.

Fig. 26.



g h is another slender brass pipe, leading from the discharging valve at *g* to the horizontal canal *h k*, to the under side of which it is screwed fast. In this horizontal canal there is a cock *n* which opens a passage from the barrel to the receiver when the key is in the position here drawn; but opens a passage from the barrel to the external air when the key is turned outwards, and from the receiver to the external air when the key is turned inwards. This communication with the external air is not immediate but through a sort of box *i*; the use of this box is to receive the oil which is discharged through the top valve *g*. In order to keep the pump tight, and in working order, it is proper sometimes to pour a table-spoonful of olive oil into the hole *a* of the pump-plate, and then to work the pump. The oil goes along the conduit *b c d f e*, gets into the barrel and through the piston-valve, when the piston is pressed to the bottom of the barrel, and is then drawn up, and forced through the discharging valve *g* along the pipe *g h*, the horizontal passage *h n*, and finally into the box *i*. This box has a small hole in its side near the top, through which the air escapes.

From the upper side of the canal *n* there arises a slender pipe which bends outward and then turns downwards, and is joined to a small box, which cannot be seen in this view. From the bottom of this box proceeds downwards the gage-pipe of glass, which enters the cistern of mercury G fixed below.

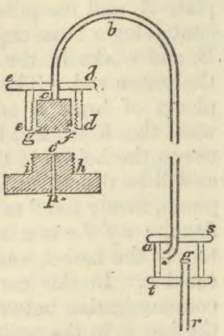
On the upper side of the other canal there is a small stud, having a short pipe of glass projecting horizontally from it, close by and parallel to the front piece of the pump, and reaching to the other canal. This pipe is close at the farther end, and has a small drop of mercury or oil in it. This serves as a gage in condensing, indicating the degree of condensation by the place of the drop; for this drop is forced along the pipe, condensing the air before it in the same degree that it is condensed in the barrel and receiver.

Method of joining together the different pipes, &c.

In constructing this pump, Mr. Smeaton introduced a method of joining together the different pipes and other pieces, which has great advantages over the usual manner of screwing them together with leather between, and which is now much used in hydraulic and pneumatic engines. We shall explain this to our readers by a description of the manner in which the exhausting gage is joined to the horizontal duct *c b*.

The piece *h i p*, in fig, 27, is the same with the little cylinder observable on the upper side of the horizontal canal *n*, in fig. 26. The upper part *h i* is formed into an outside screw, to fit the hollow screw of the piece *d e e d*. The top of this last piece has a hole in its middle, giving an easy passage to the bent tube *c b a*, so as to slip along it with freedom. To the end *c* of this bent tube is soldered a piece of brass *c f g*, perforated in continuation of the tube, and having its end ground flat on the top of the piece *h i p*, and also covered with a slip of thin leather strained across it and pierced with a hole in the middle.

Fig. 27.



It is plain from this form, that if the surface *f g* be applied to the top of *h i*, and the cover *d e e d* be screwed down on it, it will draw or press them together, so that no air can escape by the joint, and this without turning the whole tube *c b a* round, as is necessary in the usual way. This method is now adopted for joining together the conducting pipes of the machines for extinguishing fires, an operation which was extremely troublesome before this improvement.

The conduit pipe E *e f c* (fig. 26), is fastened to the bottom of the barrel, and the discharging pipe *g h* to its top, in the same manner. But to return to the gage; the bent pipe *c b a* (fig. 27), enters the box *s t* near one side, and obliquely, and the gage-pipe *q r* is inserted through its bottom towards the opposite side. The use of this box is to catch any drops of mercury which may sometimes be dashed up through the gage-pipe by an accidental oscillation. This, by going through the passages of the pump, would corrode them, and would act particularly on the joints, which are generally soldered with tin. When this happens to an air-pump, it must be cleaned with the most scrupulous attention, otherwise it will be quickly destroyed.

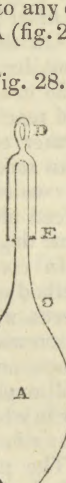
Great powers of this pump.

This account of Smeaton's pump is sufficient for enabling the reader to understand its operation and to see its superiority. It is reckoned a very fine pump of the ordinary construction which will rarefy 200 times, or raise the gage to 29·85, the barometer standing at 30. But Mr. Smeaton found, that his pump, even after long using, raised it to 29·95, which we consider as equivalent to rarefying 600 times. When in fine order, he found no bounds to its rarefaction, frequently raising the gage as high as the barometer; and he thought its performance so perfect,[1] that the barometer-gage was not sufficiently delicate for measuring the rarefaction. He therefore substituted the syphon-gage already described, which he gives some reasons for preferring; but even this he found not sufficiently sensible.

Another contrivance of Smeaton's.

He contrived another, which could be carried to any degree of sensibility. It consisted of a glass body A (fig. 28), of a pear shape, and was therefore called the pear-gage. This had a small projecting orifice at B, and at the other end a tube CD, whose capacity was the hundredth part of the capacity of the whole vessel. This was suspended at the slip-wire of the receiver, and there was set below it a small cup with mercury. When the pump was worked, the air in the pear-gage was rarefied along with the rest. When the rarefaction was brought to the degree intended, the gage was let down till B reached the bottom of the mercury. The external air being now let in, the mercury was raised into the pear, and stood at some height E in the tube CD. The length of this tube being divided into 100 parts, and those numbered from D, it is evident that $\frac{DE}{DB}$ will express the degree of rarefaction which had been produced when the gage was immersed into the mercury; or if DC be $\frac{1}{100}$ of the whole capacity, and be divided into 100 parts by a scale annexed to it, each unit of the scale will be $\frac{1}{10000}$ of the whole.

Fig. 28.



This was a very ingenious contrivance, and has been the means of making some very curious and important discoveries. By this gage Mr. Smeaton found, that his pump frequently rarefied a thousand, ten thousand, nay, an hundred thousand times. But though he in every instance saw the great superiority of his pump above all others, he frequently found irregularities which he could not explain, and a want of correspondence between the pear and the barometer gages which puzzled him. The pear-gage frequently indicated a prodigious rarefaction, when the barometer-gage would not show more than 600.

These unaccountable phenomena excited the curiosity of philosophers, who by this time were making continual use of the air-pump in their meteorological researches, and much interested in everything connected with the state or constitution of elastic fluids. Mr. Nairne, a most ingenious and accurate maker of philosophical instruments, made many curious experiments in the examination and comparison of Mr. Smeaton's pump with those of the usual construction, attending to every circumstance which could contribute to the inferiority of the common pumps or to their improvement, so as to bring them nearer to this rival machine. This rigorous comparison brought into view several circumstances in the constitution of the atmospheric air, and its relation to other bodies, which are of the most extensive and important influence in the operations of nature. We shall notice at present such only as have a relation to the operation of the air-pump in extracting AIR from the receiver.

Experiments wit it by Mr. Nairne.

Mr. Nairne found, that when a little water, or even a bit of paper damped with water, was exposed under the receiver of Mr. Smeaton's air-pump, when in the most perfect condition, raising the mercury in the barometer-gage to 29·95, he could not make it rise above 29·8 if Fahrenheit's thermometer indicated the temperature 47°, nor above 29·7 if the thermometer stood at 55°; and that to bring the gage to this height and keep it there, the operation of the pump must be continued for a long time after the water had disappeared or the paper become perfectly dry. He found that a drop of spirits, or paper moistened with spirits, could not in those circumstances allow the mercury in the gage to rise to near that height; and that similar effects followed from admittting any volatile body whatever into the receiver or any part of the apparatus. This showed him at once how improper were the directions which had been given by Guericke, Boyle, Gravesande, and others, for fitting up the air-pump for experiment, by soaking the leather in water, covering the joints with water, or in short, admitting water or any volatile body near it.

He therefore took his pumps to pieces, cleared them of all the moisture which he could drive from them by heat, and then leathered them anew with leather soaked in a mixture of olive oil and tallow, from which he had expelled all the water it usually contains, by boiling it till the first frothing was over. When the pumps were fitted up in this manner, he uniformly found that Mr. Smeaton's pump rarefied the gage to 29·95, and the best common pump to 29·87, the first of which he computed to indicate a rarefaction to 600, and the other to 230. But in this state he again found that a piece of damp paper, leather, wood, &c. in the receiver, reduced the performance in the same manner as before.

Remarkable phenomenon.

But the most remarkable phenomenon was, that when he made use of the pear-gage with the pump cleared from all moisture, it indicated the same degree of rarefaction with the barometer-gage; but when he exposed a bit of paper moistened with spirits, and thus reduced the rarefaction of the pump to what he called 50, the barometer-gage standing at 29·4, the pear-gage indicated a rarefaction exceeding 100,000. In short, it was not measurable; and this phenomenon was almost constant. Whenever he exposed any substance susceptible of evaporation, he found the rarefaction indicated by the barometer-gage greatly reduced, whilst that indicated by the pear-gage was prodigiously increased; and both these effects were the more remarkable as the subject was of easier evaporation, or the temperament of the air of the chamber was warmer.

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[1] This can only be explained by supposing that Mr. Smeaton employed an imperfect barometer.

This uniform result suggested the true cause. Water boils at the temperature of 212°, that is, it is then converted into a vapour which is permanently elastic while of that temperature, and its elasticity balances the pressure of the atmosphere. If this pressure be diminished by rarefying the air above it, a low temperature will not allow it to be converted into elastic vapour, and keep it in that state. Water will boil in the receiver of an air-pump at the temperature of 96°, or even under it. Philosophers did not think of examining the state of the vapour in temperatures lower than what produced ebullition. But it now appears, that in much lower heats than this the superficial water is converted into elastic vapour, which continues to exhale from it as long as the water lasts, and, supplying the place of air in the receiver, exerts the same elasticity, and hinders the mercury from rising in the gage in the same manner as so much air of equal elasticity would have done.

Experiments illustrative of this account.

When Mr. Nairne was exhibiting these experiments to the Hon. Henry Cavendish in 1770, this gentleman informed him that it appeared from a series of experiments of his father Lord Charles Cavendish, that when water is of the temperature 72°, it is converted into vapour, under any pressure less than three-fourths of an inch of mercury, and at 41° it becomes vapour when the pressure is less than one-fourth of an inch: even mercury evaporates in this manner when all pressure is removed. A dewy appearance is frequently observed covering the inside of the tube of a barometer, where we usually suppose a vacuum. This dew, when viewed through a microscope, appears to be a set of detached globules of mercury, and upon inclining the tube so that the mercury may ascend along it, these globules will be all licked up, and the tube become clear. The dew which lined it was the vapour of the mercury condensed by the side of the tube; and it is never observed but when one side is exposed to a stream of cold air from a window, &c.

To return to the vapour in the air-pump receiver; it must be observed, that as long as the water continues to yield it, we may continue to work the pump; and it will be continually abstracted by the barrels, and discharged in the form of water, because it collapses as soon as exposed to the external pressure. All this while the gage will not indicate any more rarefaction, because the thing immediately indicated by the barometer-gage is *diminished elasticity*, which does not happen here. When all the water which the temperature of the room can keep elastic has evaporated under a certain pressure, suppose half an inch of mercury, the gage standing at 29·5, the vapour which now fills the receiver expands, and by its diminished elasticity the gage rises, and now some more water which had been attached to bodies by chemical or corpuscular attraction is detached, and a new supply continues to support the gage at a greater height; and this goes on continually till *almost* all has been abstracted. But there will remain some which no art can take away; for as it passes through the barrels, and gets between the piston and the top, it successively collapses into water during the ascent of the piston, and again expands into vapour when we push the piston down again. Whenever this happens there is an end of the rarefaction.

Air and vapour not uniformly mixed together.

Whilst this operation is going on, the air comes out along with the vapour; but we cannot say in what proportion. If it were always uniformly mixed with the vapour, it would diminish rapidly; but this does not appear to be the case. There is a certain period of rarefaction in which a transient cloudiness is perceived in the receiver. This is watery vapour formed at that degree of rarefaction, mingled with, but not dissolved in or united with, the air, otherwise it would be transparent. A similar cloud will appear if damp air be admitted suddenly into an exhausted receiver. The vapour, which formed an uniform transparent mass with the air, is either suddenly expanded and thus detached from the other ingredient, or is suddenly let go by the air, which expands more than it does. We cannot affirm with probability which of these is the case. Different compositions of air, that is, air loaded with vapours from different substances, exhibit remarkable differences in this respect. But we see from this and other phenomena, which shall be mentioned in their proper places, that the air and vapour are not always intimately united; and therefore will not always be drawn out together by the air-pump. But let them be ever so confusedly blended, we see that the air must come out along with the vapour, and its quantity remaining in the receiver must be prodigiously diminished by this association, probably much more than could be, had the receiver only contained pure air.

Consequences of this.

Let us now consider what must happen in the pear-gage. As the air and vapour are continually drawn off from the receiver, the air in the pear expands and goes off with it. We shall suppose that the generated vapour hinders the gage from rising beyond 29·5. During the continued working of the pump, the air in the pear, whose elasticity is 0·5, slowly mixes with the vapour at the mouth of the pear, and the mixture even advances into its inside, so that if the pumping be long enough continued, what is in the pear is nearly of the same composition with what is in the receiver, consisting perhaps of 20 parts of vapour and one part of air, all of the elasticity of 0·5. When the pear is plunged into the mercury, and the external air allowed to get into the receiver, the mercury rises in the pear-gage, and leaves not $\frac{1}{60}$, but $\frac{1}{60 \times 20}$ or $\frac{1}{1200}$ of it filled with common air, the vapour having collapsed into an invisible atom of water. Thus the pear-gage will indicate a rarefaction of 1200, while the barometer-gage only showed 60, that is, showed the elasticity of the included substance diminished 60 times. The conclusion to be drawn from these two measures (the one of the rarefaction of air, and the other of the diminution of elasticity) is, that the matter with which the receiver was filled, immediately before the readmission of the air, consisted of one part of incondensible air, and $\frac{1200}{60}$, or 20 parts of watery vapour.

Difficulty in accounting for some of these.

The only obscure part of this account is what relates to the composition of the matter which filled the pear-gage before the admission of the mercury. It is not easy to see how the vapour of the receiver comes in by a narrow mouth while the air is coming out by the same passage. Accordingly it requires a very long time to produce this extreme rarefaction in the pear-gage; and there are great irregularities in any two succeeding experiments, as may be seen by looking at Mr. Nairne's account of them.[1] Some vapours appear to have mixed much more readily with the air than others; and there are some unaccountable cases where vitriolic acid and sulphureous bodies were included, in which the dimunition of density indicated by the pear-gage was uniformly less than the diminution of elasticity indicated by the barometer-gage. It is enough for us at present to have established, by unquestionable facts, this production of elastic vapour, and the necessity of attending to it, both in the construction of the air-pump, and in drawing results from experiments exhibited in it.

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[1] *Phil. Trans.* vol. lxvii.

Two new improvements.

Mr. Smeaton's pump, when in good order, and perfectly free from all moisture, will in dry weather rarefy air about 600 times, raising the barometer-gage to within $\frac{1}{20}$th of an inch of a fine barometer. This was a performance so much superior to that of all others, and by means of Mr. Nairne's experiments opened so new a field of observation, that the air-pumps once more became a capital instrument among the experimental philosophers. The causes of its superiority were also so distinct, that artists were immediately excited to a farther improvement of the machine ; so that this becomes a new epoch in its history.

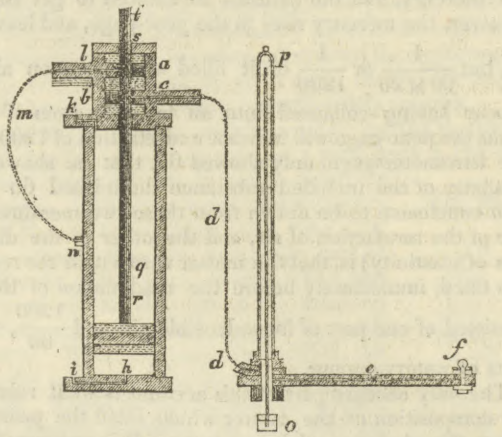
Improvements in this pump attempted.

There is one imperfection which Mr. Smeaton has not attempted to remove. The discharging valve is still opened against the pressure of the atmosphere. An author of the Swedish academy adds a subsidiary pump to this valve, which exhausts the air from above it, and thus puts it in the situation of the piston valve. We do not find that this improvement has been adopted so as to become general. Indeed the quantity of air which remains in the passage to this valve is so exceedingly little, that it does not seem to merit attention. Supposing the valve hole $\frac{1}{20}$th of an inch wide and as deep (and it need not be more), it will not occupy more than $\frac{1}{9000}$th part of a barrel twelve inches long and two inches wide.

Mr. Smeaton, by his ingenious construction, has greatly diminished, but has not annihilated, the obstructions to the passage of the air from the receiver into the barrel. His success encouraged farther attempts. One of the first and most ingenious was that of Professor Russell of the University of Edinburgh, who, about the year 1770, constructed a pump in which both cocks and valves were avoided.

The piston is solid, as represented in fig. 28, and its rod passes through a collar of leather on the top of the barrel. This collar is divided into three portions by two brass rings *a*, *b*, which leave a very small space round the piston rod. The upper ring *a* communicates by means of a lateral perforation with the bent tube, *l m n*, which enters the barrel at its middle *n*. The lower ring *b* communicates with the bent tube *c d*, which communicates with the horizontal passage *d e* going to the middle *e* of the pump plate. By the way, however, it communicates also with a barometer gage *p o*, standing in a cistern of mercury *o*, and covered with a glass tube close at the top. Beyond *e*, on the opposite circumference of the receiver plate, there is a cock or plug *f* communicating with the atmosphere.

Fig. 28.



The piston rod is closely embraced by the three collars of leather ; but, as already said, has a free space round it in the two brass rings. To produce this pressure of the leathers to the rod, the brass rings which separate them are turned thinner on the inner side, so that their cross section along a diameter would be a taper wedge. In the side of the piston rod are two cavities *q r*, *t s*, about one-tenth of an inch wide and deep, and of a length equal to the thickness of the two rings *a b*, and the intermediate collar of leathers. These cavities are so placed on the piston-rod, that when the piston is applied to the bottom of the barrel, the cavity *t s* in the upper end of the rod has its upper end opposite to the ring *a*, and its lower end opposite to the ring *b*, or to the mouth of the pipe *c d*. Therefore, if there be a void in the barrel, the air from the receiver will come from the pipe *c d*, into the cavity in the piston-rod, and by it will get past the collar of leather between the rings, and thus will get into the small interstice between the rod and the upper ring, and then into the pipe *l m n*, and into the empty barrel. When the piston is drawn up, the solid rod immediately shuts up this passage, and the piston drives the air through the discharging valve *k*. When it has reached the top of the barrel, and is closely applied to it, the cavity *q r* is in the situation in which *t s* formerly was, and the communication is again opened between the receiver and the empty barrel, and the air is again diffused between them. Pushing down the piston expels the air by the lower discharging pipe and valve *h i*; and thus the operation may be continued.

This must be acknowledged to be a most simple and ingenious construction, and can neither be called a cock nor a valve. It seems to oppose no obstruction whatever ; and it has the superior advantage of rarefying both during the ascent and the descent of the piston, doubling the expedition of the performance, and the operator is not opposed by the pressure of the atmosphere except towards the end of each stroke. The expedition, however, is not so great as one should expect ; for nothing is going on while the piston is in motion, and the operator must stop a while at the end of each stroke, that the air may have time to come through this long, narrow, and crooked passage, to fill the barrel. But the chief difficulty which occurred in the execution arose from the clammy oil with which it was necessary to impregnate the collar of leathers. These were always in a state of strong compression, that they might closely grasp the piston rod, and prevent all passage of air during the motion of the piston. Whenever therefore the cavities in the piston rod come into the situations necessary for connecting the receiver and barrel, this oil is squeezed into them, and choaks them up. Hence it always happened that it was some time after the stroke before the air could force its way round the piston rod, carrying with it the clammy oil which choaked up the tube *l m n;* and when the rarefaction had proceeded a certain length, the diminished elasticity of the air was not able to make its way through these obstructions.

Mr. Cavallo[1] has given the description of an air-pump contrived and executed by Messrs Hans and Hurter, instrument makers in London, where these artists revived Guericke's method of opening the barrel-valve during the last strokes of the pump by a force acting from without. We shall insert as much of this description as relates to the distinguishing circumstance of its construction.

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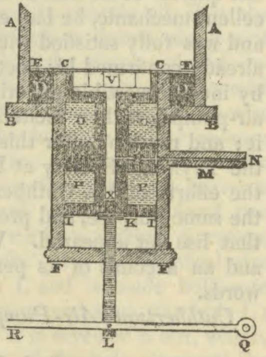
[1] *Phil. Trans.* vol. lxxiii.

Fig. 29 represents a section of the bottom of the barrel, where AA is the barrel, and BB the bottom, which has in its middle a hollow cylinder CCFF, projecting about half an inch into the barrel at CC, and extending a good way downwards to FF. The space between this projection and the sides of the barrel is filled up by a brass ring DD, over the top of which is strained a piece of oiled silk EE, which performs the office of a valve, covering the hole CC. But this hole is filled up by a piece of brass, or rather an assemblage of pieces screwed together GG, HH, II. It consists of three projecting fillets or shoulders GG, HH, II, which form two hollows between them, and which are filled with rings of oiled leather OO, PP, firmly screwed together. The extreme fillets GG, II, are of equal diameter with the inside of the cylinder, so as to fill it exactly, and the whole stuffed with oiled leather, slide up and down without allowing any air to pass. The middle fillet HH is not so broad, but thicker. In the upper fillet GG there is formed a shallow dish about $\frac{1}{8}$ of an inch deep and $\frac{3}{4}$ wide. This dish is covered with a thin plate, pierced with a grating like Mr. Smeaton's valve plate. There is a perforation VX along the axis of this piece, which has a passage out at one side H, through the middle fillet. Opposite to this passage, and in the side of the cylinder CC,FF, is a hole M, communicating with the conduit pipe MN, which leads to the receiver. Into the lower end of the perforation is screwed the pin KL, whose tail L passes through the cap FF. The tail L is connected with a lever RQ, moveable round the joint Q. This lever is pushed upwards by a spring, and thus the whole piece which we have been describing is kept in contact with the slip of oiled silk or valve EE. This is the usual situation of things.

Fig. 29.



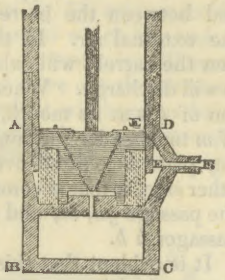
Now suppose a void formed in the barrel by drawing up the piston; the elasticity of the air in the receiver, in the pipe MN, and in the passage XV, will press on the great surface of the valve exposed through the grating, will raise it, and the pump will perform precisely as Mr. Smeaton's does. But suppose the rarefaction to have been so long continued, that the air is no longer able to raise the valve; this will be seen by the mercury rising no more in the pump-gage. When this is perceived, the operator must press with his foot on the end R of the lever RQ. This draws down the pin KL, and with it the whole hollow plug with its grated top. And thus, instead of raising the valve from its plate, the plate is here drawn down from the valve. The air now gets in without any obstruction whatever, and the rarefaction proceeds as long as the piston rises. When it is at the top of the barrel, the operator takes his foot from the lever, and the spring presses up the plug again and shuts the valve. The piston rod passes through a collar of leather, as in Mr. Smeaton's pump, and the air is finally discharged through an outward valve in the top of the barrel. These parts have nothing peculiar in them.

This is an ingenious contrivance, similar to what was adapted by Guericke himself; and we have no doubt of these pumps performing extremely well if carefully made; and it seems not difficult to keep the plug perfectly air-tight by supplying plenty of oil to the leathers. We cannot say, however, with precision, what may be expected from it, as no account has been given of its effects, besides what Mr. Cavallo published in the *Philosophical Transactions* for 1783, where he only says, that when it had been long used, it had, in the course of some experiments, rarefied 600 times.

Prince.

Aiming still at the removing the obstructions to the entry of the air from the receiver into the barrels, Mr. Prince, an American, has constructed a pump in which there is no valve or cock whatever between them. In this pump the piston rod passes through a collar of leather, and the air is finally discharged through a valve, as in the two last. But we are chiefly to attend, in this place, to the communication between the barrel and the receiver. The barrel widens below into a sort of cistern ABCD, communicating with the receiver by the pipe EF. As soon, therefore, as the piston gets into this wider part, where there is a vacancy all round it, the air of the receiver expands freely through the passage FEE into the barrel, in which the descent of the piston had made a void. When the piston is again drawn up, as soon as it gets into the cylindric part of the barrel, which it exactly fills, it carries up the air before it, and expels it by the top valve; and, that this may be done more completely, this valve opens into a second barrel or air-pump whose piston is rising at the same time, and therefore the valve of communication (which is the discharging valve of the primary pump) opens with the same facility as Mr. Smeaton's piston valve. While the piston is rising, the air in the receiver expands into the barrel; and when the piston descends, the air in the barrel again collapses till the piston gets again into the cistern, when the air passes out, and fills the evacuated barrel, to be expelled by the piston as before.

Fig. 30.



No distinct account has yet been given of the performance of this pump. We only learn that great inconveniences were experienced from the oscillations of the mercury in the gage. As soon as the piston comes into the cistern, the air from the receiver immediately rushes into the barrel, and the mercury shoots up in the gage, and gets into a state of oscillation. The subsequent rise of the piston will frequently keep time with the second oscillation, and increase it. The descent of the piston produces a downward oscillation, by allowing the air below it to collapse; and by improperly timing the strokes, this oscillation becomes so great as to make the mercury enter the pump. To prevent this, and a greater irregularity of working as a condenser, valves were put in the piston; but as these require force to open them, the addition seemed rather to increase the evil, by rendering the oscillations more simultaneous with the ordinary rate of working.

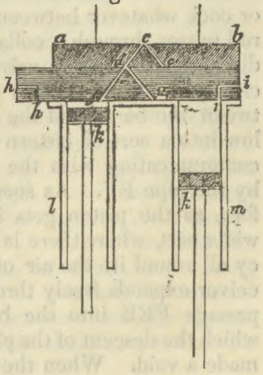
It appears, however, of very difficult execution. It has many long, slender, and crooked passages, which must be drilled through broad plates of brass, some of them appearing scarcely practicable. It is rare to find plates and other pieces of brass without air-holes, which it would be very difficult to find out and to close; and it must be very difficult to clear it of obstructions; so that it appears rather a suggestion of theory than a thing warranted by its actual performance.

Lavoisier.

M. Lavoisier, or some of the naturalists who were occupied in concert with him in the investigation of the different species of gas which are disengaged from bodies in the course of chemical operations, contrived an air-pump which has great appearance of simplicity, and, being very different from all others, deserves to be taken notice of.

It consists of two barrels *l m*, (fig. 31) with solid pistons *k k*. The pump plate *a b*, is pierced at its centre *c* with a hole which branches towards each of the barrels, as represented by *c d*, *c e*. Between the plate and the barrels slides another plate *h i*, pierced in the middle with a branched hole *f d g*, and near the ends with two holes *h h*, *i i*, which go from its under side to the ends. The holes in these two plates are so adjusted, that when the plate *h i* is drawn so far towards *h* that the hole *i* comes within the barrel *m*, the branch *d f* of the hole in the middle plate coincides with the branch *cd* of the upper plate, and the holes *e g* are shut. Thus a communication is established between the barrel *l* and the receiver on the pump-plate, and between the barrel *m* and the external air. In this situation the barrel *l* will exhaust, and *m* will discharge. When the piston of *l* is at its mouth, and that of *m* touches its bottom, the sliding plate is shifted over to the other side, so that *m* communicates with the receiver through the passage *gd*, *ec*, and *l* communicates with the air by the passages *h h*.

Fig. 31.



It is evident that this sliding plate performs the office of four cocks in a very beautiful and simple manner, and that if the pistons apply close to the ends of the barrels so as to expel the whole air, the pump will be perfect. It works, indeed, against the whole pressure of the external air. But this may be avoided by putting valves on the holes *h i*; and these can do no harm, because the air remaining in them never gets back into the barrel till the piston be at the farther end, and the exhaustion of that stroke completed. But the best workmen of London think that it will be incomparably more difficult to execute this cock (for it is a cock of an unusual form), in such a manner that it shall be air-tight and yet move with tolerable ease, and that it is much more liable to wearing loose than common cocks. No accurate accounts have been received of its performance. It must be acknowledged to be ingenious, and it may suggest to an intelligent artist a method of combining common conical cocks upon one axis so as to answer the same purposes much more effectually; for which reason we have inserted it here.

Cuthbertson.

The last improvement which we shall mention, is that published by Mr. Cuthbertson. His pump has given such evidences of its perfection, that we can hardly expect or wish for any thing more complete. But we must be allowed to observe, beforehand, that the same construction was invented, and in part executed, before the end of 1779, by Dr. Daniel Rutherford, then professor of botany in the University of Edinburgh, who was at that time engaged in experiments on the production of air during the combustion of bodies in contact with nitre, and who was vastly desirous of procuring a more complete abstraction of pure aerial matter than could be effected by Mr. Smeaton's pump. The compiler of this article had then an opportunity of perusing the Doctor's dissertation on this subject, which was read in the Philosophical Society of Edinburgh. In this dissertation he appears fully apprised of the existence of pure vital air in the nitrous acid, as its chief ingredient, and as the cause of its most remarkable phenomena, and to want but a step to the discoveries which have ennobled the name of M. Lavoisier. He was particularly anxious to obtain *apart* this distinguishing ingredient in its composition, and, for this purpose, to abstract completely from the vessel in which he subjected it to examination, every particle of elastic matter. The writer of this article proposed to him to cover the bottom of Mr. Smeaton's piston with some clammy matter, which should take hold of the bottom valve, and *start it* when the piston is drawn up. A few days after, the Doctor showed him a drawing of a pump, having a conical metal valve in the bottom, furnished with a long slender wire, sliding in the inside of the piston-rod with a gentle friction, sufficient for lifting the valve, and secured against all chance of failure by a spring a-top, which took hold of a notch in the inside of the piston-rod about a quarter of an inch from the lower end, so as certainly to lift the valve during the last quarter of an inch of the piston's motion. Being an excellent mechanic, he had executed a valve on this principle, and was fully satisfied with its performance. But having already confirmed his doctrines respecting the nitrous acid by incontrovertible experiments, his wishes to improve the air-pump lost their incitement, and he thought no more of it; and not long after this the ardour of the philosophers of the Teylerian Society at Haerlem and Amsterdam excited the efforts of Mr. Cuthbertson, their instrument maker, to the same purpose, and produced the most perfect air-pump that has yet appeared. We shall give a description of it, and an account of its performance, in the inventor's own words.

Cuthbertson's Air-Pump.—On fig. 32 is a perspective view of Cuthbertson's pump, with its two principal gages screwed into their places. These need not be used together, except in cases where the utmost exactness is required. In common experiments one of them is removed, and a stop-screw put in its place. When the pear-gage is used, a small round plate, on which the receiver may stand, must be first screwed into the hole at A; but this hole is stopped on other occasions with a screw. When all the three gages are used, and the receiver is exhausted, the stop-screw B, at the bottom of the pump, must be unscrewed, to admit the air into the receiver; but when they are not all used, either of the other stop-screws will answer this purpose.

Fig. 32.

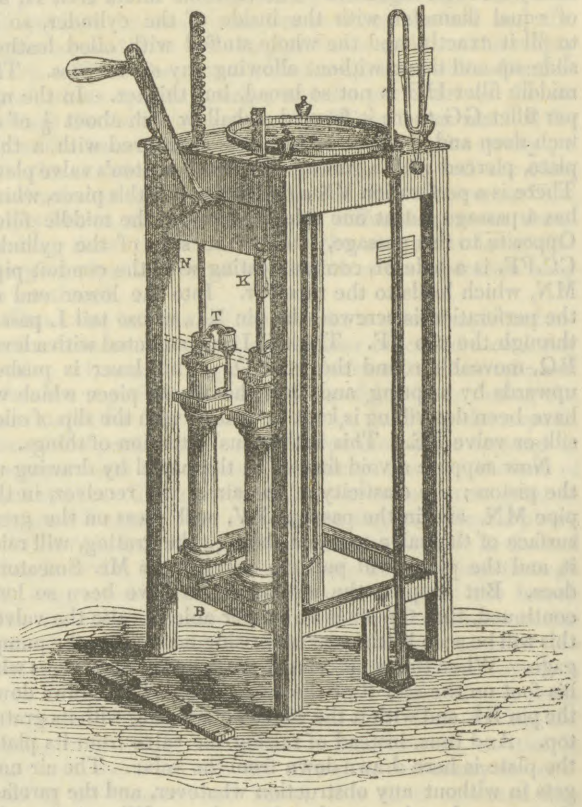


Fig 33 represents a cross bar for preventing the barrels from being shaken by working the pump or by any accident. Its place in fig. 32 is represented by the dotted lines.

Fig. 33.

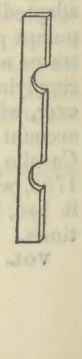


Fig. 34 is a section of one of the barrels, with all its internal parts; and figs. 35, 36, 37, and 38, are different parts of the piston, proportioned in size to one another.[1]

In fig. 34 CD represents the barrel, F the collar of leathers, G a hollow cylindrical vessel to contain oil, R is also an oil-vessel to receive the oil which is drawn, along with the air, through the hole *a a*, when the piston is drawn upwards; and, when this is full, the oil is carried over with the air, along the tube T, into the oil-vessel G, *c c* is a wire which is driven upwards from the hole *a a* by the passage of the air; and as soon as this has escaped, it falls down again by its own weight, shuts up the hole, and prevents all return of the air into the barrel. At *d d* are fixed two pieces of brass, to keep the wire *c c* in a vertical direction, that it may accurately shut the hole. H is a cylindrical wire or rod which carries the piston I, and is made hollow to receive a long wire *g g*, which opens and shuts the hole L; and on the other end of the wire O is screwed a nut, which, by stopping in the narrowest part of the hole, prevents the wire from being driven up too far. This wire and screw are more clearly seen in figs. 35 and 39; they slide in a collar of leather *r*, figs. 35 and 38, in the middle piece of the piston. Figs. 37 and 38 are the two main parts which compose the piston, and when the pieces 36 and 39 are added to it the whole is represented by fig. 35. Fig. 38 is a piece of brass of a conical form, with a shoulder at the bottom. A long hollow screw is cut in it, about two-thirds of its length, and the remainder of the hole, in which there is no screw, is of about the same diameter with the screwed part, except a thin plate at the end, which is of a width exactly equal to the thickness of *g g*, fig. 34. That part of the inside of the conical brass in which no thread is cut, is filled with oiled leathers with holes through which *g g* can slide stifly. There is also a male screw with a hole in it, fitted to *g g*, serving to compress the leathers *r*. In fig. 37, *a a a a* is the outside of the piston, the inside of which is turned so as exactly to fit the outside of fig. 38; *b b* are round leathers about 60 in number, *c c* is a circular piece of brass of the size of the leathers, and *d d* is a screw serving to compress them. The screw at the end of fig. 36 is made to fit the screw in fig. 38. Now if fig. 39 be pushed into fig. 38, this into fig. 37, and fig. 36 be screwed into the end of fig. 38, these will compose the whole of the piston, as represented in fig. 34. H, in fig. 34, represents the same part as H in fig. 35, and is that to which the rack is fixed. If, therefore, this be drawn upwards, it will cause fig. 38 to shut close into fig. 37, and drive out the air above it; and when it is pushed downwards it will open as far as the shoulder *a a* will permit, and suffer air to pass through. AA (fig. 40) is the receiver plate, BB is a long square piece of brass, screwed into the under side of the plate, through which a hole is drilled corresponding to that in the centre of the receiver-plates and with three female screws *a*, *b*, *c*.

Fig. 34.

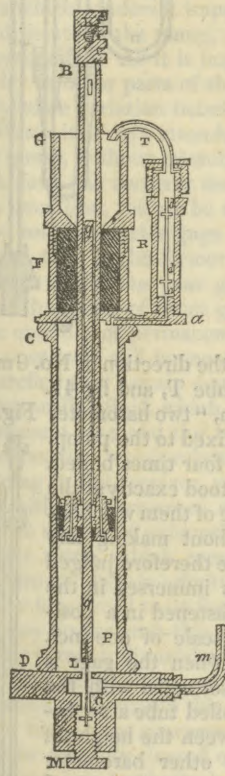


Fig. 35.

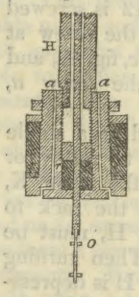


Fig. 36.

Fig. 37.

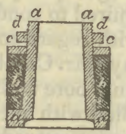


Fig. 38.

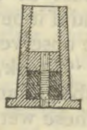
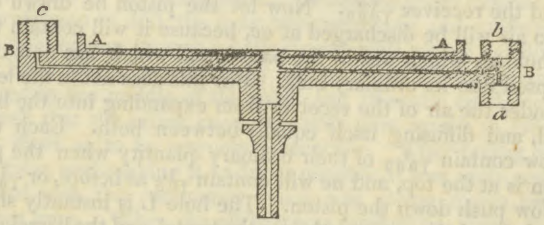


Fig 39.

Fig. 40.



The rarefaction of the air in the receiver is effected as follows. Suppose the piston at the bottom of the barrel. The inside of the barrel, from the top of the piston to *a*, (fig. 34) contains common air. When the rod is drawn up, the outer part of the piston sticks fast in the barrel till the conical part connected with the rod shuts the conical hole, and its shoulder applies close to its bottom. The piston is now shut, and therefore the *whole* is drawn up by the rack-work, driving the air before it through the hole *a c*, into the oil-vessel at R, and out into the room by the tube T. The piston will then be at the top of the barrel at *a*, and the wire *gg* will stand nearly as represented in the figure just raised from the hole L, and prevented from rising higher by the nut O. During this motion the air will expand in the receiver, and come along the bent tube *m* into the barrel. Thus the barrel will be filled with air, which, as the piston rises, will be rarefied in proportion as the capacity of the receiver, pipes, and barrel, is to the barrel alone. When the piston is moved down again by the rack-work, it will force the conical part (fig. 38) out of the hollow part (fig. 37) as far as the shoulders *a a*; fig. 35 will rest on *a a* (fig. 37) which will then be so far open as to permit the air to pass freely through it, while at the same time the end of *g g* is forced against the top of the hole, and shuts it, in order to prevent any air from returning into the receiver. Thus the piston, moving downwards, suffers the air to pass out between the sides of figs. 37 and 38; and, when it is at the bottom of the barrel, will have the column of air above it; and, consequently, when drawn upwards it will shut, and drive out this air, and, by opening the hole L at the same time, will give a free passage to more air from the receiver. This process being continued, the air of the receiver will be rarefied as far as its expansive power will permit. For in this machine there are no valves to be forced open by the elasticity of the air in the receiver, which at last it is unable to effect. There is therefore nothing to prevent the air from expanding to its utmost degree.

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[1] The piston and barrel are 1·65 inches in diameter, in proportion to which the scale is drawn. Figures 35, 36, 37, and 38, are, however, of double size.

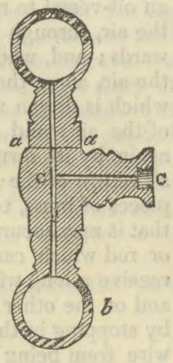
It may be suspected here, that as the air must escape through the discharging passage *ac*, fig. 34, against the pressure of a column of oil and the weight of the wire, there will remain in this passage a quantity of air of considerable density, which will expand again into the barrel during the descent of the piston, and thus put a stop to the progress of rarefaction. This is the case in Mr. Smeaton's pump, and all which have valves in the piston. But it is the peculiar excellency of this pump, that whatever be the density of the air remaining in *ac*, the rarefaction will still go on. It is worth while to be perfectly convinced of this. Let us suppose that the air contained in *ac* is $\frac{1}{100}$th part of the common air which would fill the barrel, and that the capacity of the barrel is equal to that of the receiver and passages, and that the air in the receiver and barrel is of the same density, the piston being at the bottom of the barrel: the barrel will therefore contain $\frac{10}{1000}$ parts of its natural quantity, and the receiver $\frac{10}{1000}$. Now let the piston be drawn up. No air will be discharged at *ac*, because it will contain the whole air which was in the barrel, and which has now collapsed into its ordinary bulk. But this does not in the least hinder the air of the receiver from expanding into the barrel, and diffusing itself equally between both. Each will now contain $\frac{5}{1000}$ of their ordinary quantity when the piston is at the top, and *ac* will contain $\frac{1}{100}$ as before, or $\frac{10}{1000}$. Now push down the piston. The hole L is instantly shut, and the air in *ac* expands into the barrel, and the barrel now contains $\frac{15}{1000}$. When the piston has reached the bottom, let it be again drawn up. There will be $\frac{5}{1000}$ discharged through *c*, and the air in the receiver will again be equally distributed between it and the barrel. Therefore the receiver will now contain $\frac{2\frac{1}{2}}{1000}$. When the piston reaches the bottom, there will be $\frac{12\frac{1}{2}}{1000}$ in the barrel. When again drawn up to the top, there will be $\frac{2\frac{1}{2}}{1000}$ discharged, and the receiver will contain $\frac{1\frac{1}{4}}{1000}$; and when the piston reaches the bottom, there will be $\frac{11\frac{1}{4}}{1000}$. At the next stroke the receiver will contain only $\frac{0\cdot\frac{5}{8}}{1000}$, &c. &c.

Thus it appears, that notwithstanding the $\frac{10}{1000}$ which always expands back again out of the hole *ac* into the barrel, the rarity of the air in the receiver will be doubled at every stroke. There is therefore no need of a subsidiary air-pump at *c*, as in the American air-pump, and in the Swedish attempt to improve Smeaton's.

In using this air-pump no particular directions are necessary, nor is any peculiar care necessary for keeping it in order, except that the oil-vessel A be always kept about half full of oil. When the pump has stood long without being used, it will be proper to draw a table-spoonful of olive-oil through it, by pouring it into the hole in the middle of the receiver-plate when the piston is at the bottom of the barrel. Then by working the piston, the oil will be drawn through all the parts of the pump, and the surplus will be driven through the tube T into the oil-vessel G. Near the top of the piston rod at H, there is a hole which lets some oil into the inside of the rod, which gets at the collar of leathers *rr*, and keeps the wire *gg* air-tight.

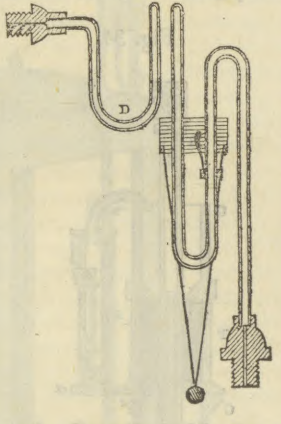
When the pump is used for condensation at the same time that it rarifies, or separately, the piece containing the bent tube T must be removed, and fig. 41 put into its place, and fixed by its screws. Fig. 41, as drawn in the plate, is intended for a double-barrelled pump. But for a single barrel only one piece is used, represented by *b a a*, the double piece being cut off at the dotted line *a a*. In this piece is a female screw to receive the end of a long brass tube, to which a bladder (if sufficient for the experiment of condensation,) or a glass, properly secured for this purpose, must be screwed. Then the air which is abstracted from the receiver on the pump-plate will be forced into the bladder or glass. But if the pump be double, the apparatus fig. 41 is used, and the long brass tube screwed on at *c*.[1]

Fig. 41.



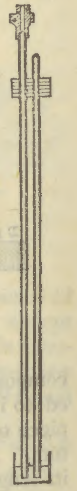
Figs. 42 and 43 represent the two gages, which will be sufficiently explained afterwards. Fig. 42 is screwed into *b*, or into the screw at the other end *c*, fig. 40, and fig 43 into the screw *a*, fig. 40.

Fig. 42.



If it be used as a single pump, either to rarefy or to condense, the screw K, which fastens the rack to the piston rod H, must be taken out. Then turning the winch till H is depressed as low as possible, the machine will be fitted to exhaust as a single pump; and if it be required to condense, the direction in No. 8 must be observed with regard to the tube T, and fig 41.

Fig. 43.



"I took," says Mr. Cuthbertson, "two barometer tubes of an equal bore with that fixed to the pump. These were filled with mercury four times boiled. They were then compared, and stood exactly at the same height. The mercury in one of them was boiled in it four times more, without making any change in their height; they were therefore judged very perfect. One of these was immersed in the cistern of the pump gage, and fastened in a position parallel to it, and a sliding scale of one inch was attached to it. This scale, when the gage is used, must have its upper edge set equal with the surface of the mercury in the boiled tube after exhaustion, and the difference between the height of the mercury in this and in the other barometer tube may be observed to the $\frac{1}{100}$ of an inch; and being close together, no error arises from their not being exactly vertical, if they are only parallel. This gage will be better understood by inspecting fig. 43.

"I used a second gage, which I shall call a double syphon. (See fig. 42.) This was also prepared with the utmost care. I had a scale for measuring the difference between the height of the columns in the two legs. It was an inch long, and divided as the former, and kept in a truly vertical position by suspending it from a point with a weight hung to it, as represented in the figure. Upon comparing these two gages, I always found them to indicate the same degree of rarefaction. I also used a pear-gage, though the most imperfect of all, in order to repeat the curious experiments of Mr. Nairne and others."

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[1] An air-pump of this description is by far too delicate to be employed without risk of injury in experiments on condensed air.

When experiments require the utmost rarefying power of the pump, the receiver must not be placed on leather, either oiled or soaked in water, as is usually done. The pump plate and the edge of the receiver must be ground very flat and true, and this with very fine emery, that no roughness may remain. The plate of the pump must then be wiped very clean and very dry, and the receiver rubbed with a warm cloth till it become electrical. The receiver being now set on the plate, hog's lard, either alone or mixed with a little oil which has been cleared of water by boiling, must be smeared round its outside edge. In this condition the pump will rarefy its utmost, and what still remains in the receiver will be permanent air. Or a little of this composition may be thinly smeared on the pump plate; this will prevent all risk of scratching it with the edge of the receiver. Leather of very uniform thickness, long dried before a fire, and well soaked in this composition, which must be cleared of all water by the first boiling, will answer very well, and is expeditious, when receivers are to be frequently shifted. Other leathers should be at hand soaked in a composition containing a little rosin. This gives it a clamminess which renders it impermeable to air, and is very proper at all joints of the pump, and all apparatus for pneumatic experiments. As it is impossible to render the pear-gage as dry as other parts of the apparatus, there will be generally some variation between this and the other gages.

When it is only intended to show the utmost power of the pump, without intending to ascertain the quality of the residuum, the receiver may be set on wet leather. If, in this condition, the air be rarefied as far as possible, the syphon and barometer gage will indicate a less degree of rarefaction than in the former experiments. But when the air is let in again, the pear gage will point out a rarefaction some thousands of times greater than it did before If the true quantity of permanent air after exhaustion be required, the pear gage will be nearest the truth; for when the air is rarefied to a certain degree, the moistened leather emits an expansible fluid, which, filling the receiver, forces out the permanent air; and the two first gages indicate a degree of exhaustion which relates to the whole elastic matter remaining in the receiver, viz. to the expansible fluid together with the permanent air; whereas the pear gage points out the degree of exhaustion, with relation to the permanent air alone, which remains in the receiver; for by the pressure of the air admitted into the receiver, the elastic vapour is reduced to its former bulk, which is imperceptible.

Many bodies emit this elastic fluid when the pressure of the air is much diminished; a piece of leather, in its ordinary damp state, about an inch square, or a bit of green or dry wood, will supply this for a great while. When such fluids have been generated in any experiments, the pump must be carefully cleared of them, for they remain not only in the receiver, but in the barrels and passages, and will again expand when the exhaustion has been carried far.

The best method of clearing the pump is to take a very large receiver, and, using every precaution, to exhaust it as far as possible. Then the expansible matter lurking in the barrels and passes will be diffused through the receiver also, or will be carried off along with its air. It will be as much rarer than it was before, as the aggregate capacity of the receiver, barrels and passes is larger than that of the two last.

The performance of the pump may be judged of from the four following experiments: The two gages being screwed into their places, and the hole in the receiver-plate shut up the pump was made to exhaust as far as it could. The mercury in the legs of the syphon was only $\frac{1}{40}$ of an inch out of the level, and that in the boiled barometer-tube $\frac{1}{40}$ of an inch higher than in the one screwed to the pump. A standard barometer then stood at 30 inches, and therefore the pump rarefied the permanent air 1200 times. This is twice as much as Mr. Nairne found Mr. Smeaton's do in its best state. Mr. Cavallo seems disposed to give a favourable account of Haas and Hurter's pump, and it appears never to have exceeded 600 times. Mr. Cuthbertson has often found the mercury within $\frac{1}{100}$ of an inch of the level in the syphon-gage, indicating a rarefaction of 3000.[1]

To one end of a glass tube, two inches diameter and thirty inches long, was fitted a brass cap and collar of leather, through which a wire was inserted, reaching about two inches within the tube. This was connected with the conductor of an electric machine. The other end was ground flat and set on the pump plate. When the gages indicated a rarefaction of 300, the light became steady and uniform, of a pale colour, though a little tinged with purple; at 600 the light was of a pale dusky white; when 1200 it disappeared in the middle of the tube, and the tube conducted so well that the prime conductor only gave sparks so faint and short as to be scarcely perceptible. After taking off the tube, and making it as dry as possible, it was again connected with the conductor, which was giving sparks two inches long. When the air in it was rarefied ten times, the sparks were of the same length. Sometimes a pencil of light darted along the tube. When the rarefaction was 20, the spark did not exceed an inch, and light streamed the whole length of the tube. When the rarefaction was 30, the sparks were half an inch, and the light rushed along the tube in great streams. When the rarefaction was 100, the sparks were about $\frac{1}{8}$ long, and the light filled the tube in an uninterrupted body. When 300, the appearances were as before. When 600, the sparks were $\frac{1}{10}$, and the light was of a faint white colour in the middle, but tinged with purple toward the ends. When 1200, the light was hardly perceptible in the middle, and was much fainter at the ends than before, but still ruddy. When 1400, which was the most the pump could produce, six inches of the middle of the tube were quite dark, and the ends free of any tinge of red, and the sparks did not exceed $\frac{1}{40}$ of an inch.[2]

The best improvements of the air-pump made in Britain.

We trust that our readers will not be displeased with the preceding history of the air-pump. The occasional information which it gives will be of great use to every person much engaged in pneumatic experiments, and help him in the contrivance and construction of the necessary apparatus. We may be indulged in one remark, that although this noble instrument originated in Germany, all its improvements were made in this kingdom. Both the mechanical and pneumatical principles of Mr. Boyle's construction were extremely different from the German, and, in respect of expedition and conveniency, much superior. The double barrel and gage by Hawkesbee were capital improvements, and on principle; and Mr. Smeaton's method of making the piston work in rarefied air made a complete change in the whole process.

Utility of the air-pump.

Aided by this machine, we can make experiments establishing and illustrating the gravity and elasticity of the air, in a much more perspicuous manner than could be done by the spontaneous phenomena of nature. It allows us in the

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[1] We are disposed to place most reliance on the experiment where $\frac{1}{1200}$ is stated as the limit of exhaustion, particularly as this result corresponds with the best information we have been able to obtain, regarding the performance of various very fine instruments.

[2] Since this article was originally written, a mathematical instrument maker of Edinburgh has invented an air-pump, possessing all the ad-

Air-pump.

first place to show the materiality of air in a very distinct manner. Bodies cannot move about in the atmosphere without displacing it. This requires force; and the resistance of the air always diminishes the velocity of bodies moving in it. A heavy body therefore has the velocity of its fall diminished; and if the quantity of air displaced be very great, the diminution will be very considerable. This is the reason why light bodies, such as feathers, fall very slowly. Their moving force is very small, and can therefore displace a great quantity of air only with a very small velocity. But if the same body be dropped *in vacuo*, when there is no air to be displaced, it falls with the whole velocity competent to its gravity. Fig. 44 represents an apparatus by which a guinea and a downy feather are dropped at the same instant. If this be done after the air has been pumped out, the guinea and the feather will be observed to reach the bottom at the same instant.

Fig. 44.

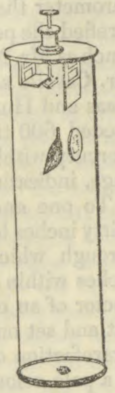
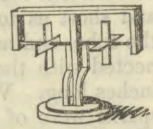


Fig. 45 represents another apparatus for showing the same thing. It consists of two sets of brass vanes put on separate axles, in the manner of windmill sails. One set has their edges placed in the direction of their whirling motion, that is, in a plane to which the axis is perpendicular. The planes of the other set pass through the axis, and they are therefore trimmed so as directly to front the air through which they move. Two springs act upon pins projecting from the axis; and their strength or tensions are so adjusted, that when they are disengaged *in vacuo*, the two sets continue in motion equally long. If they are disengaged in the air, the vanes which beat the air with their planes will stop long before those which cut it edgewise.

Fig. 45.

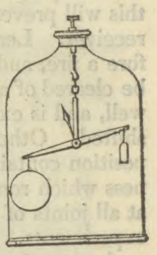


We can now abstract the air most completely from a dry vessel, so as to know the precise weight of the air which filled it. The first experiment we have of this kind, done with accuracy, is that of Dr. Hooke, February 10, 1664, when he found 114 pints of air to weigh 945 grains. One pint of water was $8\frac{7}{32}$ ounces. This gives for the specific gravity of air $\frac{1}{850}$ very nearly.

The effect of air on the weight of bodies immersed in it.

Since we are thus immersed in a gravitating fluid, it follows, that every body preponderates only with the excess of its own weight above that of the air which it displaces; for every body loses by this immersion the weight of the displaced air. A cubic foot loses about 521 grains in frosty weather. We see balloons even rise in the air, as a piece of cork rises in water. A mass of water which really contains 850 pounds will load the scale of a balance with 849 only, and will be balanced by about $849\frac{1}{8}$ pounds of brass. This is evinced by a very pretty experiment, represented in fig. 46. A small beam is suspended within a receiver. To one end of the beam is appended a thin glass or copper ball, close in every part. This is balanced by a small piece of lead hung on the other arm. As the air is pumped out of the receiver, the ball will gradually preponderate, and will regain its equilibrium when the air is re-admitted.

Fig. 46.



Some naturalists have proposed, and actually used, a large globe of light make, suspended at a beam, for a barometer. If its capacity be a cubic foot, $1\frac{7}{10}$ grains will indicate the

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vantages of Mr. Cuthbertson's, with this other in addition, that it is much simpler in its construction. Fig. 1 presents a view of this pump. A A are the barrels, B the pipe leading from them to C, the receiver plate D the barometer gage, E a stop-cock for re-admitting the air, or for attaching a syphon gage, or other piece of apparatus. Fig. 2 is a section of the piston, and of the under part of one of the barrels, shewing the whole of the internal construction; A A, *a a* is the barrel, O N the piston, G I the piston rod containing the rod *r*, which slides in the collar of leathers T, and opens the valve *v e*; in this respect it is precisely the same as Cuthbertson's, but the maker dispenses with all the apparatus at the top of Cuthbertson's barrels, and has only an oiled silk valve S, in the piston, which is exposed to the atmosphere, as in Hook's pump. The exclusion of the atmosphere from the piston valve, the maker considers as unnecessary. From the account previously given of the performance of Cuthbertson's, and of the other pumps described, as well as from his own experience, he is of opinion that the action of the best air pump is stopped, either by the formation of elastic vapour from the oil necessarily present, or from some unknown property of the air itself, long before it has been so much rarefied as as to be unable to open the piston valves. His reason for this opinion is, that the capacity of the barrels of any well-constructed pump is several thousand times greater than the space which exists between the valves, when the piston has reached the bottom of the barrel; in short, this may be limited to the small hole S N. For example, in an air-pump, the length of the stroke of which is 12 inches, the diameter of the barrels $2\frac{1}{2}$ in. the diameter of the hole S N $\frac{1}{10}$th of an inch, and its length one inch, the capacity of the hole S N is 7500 times less than the capacity of the barrel, and consequently air 7500 times rarer than the atmosphere when filling the whole barrel, will, by the descent of the piston, become of the same density, but as it is known from the performance of Hook's pump, that air $\frac{1}{100}$th part of the density of the atmosphere has sufficient elastic force to open an oil silk valve, it follows that the pump we have supposed, will exhaust 7425 times, but as this degree of exhaustion has nev er yet been attained, it is evident that some other reason must be sought for in explanation of this, than the imperfection of the mechanical arrangement. A metallic valve T *p*, may be placed in the piston instead of the oiled silk one, having a projecting point *p* to open it, on the piston reaching the bottom of the barrel, and a space OT filled with oil, to prevent the return of the air during the time which elapses betwixt the commencement of the ascent of the piston and the complete shutting of the valve.

Fig. 1.

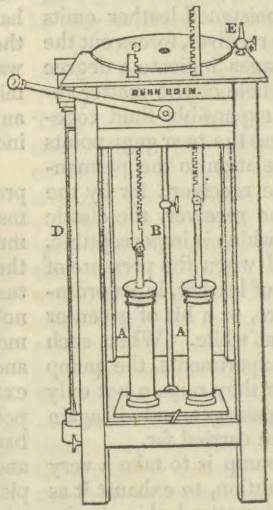
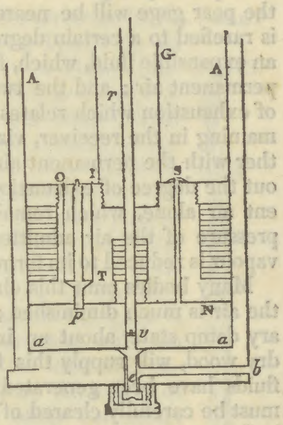


Fig. 2.



same change that is indicated by $\frac{1}{10}$ of an inch of an ordinary barometer. But a vessel of this size will load a balance too much to leave it sufficiently sensible to small changes of density. Besides, it is affected by heat and cold, and would require a very troublesome equation to correct their effects.

It may perhaps be worth while to attend to this in buying and selling precious commodities; such as pearls, diamonds, silk, and some drugs. As they are generally sold by brass or leaden weights, the buyer will have some advantage when the air is heavy and the barometer high. On the other hand, he will have the advantage in buying gold and mercury when the air is light. It is needless to confine this observation to precious commodities, for the advantage is the same in all in proportion to their levity.

There is a case in which this observation is of consequence to the philosopher: we mean the measuring of time by pendulums. As the accelerating force on a pendulum is not its whole weight, but the excess of its weight over that of the displaced air, it follows that a pendulum will vibrate more slowly in the air than *in vacuo*. A pendulum composed of lead, iron, and brass, may be about 8400 times heavier than the air which it displaces when the barometer is at 30 inches and the thermometer is at 32°, and the accelerating force will be diminished about $\frac{1}{8400}$. This will cause a second pendulum to make about five vibrations less in a day than it would do *in vacuo*. In order therefore to deduce the accelerative power of gravity from the length of a pendulum vibrating in the air, we must make an allowance of 0″.17, or $\frac{17}{100}$ of a second per day, for every inch that the barometer stands lower than 30 inches. But we must also note the temperature of the air; because when the air is warm it is less dense when supporting by its elasticity the same weight of atmosphere, and we must know how much its density is diminished by an increase of temperature. The correction is still more complicated; for the change of density affects the resistance of the air, and this affects the time of the vibration, and this by a law that is not yet well ascertained. As far as we can determine from any experiments that have been made, it appears that the change arising from the altered resistance takes off about 2-5ths of the change produced by the altered density, and that a second pendulum makes but three vibrations a-day more *in vacuo* than in the open air. This is a very unexpected result; but it must be owned that the experiments have neither been numerous nor very nicely made.

The air-pump also allows us to shew the effects of the air's pressure in a great number of amusing and instructive phenomena.

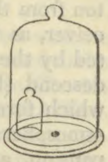
Experiments to shew the effects of the pressure of the air.

When the air is abstracted from the receiver, it is strongly pressed to the pump-plate by the incumbent atmosphere, and it supports this great pressure in consequence of its circular form. Being equally compressed on all sides, there is no place where it should give way rather than another; but if it be thin, and not very round, which is sometimes the case, it will be crushed to pieces. If we take a square thin vial, and apply an exhausting syringe to its mouth, it will not fail being crushed.

As the operation of pumping is something like sucking, many of these phenomena are in common discourse ascribed to suction, a word much abused; and this abuse misleads the mind exceedingly in its contemplation of natural phenomena. Nothing is more usual than to speak of the suction of a syringe, the suction and draught of a chimney, &c. The following experiment puts the true cause of the strong adhesion of the receiver beyond a doubt.

Place a small receiver, or cupping-glass on the pump-plate without covering the central hole, as represented in fig. 47, and cover it with a larger receiver. Exhaust the air from it; then admit it as suddenly as possible. The outer receiver, which, after the rarefaction, adhered strongly to the plate, is now loose, and the cupping-glass will be found sticking fast to it. While the rarefaction was going on, the air in the small receiver also expanded, escaped from it, and was abstracted by the pump. When the external air was suddenly admitted, it pressed on the small receiver, and forced it down to the plate, and thus shut up all entry. The small receiver must now adhere; and there can be no suction, for the pipe of the pump was on the outside of the cupping-glass.

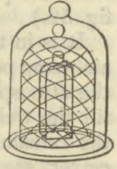
Fig 47.



This experiment sometimes does not succeed, because the air occasionally finds a passage under the brim of the cupping-glass. But if the cupping-glass be pressed down by the hand on the greasy leather or plate, every thing will be made smooth, and the glass will be so little raised by the expansion of its air during the pumping, that it will instantly clap close when the air is re-admitted.

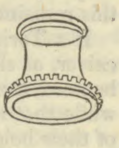
In like manner, if a thin square phial be furnished with a valve, opening from within, but shutting when pressed from without, and if this phial be put under a receiver, and the air be abstracted from the receiver, the air in the phial will expand during the rarefaction, escape through the valve, and be at last in a very rarefied state within the phial. If the air be now admitted into the receiver, it will press on the flat sides of the included phial and crush it to pieces. (See fig. 48.)

Fig. 48.



If a piece of wet ox-bladder be laid over the top of a receiver whose orifice is about four inches wide, and the air be exhausted from within it, the incumbent atmosphere will press down the bladder into a hollow form, and then burst it inward with a prodigious noise. (See fig. 49.) Or if a piece of thin flat glass be laid over the receiver, with an oiled leather between them to make the juncture air-tight, the glass will be broken downwards. This must be done with caution, because the pieces of glass sometimes fly about with great force.[1]

Fig. 49.



If there be formed two hemispherical cups of brass, with very flat thick brims, and one of them be fitted with a neck and stopcock, as represented by fig. 50, the air may be abstracted from them by screwing the neck into the hole in the pump-plate. To prevent the insinuation of air, a ring of oiled leather may be put between the rims. Now unscrew the sphere from the pump, and fix hooks to each, and suspend them from a strong nail, and hang a scale to the lowest. It will require a considerable weight to separate them; namely, about 15 pounds for every square inch of the great circle of the sphere. If this be four inches diameter, it will require near 190 pounds. This pretty experiment was first made by Otto Guericke, and on a very great scale. His sphere was of a large size, and when exhausted, the hemispheres could not be drawn asunder by 20 horses. It was exhibited, along with many others equally curious and magnificent, to the emperor of

Fig. 50.

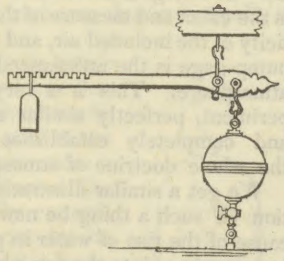
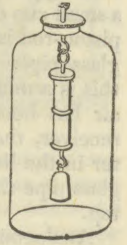


Fig. 51.



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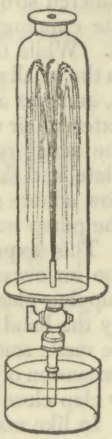
[1] Such experiments should never be performed with a good pump; for fragments of the glass will get into the pump and impair its working, in spite of the utmost skill of the operator.

Experiments on air.

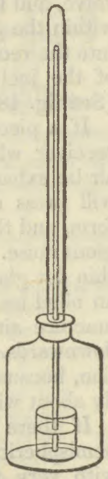
Germany and his court, at the breaking up of the diet of Ratisbon in 1654. If a loaded syringe be suspended by its piston from the hook in the top plate of the receiver, as in fig. 51, and the air be abstracted by the pump, the syringe will gradually descend (because the elasticity of the air, which formerly balanced the pressure of the atmosphere, is now diminished by its expansion, and is therefore no longer able to press the syringe to the piston), and it will at last drop off. If the air be admitted before this happens, the syringe will immediately rise again.

Fig. 52.



Screw a short brass pipe into the neck of a transporter, on which is set a tall receiver, and immerse it into a cistern of water. On opening the cock, the pressure of the air on the surface of the water in the cistern will force it up through the pipe, and cause it to spout into the receiver with a strong jet, because there is no air within to balance by its elasticity the pressure of the atmosphere. (See fig. 52.)

Fig. 53.

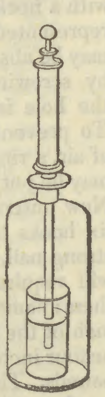


By this pressure the gage of an air-pump acts.

It is in the same way that the gage of the air-pump performs its office. The pressure of the atmosphere raises the mercury in the gage till the weight of the mercury, together with the remaining elasticity of the air in the receiver, are in equilibrio with the whole pressure of the atmosphere: therefore the height and weight of the mercury in the gage is the excess of the weight of the atmosphere above the elasticity of the included air; and the deficiency of this height from that of the mercury in the Toricellian tube is the measure of this remaining elasticity.

If a Toricellian tube be put under a tall receiver, as shown in fig. 53, and the air be exhausted, the mercury in the tube will descend, while that in the gage will rise; and the sum of their heights will always be the same, that is, equal to the height in an ordinary barometer. The height of the mercury in the receiver is the effect and measure of the remaining elasticity of the included air, and the height in the pump-gage is the unbalanced pressure of the atmosphere. This is a very instructive experiment, perfectly similar to Mr. Auzout's, and completely establishes and illustrates the whole doctrine of atmospheric pressure.

Fig. 54.



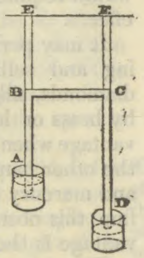
Water rises in pumps.

We get a similar illustration and confirmation (if such a thing be now needed) of the cause of the rise of water in pumps, by screwing a syringe into the top plate of a receiver, which syringe has a glass pipe plunging into a small cup of water. (See fig. 54.) When the piston-rod is drawn up, the water rises in the glass pipe, as in any other pump, of which this is a miniature representation. But if the air has been previously exhausted from the receiver, there is nothing to press on the water in the little jar; and it will not rise in the glass pipe though the piston of the syringe be drawn to the top.

It moves in syphons.

Analogous to the rise of water in pumps is its rise and motion in syphons. Suppose a pipe ABCD, fig. 55, bent at right angles at B and C, and having its two ends immersed in the cisterns of water A and D. Let the leg CD be longer than the leg BA, and let the whole be full of water. The water is pressed upwards at A with a force equal to the weight of the column of air EA reaching to the top of the atmosphere; but it is pressed downwards by the weight of the column of water BA. The water at D is pressed downwards by the weight of the column CD, and upwards by the weight of the column of air FD reaching to the top of the atmosphere. The two columns of air differ very little in their weight, and may without any sensible error be considered as equal. Therefore there is a superiority of pressure downwards at D, and the water will flow out there. The pressure of the air will raise the water in the leg AB, and thus the stream will be kept up till the vessel A is emptied as low as the orifice of the leg BA, provided that the height of AB is not greater than what the pressure of the atmosphere can balance, that is, does not exceed 32 or 33 feet for water, 30 inches for mercury, &c.

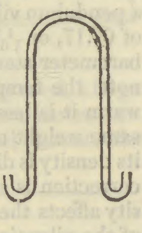
Fig. 55.



A syphon then will always run from that vessel whose surface is highest; the form of the pipe is indifferent, because the hydrostatical pressures depend on the vertical height only. It must be filled with water by some other contrivance, such as a funnel, or a pump applied a-top; and the funnel must be stopped up, otherwise the air would get in, and the water would fall in both legs.

If the syphon have equal legs, and be turned up at the ends, it will remain full of water, and be ready for use. One end of it need only be dipped into any vessel of water, and the water will then flow out at the other end of the syphon. This is called the Wirtemberg syphon, and is represented in fig. 56.

Fig. 56.

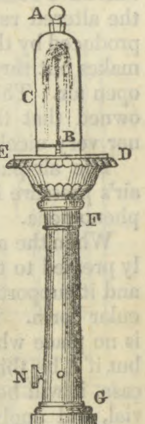


The syphon fou tain.

What is called the *syphon fountain*, constructed on this principle, is shown in fig. 57, where AB is a tall receiver, standing in a wide bason DE, which is supported on the pedestal H, by the hollow pillar FG. In the centre of the receiver is a jet pipe C, and in the top a ground stopper A. Near the base of the pillar is a cock N, and in the pedestal is another cock O.

Fill the bason DE with water within half an inch of the brim. Then pour in water at the top of the receiver (the cock N being shut) till it is about half full, and then put in the stopper. A little water will run out into the vessel DE. But before it runs over, open the cock N, and the water will run into the cistern H; and by the time that the pipe C appears above water, a jet will rise from it, and continue as long as water is supplied from the bason DE. The passage into the base cistern may be so tempered by the cock N that the water within the receiver shall keep at the same height, and what runs into the base may be received from the cock O into another vessel, and returned into DE, to keep up the stream.

Fig. 57.



Manner of its construction and operation.

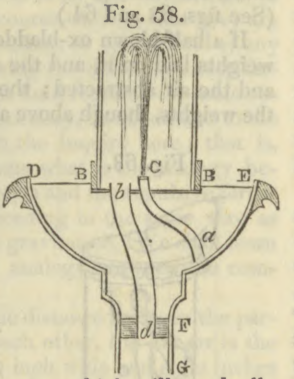
This pretty philosophical toy may be constructed in the following manner. BB, (fig. 58,) is the ferril or cap into which the receiver is cemented. From its centre descends the jet pipe C*a*, sloping outwards, to give room for the discharge pipe *bd* of larger diameter, the lower extremity of which *d* fits tightly into the top of the hollow pillar FG.

The operation of the toy is easily understood. Suppose the distance from C to H (fig. 57,) three feet, which is about $\frac{1}{11}$ of the height at which the atmosphere would support a column of water. The water poured into AB would descend through FG (the hole A being shut) till the air has

Experiments on air.

expanded $\frac{1}{15}$, and then it would stop. If the pipe C*a* be now opened, the pressure of the air on the surface of the water in the cistern DE will cause it to spout through C to the height of three feet nearly, and the water will continue to descend through the pipe FG. By tempering the cock N so as to allow the water to pass through it as fast as it is supplied by the jet, the amusement may be continued a long time. It will stop at last, however; because, as the jet is made into rarefied air, a little air will be extricated from the water, which will gradually accumulate in the receiver, and diminish its rarefaction, which is the moving cause of the jet. This indeed is an inconvenience felt in every employment of syphons, so much the more remarkably as their top is higher than the surface of the water in the cistern of supply.

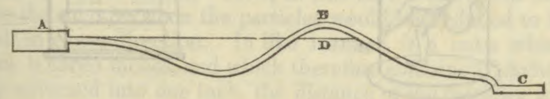
Fig. 58.



Syphons tare ofen used thus.

Cases of this employment of a syphon are not unfrequent. When water collected at A (fig. 59,) is to be conducted in a pipe to C, situated in a lower part of the country, it sometimes happens that the intervening ground is higher than the fountain-head as at B. A forcing pump is erected at A, and the water forced along the pipe. Once it runs out at C, the pump may be removed, and the water will continue to run on the syphon principle, provided BD do not exceed 33 feet. But the water in that part of the conduit which is above the horizontal plane AD, is in the same state as in a receiver of rarefied air, and gives out some of the air which is united with it. This gradually accumulates in the elevated part of the conduit, and at last choaks it entirely.

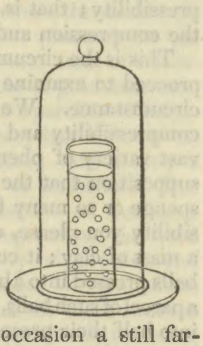
Fig. 59.



The air-pump discovers the combination of air with water, &c.

This combination of air with water is very distinctly seen by means of the air-pump. If a small glass containing cold water, fresh drawn from the spring, be exposed, as in fig. 60, under the receiver, and the air rarefied, small bubbles will be observed to form on the inner surface of the glass, or on the surface of any body immersed in it, which will increase in size, and then detach themselves from the glass and reach the top; as the rarefaction advances, the whole water begins to show very minute air-bubbles rising to the top; and this appearance will continue for a very long time, till it be completely disengaged. Warming the water will occasion a still farther separation of air, and a boiling heat will separate all that can be disengaged. The reason assigned for these air-bubbles first appearing on the surface of the glass, &c. is, that air is attracted by bodies, and adheres to their surface. This may be so. But it is more probably owing to the attraction of the water for the glass, which causes it to quit the air which it held in solution, in the same manner as we see it happen when it is mixed with spirits-of-wine, with vitriolic acid, &c., or when salts or sugar are dissolved in it. For if we pour out the water which has been purged of air by boiling *in vacuo*, and fill the glass with fresh water, we shall observe the same thing, although a film of the purified water was left adhering to the glass. In this case there can be no air adhering to the glass.

Fig. 60.



Experiments on air.

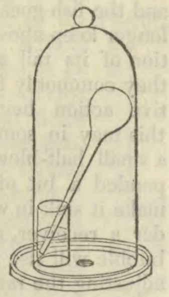
Water thus purged of air by boiling (or even without boiling) *in vacuo*, will again absorb air when exposed to the atmosphere. The best demonstration of this is to fill with this water a phial, leaving about the size of a pea not filled. Immerse this in a vessel of water, with the mouth undermost, by which means the air-bubble will mount up to the bottom of the phial. After some days standing in this condition, the air-bubble will be completely absorbed, and the vessel quite filled with water. A glass of beer placed under the receiver and treated in the same way will be almost wholly converted into froth by the escape of its fixed air, and will have lost entirely the prickling smartness which is so agreeable, and become quite vapid.

Experiments illustrative of the elasticity and expansibility of the air.

The air-pump gives us, in the next place, a great variety of experiments illustrative of the air's elasticity and expansibility. The very operation of exhaustion, as it is called, is an instance of its great expansibility. But this is not palpably exhibited to view. The following experiments show it most distinctly. First, put a flaccid bladder, of which the neck is firmly tied with a thread, under a receiver, and work the pump. The bladder will gradually swell, and will even be fully distended. Upon readmitting the air into the receiver, the bladder gradually collapses again into its former dimensions; while the bladder is flaccid, the air within it is of the same density and elasticity with the surrounding air, and its elasticity balances the pressure of the atmosphere. When part of the air of the receiver is abstracted, the remainder expands so as still to fill the receiver; but by expanding, its elasticity is plainly diminished; for we see by the fact, that the elasticity of the air of the receiver no longer balances the elasticity of that in the bladder, as it no longer keeps it in its dimensions. The air in the bladder expands also; it expands till its diminished elasticity is again *in equilibrio* with the diminished elasticity of the air in the receiver; that is, till its density is the same. When all the wrinkles of the bladder have disappeared, its air can expand no more, although we continue to diminish the elasticity of the air of the receiver by further rarefaction. The bladder now tends to burst; and if it be pierced by a point or knife fastened to the slip-wire, the air will rush out, and the mercury descend rapidly in the gage.

If a phial or tube (fig. 61) be partly filled with water, and immersed in a vessel of water with the mouth downwards, the air will occupy the upper part of the phial. If this apparatus be put under a receiver, and the air be abstracted, the air in the phial will gradually expand, allowing the water to run out by its weight till the surface of the water be on a level within and without. When this is the case, we must grant that the density and elasticity of the air in the phial is the same with that in the receiver. When we work the pump again, we shall observe the air in the phial expand still more, and come out of the water in bubbles. Continuing the operation, we shall see the air continually escaping from the phial; when this is over, it shows that the pump can rarefy no more. If we now admit the air into the receiver, we shall see the water rise into the phial, and at last almost completely fill it, leaving only a very small bubble of air at the top. This bubble had expanded so as to fill the whole phial.

Fig. 61.



Every one must have observed a cavity at the big end of an egg between the shell and the white. The white and

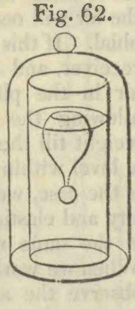
Experiments on air.

yolk are contained in a thin membrane or bladder which adheres loosely to the shell, but is detached from it at that part; and this cavity increases by keeping the egg in a dry place. One may form a judgment of its size, and therefore of the freshness of the egg, by touching it with the tongue; for the shell, where it is not in contact with the contents, will presently feel warm, being quickly heated by the tongue, whilst the rest of the egg will feel cold.

If a hole be made in the opposite end of the egg, and it be set on a little tripod, and put under a receiver, the expansion of the air in the cavity of the egg will force the contents through the hole till the egg be quite emptied; or, if nearly one-half of the egg be taken away at the other end, and the white and yolk taken out, and the shell be put under a receiver, and the air abstracted, the air in the cavity of the egg will expand, gradually detaching the membrane from the shell, till it causes it to swell out, and gives the whole the appearance of an entire egg. In like manner shrivelled apples and other fruits will swell in vacuo by the expansion of the air confined in their cavities.

If a piece of wood, a twig with green leaves, charcoal, plaster of Paris, &c. be kept under water in vacuo, a prodigious quantity of air will be extracted; and if we readmit the air into the receiver, it will force the water into the pores of the body. In this case the body will not swim in water as it did before, showing that the vegetable fibres are specifically heavier than water. It is found, however, that the air contained in the pith and bark, such as cork, is not all extricated in this way; and that much of it is contained in vesicles which have no outlet; being secreted into them in the process of vegetation, as it is secreted in the air-bladder of fishes, where it is generally found in a pretty compressed state, considerably denser than the surrounding air. The air-bladder of a fish is surrounded by circular and longitudinal muscles, by which the fish can compress the air still further; and, by ceasing to act with them, allow it to swell out again. It is in this manner that the fish can suit its specific gravity to its situation in the water, so as to have no tendency either to rise or sink; but if the fish be put into the receiver of an air-pump, the rarefaction of the air obliges the fish to act more strongly with these contracting muscles, in order to adjust its specific gravity; and if too much air has been abstracted from the receiver, the fish is no longer able to keep its air-bladder in the proper degree of compression. It becomes therefore too buoyant, and comes to the top of the water, and is obliged to struggle with its tail and fins in order to get down; frequently in vain. The air-bladder sometimes bursts, and the fish goes to the bottom, and can no longer keep above without the continual action of its tail and fins. When fishes die, they commonly float at top, their contractive action being now at an end. All this may in some degree be illustrated by a small half-blown bladder, to which is appended a bit of lead, just so heavy as to make it sink in water; when this is put under a receiver, and the air abstracted, the bubble will rise to the top; and, by nicely adjusting the rarefaction, it may be kept at any height.

Fig. 62.



The playthings called *Cartesian devils* are similar to this. They are hollow glass figures, having a small aperture in the lower part of the figures, as at the point of the foot; their weight is adjusted so that they swim upright in water. When put into a tall jar filled to the top, and having a piece of leather tied over it, they will sink in the water, by pressing on the leather with the ball of the hand. This, by compressing the water, forces some of it to enter into the figure, and makes it heavier than the water; for which reason it sinks, but rises again on removing the pressure of the hand. (See figs. 63 and 64.)

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If a half-blown ox-bladder be put into a box, and great weights laid on it, and the whole be put under a receiver, and the air abstracted; the air will, by expanding, lift up the weights, though above an hundred pounds. (See fig. 65.)

Fig. 63.

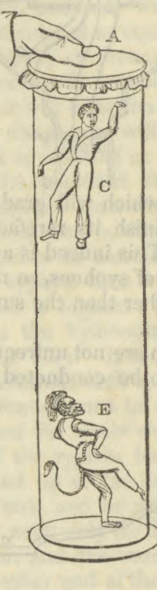


Fig. 64.

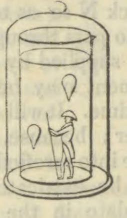
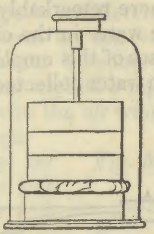


Fig. 65.



Compressibility and expansibility are in no state of the air very dissimilar.

By such experiments, the great expansibility of the air is abundantly illustrated, as its compressibility was formerly by means of the condensing syringe. We now see that the two sets of experiments form an uninterrupted chain; and that there is no particular state of the air's density where the compressibility and expansibility are remarkably dissimilar. Air in its ordinary state expands; because its ordinary state is a state of compression by the weight of the atmosphere; and if there were a pit about thirty-three miles deep, the air at the bottom would probably be as dense as water; and if it were fifty miles deep, it would be as dense as gold, if it did not become a liquid before this depth; nay, if a bottle with its mouth undermost were immersed six miles under water, it would probably be as dense as water; we say probably, for this depends on the nature of its compressibility; that is, on the relation which subsists between the compression and the force which produces it.

Relation between compression and the force producing it.

This is the circumstance of its constitution, which we now proceed to examine; and it is evidently a very important circumstance. We have long ago observed, that the great compressibility and permanent fluidity of air, observed in a vast variety of phenomena, is totally inexplicable, on the supposition that the particles of air are like so many balls of sponge or so many foot-balls. Give to those what compressibility you please, common air could no more be fluid than a mass of clay; it could no more be fluid than a mass of such balls pressed into a box. It may be demonstrated, that before a parcel of such balls, just touching each other, can be squeezed into half their present dimensions, their globular shape will be entirely gone, and each will have become a perfect cube, touching six other cubes with its whole surface; and these cubes will be strongly compressed together, so that motion could never be performed through among them by any solid body without a very great force. Whereas we know that in this state air is just as permeable to every body as the common air that we breathe. There is no way in which we can represent this fluidity to our imagination, but by conceiving air to consist of particles, not only discrete, but distant from each other, and actuated by repulsive forces, or

Experiments on air.

something analogous to them. It is an idle subterfuge, to which some naturalists have recourse, saying, that they are kept asunder by an intervening ether, or elastic fluid of any other name. This is only removing the difficulty a step farther off; for the elasticity of this fluid requires the same explanation; and therefore it is necessary, in obedience to the rules of just reasoning, to begin the inquiry here; that is, to determine from the phenomena what is the analogy between the distances of the particles and the repulsive forces exerted at these distances, proceeding in the same way as in the examination of planetary gravitation. We shall learn the analogy by attending to the analogy between the compressing force and the density.

Density explained as applied to air.

For the density depends on the distance between the particles; the nearer they are to each other, the denser is the air. Suppose a square pipe one inch wide and eight inches long, shut at one end, and filled with common air; then suppose a plug so nicely fitted to this pipe that no air can pass by its sides; suppose this piston thrust down to within an inch of the bottom: it is evident that the air which formerly filled the whole pipe now occupies the space of one cubic inch, which contains the same number of particles as were formerly diffused over eight cubic inches.

The condensation would have been the same if the air which fills a cube whose side is two inches had been squeezed into a cube of one inch, for the cube of two inches also contains eight inches. Now, in this case it is evident that the distance between the particles would be reduced to its half in every direction. In like manner, if a cube whose side is three inches, and which therefore contains 27 inches, be squeezed into one inch, the distance of the particles will be one-third of what it was: in general the distance of the particles will be as the cube-root of the space into which they are compressed. If the space be $\frac{1}{8}$, $\frac{1}{27}$, $\frac{1}{64}$, $\frac{1}{125}$, &c. of its former dimensions, the distance of the particles will be $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, &c. Now the term *density*, in its strict sense, expresses the vicinity of the particles; thus, *densi arbores* are trees growing near each other. The measure of this vicinity therefore is the true measure of the density; and when 27 inches of air are compressed into one, we should say that it is three times as dense; but we say, that it is 27 times denser.

Further explanation.

Density is therefore used in a sense different from its strictest acceptation; it expresses the comparative number of equidistant particles contained in the same bulk. This is also abundantly precise, when we compare bodies of the same kind, differing in density only; but we also say, that gold is 19 times denser than water, because the same bulk of it is 19 times heavier. This assertion proceeds on the assumption, or the fact, that every ultimate atom of terrestrial matter is equally heavy. A particle of gold may contain more or fewer atoms of matter than a particle of water. In such a case, therefore, the term density has little or no reference to the vicinity of the particles; and is only a term of comparison of other qualities or accidents. But when we speak of the respective densities of the same substance in its different states of compression, the word *density* is strictly connected with vicinity of particles, and we may safely take either of the measures. We shall abide by the common acceptation, and call that air eight times as dense which has eight times as many particles in the same bulk, although the particles are only twice as near to each other.

Analogy.

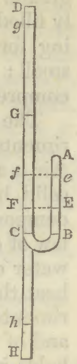
Thus then we see, that by observing the analogy between the compressing force and the density, we shall discover the analogy between the compressing force and the distance of the particles. Now the force which is necessary for compressing two particles of air to a certain vicinity is a proper measure of the elasticity of the particles corresponding to that vicinity or distance; for it balances it, and forces which balance must be esteemed equal. Elasticity is a distinctive name for that corpuscular force which keeps the particles at that distance; therefore observations made on the analogy between the compressing force and the density of air will give us the law of its corpuscular force, in the same way that observations on the simultaneous deflections of the planets towards the sun gives us the law of celestial gravitation.

But the sensible compressing forces which we are able to apply is at once exerted on unknown thousands of particles, whilst it is the law of action of a single particle that we want to discover. We must therefore know the proportion of the numbers of particles on which the compressing force is exerted. It is easy to see, that since the distance of the particles is as the cube root of the density inversely, the number of particles in physical contact with the compressing surface must be as the square of this root. Thus, when a cube of eight inches is compressed into one inch, and the particles are twice as near each other as they were before, there must be four times the number of particles in contact with each of the sides of this cubical inch; or, when we have pushed down the square piston of the pipe spoken of above to within an inch of the bottom, there will be four times the number of particles *immediately* contiguous to the piston, and resisting the compression; and in order to obtain the force really exerted on one particle, and the elasticity of that particle, we must divide the whole compressing force by 4. In like manner, if we have compressed air into $\frac{1}{27}$th of its former bulk, and brought the particles into $\frac{1}{3}$d of their former distance, we must divide the compressing force by 9. In general, if d express the density, $\frac{1}{\sqrt[3]{d}}$ will express the distance x of the particles; $\sqrt[3]{d}$, or $d^{\frac{1}{3}}$ will express the vicinity or real density; and $d^{\frac{2}{3}}$ will express the number of particles acting on the compressing surface; and if f express the accumulated external compressing force, $\frac{f}{d^{\frac{2}{3}}}$ will express the force acting on one particle; and therefore the elasticity of that particle corresponding to the distance x.

Compressibility of air.

We now proceed to consider the experiments by which the law of compression is to be established.[1] In order to examine the compressibility of air that is not rarer than the atmosphere at the surface of the earth, we employ a bent tube or syphon ABCD (fig. 66), hermetically sealed at A, and open at D. The short leg AB must be very accurately divided in the proportion of its solid contents, and fitted with a scale whose units denote equal increments, not of length, but of capacity. There are various ways of doing this; but it requires the most scrupulous attention, and without this the experiments are of no value. In particular, the arched form at A must be noticed. A small quantity of mercury must then be poured into the tube, and passed backwards and forwards till it stands (the tube being held in a vertical position) on a level at B and C. Then we are certain that the included air is of the same density with that of the contiguous atmosphere. Mercury is now poured into the leg DC, which will fill it,

Fig. 66.



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[1] The first experiments to this purpose were those made by Mr. Boyle, published in his *Defensio Doctrinæ de Aere contra Linum*, and exhibited before the Royal Society the year before. Mariotte made experiments of the same kind, which were published in 1676 in his *Essai sur la Nature de l'Air*, and *Traité des Mouvemens des Eaux*. The most copious experiments are those by Sulzer (*Mem. Berlin*, ix.) those by Fontana (*Opuscula Physico-Mathematica*), and those by Sir George Shuckburgh and General Roy in the *Philosophical Transactions*.

suppose to G, and will compress the air into a smaller space AE. Draw the horizontal line EF; the new bulk of the compressed air is evidently AE, measured by the adjacent scale, and the addition made to the compressing force of the atmosphere is the weight of the column GF. Produce GF downwards to H, till FH is equal to the height shown by a Toricellian tube filled with the *same mercury;* then the whole compressing force is HG. This is evidently the measure of the elasticity of the compressed air in AE, for it balances it. Now, pour in more mercury, and let it rise to *g*, compressing the air into A *e*. Draw the horizontal line *e f*, and make *f h* equal to FH; then A *e* will be the new bulk of the compressed air, $\frac{AB}{Ae}$ will be its new density, and *h g* will be the measure of the new elasticity. This operation may be extended as far as we please, by lengthening the tube CD, and taking care that it be strong enough to resist the great pressure. Great care must be taken to keep the whole in a constant temperature, because the elasticity of air is greatly affected by heat, and the change by any increase of temperature is different according to its density or compression.

Experiments of Boyle, &c.

The experiments of Boyle, Mariotte, Amontons, and others, were not extended to very great compressions, the density of the air not having been quadrupled in any of them; nor do they seem to have been made with very great nicety. It may be collected from them in general, that the elasticity of the air is very nearly proportioned to its density; and accordingly this law was almost immediately acquiesced in, and was called the *Boylean law;* it is accordingly assumed by almost all writers on the subject as exact. Of late years, however, there occurred questions in which it was of importance that this point should be more scrupulously settled, and the former experiments were repeated and extended. Sulzer and Fontana have carried them farther than any other. Sulzer compressed air into one-eighth of its former dimensions.

Varieties in these experiments.

Considerable varieties and irregularities are to be observed in these experiments. It is extremely difficult to preserve the temperature of the apparatus, particularly of the leg AB, which is most handled. A great quantity of mercury must be employed; and it does not appear that philosophers have been careful to have it precisely similar to that in the barometer, which gives us the unit of compressing force and of elasticity. The mercury in the syphon as well as in the barometer should be pure and boiled. If the mercury in the syphon is adulterated with bismuth and tin, which it commonly is to a considerable degree, the compressing force, and consequently the elasticity, will appear greater than the truth. If the barometer has not been nicely filled, it will be lower than it should be, and the compressing force will appear too great, because the unit is too small; and this error will be most remarkable in the smaller compressions.

Heterogeneous nature of the air.

The greatest source of error and irregularity in the experiments is the very heterogeneous nature of the air itself. Air is a solvent of all fluids, all vapours, and perhaps of many solid bodies. It is highly improbable that the different compounds shall have the same elasticity, or even the same law of elasticity; and it is well known, that air loaded with water or other volatile bodies, is much more expansible by heat than pure air; nay, it would appear from many experiments, that certain determinate changes both of density and of temperature, cause air to let go the vapours which it holds in solution. Cold causes it to precipitate water, as appears in dew; so does rarefaction, as is seen in the receiver of an air-pump.

The elasticity of air.

In general, it appears that the elasticity of air does not increase quite so fast as its density. This will be best seen by the following tables, calculated from the experiments of Mr. Sulzer. The column E in each set of experiments expresses the length of the column GH, the unit being FH, whilst the column D expresses $\frac{AB}{AE}$.

First set.		Second set.		Third set.	
D	E	D	E	D	E
1·000	1·000	1·000	1·000	1·000	1·000
1·100	1·093	1·236	1·224	1·091	1·076
1·222	1·211	1·294	1·288	1·200	1·183
1·375	1·284	1·375	1·332	1·333	1·303
1·571	1·559	1·466	1.417	1·500	1·472
1·692	1·669	1·571	1·515	1·714	1·659
1·833	1·796	1·692	1·647		
2·000	1·958	2·000	1·964	2·000	1·900
2·288	2·130				
2·444	2·375	2·444	2·392	2·400	2·241
3·143	2·936	3·143	3·078	3·000	2·793
3·666	3·391	3·666	3·575		
4·000	3·706			4·000	3·631
4·444	4·035	4·444	4·320		
4·888	4·438				
5·500	4·922	5·500	5·096		
5·882	5·522			6·000	5·297
		7·333	6·694		
				8·000	6·835

There appears in these experiments to be sufficient grounds for calling in question the Boylean law; and the writer of this article thought it incumbent on him to repeat them with some precautions, which probably had not been attended to by Mr. Sulzer. He was particularly anxious to have the air as free as possible from moisture. For this purpose, having detached the short leg of the syphon, which was 34 inches long, he boiled mercury in it, and filled it with mercury boiling hot. He took a tinplate vessel of sufficient capacity, and put into it a quantity of powdered quicklime just taken from the kiln; and having closed the mouth, he agitated the lime through the air in the vessel, and allowed it to remain there all night. He then emptied the mercury out of the syphon into this vessel, keeping the open end far within it. By this means the short leg of the syphon was filled with very dry air. The other part was now joined, and boiled mercury put into the bend of the syphon; and the experiment was then prosecuted with mercury which had been recently boiled, and was the same with which the barometer had been carefully filled.

The results of the experiments are expressed in the following table:

First set.		Second set.		Third set.	
D	E	D	E	D	E
1·000	1·000	1·000	1·000	1·000	1·000
2·000	1·957	2·000	1·920	2·000	1·909
3·000	2·848	3·000	3·839	3·000	2·845
4·000	3·737	4·000	3·726	4·000	3·718
5·500	4·930	5·500	5·000	5·500	5·104
6·000	5·342	6·000	5·452	6·000	5·463
7·620	6·490	7·620	6·775	7·620	6·812

Here it appears again in the clearest manner that the elasticities do not increase as fast as the densities, and the differences are even greater than in Mr. Sulzer's experiments.

The second table contains the results of experiments which were made on very damp air in a warm summer's morning. In these it appears that the elasticities are almost precisely proportional to the densities + a small constant quantity, nearly 0·11, deviating from this rule chiefly between the densities 1 and 1·5, within which limits we have very nearly $D = E^{1\cdot0017}$. As this air is nearer to the constitution of atmospheric air than the former, this rule may be safely followed in cases where atmospheric air is concerned, as in measuring the depths of pits by the barometer.

The third table shows the compression and elasticity of air strongly impregnated with the vapours of camphire. Here the Boylean law appears pretty exact, or rather the elasticity seems to increase a little faster than the density.

Dr. Hooke examined the compression of air by immersing a bottle to great depths in the sea, and weighing the water which got into it without any escape of air. But this method was liable to great uncertainty, on account of the unknown temperature of the sea at great depths.

Mode of examining the elasticity of rarefied air.

Hitherto we have considered only such air as is not rarer than what we breathe; we must take a very different method for examining the elasticity of rarefied air. Let *gh* (fig. 67,) be a long tube, formed a-top into a cup, and of sufficient diameter to receive another smaller tube *af*, open at first at both ends. Let the outer tube and cup be filled with mercury, which will rise in the inner tube to the same level. Let *af* now be stopped at *a*. It contains air of the same density and elasticity with the adjoining atmosphere. Note exactly the space *ab* which it occupies. Draw it up into the position of fig. 68, and let the mercury stand in it at the height *de*, whilst *ce* is the height of the mercury in the barometer. It is evident that the column *d e* is in equilibrio between the pressure of the atmosphere and the elasticity of the air included in the space *a d*. And since the weight of *c e* would be in equilibrio with the whole pressure of the atmosphere, the weight of *c d* is equivalent to the elasticity of the included air. Whilst therefore *c c* is the measure of the elasticity of the surrounding atmosphere, *c d* will be the measure of the elasticity of the included air; and since the air originally occupied the space *a b*, and has now expanded into *a d*, we have $\frac{ab}{ad}$ for the measure of its density. N.B. *c e* and *c d* are measured by the *perpendicular heights* of the columns, but *a b* and *a d* must be measured by their *solid capacities*.

By raising the inner tube still higher, the mercury will also rise higher, and the included air will expand still farther, and we obtain another *c d*, and another $\frac{ab}{ad}$; and in this manner the relation between the density and elasticity of rarefied air may be discovered.

Fig. 67.

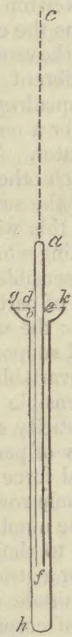


Fig. 68.

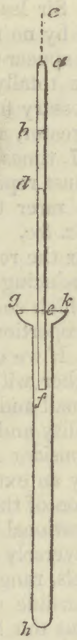
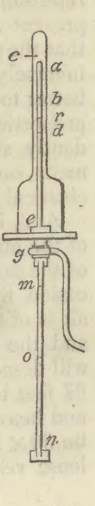


Fig. 69.



An easier method.

This examination may be managed more easily by means of the air-pump. Suppose a tube *ae* (fig. 69) containing a small quantity of air *a b*, set up in a cistern of mercury, which is supported in the tube at the height *e b*, and let *e c* be the height of the mercury in the barometer. Let this apparatus be set under a tubulated receiver on the pump-plate, and let *g n* be the pump-gage, and *m n* be made equal to *c e*.

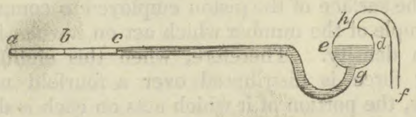
Then, as has been already shown, *c b* is the measure of the elasticity of the air in *a b*, corresponding to the bulk *a b*. Now let some air be abstracted from the receiver. The elasticity of the remainder will be diminished by its expansion; and therefore the mercury in the tube *a e* will descend to some point *d*. For the same reason, the mercury in the gage will rise to some point *o*, and *m o* will express the elasticity of the air in the receiver. This would support the mercury in the tube *a e* at the height *e r*, if the space *a r* were entirely void of air. Therefore *r d* is the effect and measure of the elasticity of the included air when it has expanded to the bulk *a d;* and thus its elasticity, under a variety of other bulks, may be compared with its elasticity when of the bulk *a b*. When the air has been so far abstracted from the receiver that the mercury in *a e* descends to *e*, then *m o* will be the precise measure of its elasticity.

In all these cases it is necessary to compare its bulk *a b* with its natural bulk, in which its elasticity balances the pressure of the atmosphere. This may be done by laying the tube *a c* horizontally, and then the air will collapse into its ordinary bulk.

Another method.

Another easy method may be taken for this examination. Let an apparatus *a b c d e f* (fig. 70,) be made, consisting of a horizontal tube *a e* of even bore, a ball *d g e* of a large diameter, and a swan-neck tube *h f*. Let the ball and part of the tube *g e b* be filled with mercury, so that the tube may be in the same horizontal plane with the surface *d e* of the mercury in the ball. Then seal up the end *a*, and connect *f* with an air-pump. When the air is abstracted from the surface *d e*, the air in *a b* will expand into a larger bulk *a c*, and the mercury in the pump-gage will rise to some distance below the barometric height. It is evident that this distance, without any farther calculation, will be the measure of the elasticity of the air pressing on the surface *d e*, and therefore of the air in *a e*.

Fig. 70.



The most exact mode.

The most exact of all methods is to suspend in the receiver of an air-pump a glass vessel, having a very narrow mouth, over a cistern of mercury, and then abstract the air till the gage rises to some determined height. The difference *e* between this height and the barometric height determines the elasticity of the air in the receiver and in the suspended vessel. Now, lower down that vessel by the slip-wire till its mouth is immersed into the mercury, and admit the air into the receiver; it will press the mercury into the little vessel. Lower it still further down, till the mercury within it is level with that without; then stop its mouth, take it out and weigh the mercury, and let its weight be *w*. Subtract this weight from the weight *v* of the mercury, which would completely fill the whole vessel; then the natural bulk of the air will be *v—w*, whilst its bulk, when of the elasticity *e* in the rarefied receiver, was the bulk or capacity *w* of the vessel. Its density therefore, corresponding to this elasticity *e*, was $\frac{v-w}{w}$. And thus may the relation between density and elasticity in all cases be obtained.

Various experiments made to this purpose.

A great variety of experiments to this purpose have been made, with different degrees of attention, according to the interest which the philosophers had in the result. Those made by M. de Luc, General Roy, Mr. Trembley, and Sir George Shuckburgh, are by far the most accurate; but they are all confined to very moderate rarefactions. The gene-

Boylean Law.

ral result has been, that the elasticity of rarefied air is very nearly proportional to its density. We cannot say with confidence that any regular deviation from this law has been observed, there being as many observations on one side as on the other; but we think that it is not unworthy the attention of philosophers to determine it with precision in the cases of extreme rarefaction, where the irregularities are most remarkable. The great source of error is a certain adhesive sluggishness of the mercury when the impelling forces are very small; and other fluids can hardly be used, because they either smear the inside of the tube and diminish its capacity, or they are converted into vapour, which alters the law of elasticity.

The Boylean law may be assumed.

Let us, upon the whole, assume the Boylean law, viz. that the elasticity of the air is proportional to its density. The law deviates not in any sensible degree from the truth in those cases which are of the greatest practical importance, that is, when the density does not much exceed or fall short of that of ordinary air.

Investigation.

Let us now see what information this gives us with respect to the action of the particles on each other. The investigation is extremely easy. We have seen that a force eight times greater than the pressure of the atmosphere will compress common air into the eighth part of its common bulk, and give it eight times its common density; and in this case we know, that the particles are at half their former distance, and that the number which are now acting on the surface of the piston employed to compress them is quadruple of the number which act on it when it is of the common density. Therefore, when this eightfold compressing force is distributed over a fourfold number of particles, the portion of it which acts on each is double. In like manner, when a compressing force 27 is employed, the air is compressed into $\frac{1}{27}$ of its former bulk, the particles are at $\frac{1}{3}$ of their former distance, and the force is distributed among 9 times the number of particles; the force on each is therefore 3. In short, let $\frac{1}{x}$ be the distance of the particles, the number of them in any given vessel, and therefore the density will be as x^3, and the number pressing by their elasticity on its whole internal surface will be as x^2. Experiment shews, that the compressing force is as x^3, which being distributed over the number as x^2, will give the force on each as x. Now, this force is in immediate equilibrium with the elasticity of the particle immediately contiguous to the compressing surface. This elasticity is therefore as x; and it follows from the nature of perfect fluidity, that the particle adjoining to the compressing surface presses with an equal force on its adjoining particles on every side. Hence we must conclude, that the corpuscular repulsions exerted by the adjoining particles are inversely as their distances from each other, or that the adjoining particles tend to recede from each other with forces inversely proportional to their distances.

Sir Isaac Newton first reasoned properly.

Sir Isaac Newton was the first who reasoned in this manner from the phenomena. Indeed he was the first who had the patience to reflect on the phenomena with any precision. His discoveries in gravitation naturally gave his thoughts this turn, and he very early hinted his suspicions that all the characteristic phenomena of tangible matter were produced by forces which were exerted by the particles at small and insensible distances. And he considers the phenomena of air as affording an excellent example of this investigation, and deduces from them the law which we have now demonstrated; and says, that air consists of particles which avoid the adjoining particles with forces inversely proportional to their distances from each other. From this he deduces (in the second book of his Principles) several beautiful propositions, determining the mechanical constitution of the atmosphere.

Limits.

But it must be noticed that he limits this action to the *adjoining* particles; and this is a remark of immense consequence, though not attended to by the numerous experimenters who adopt the law.

Height of the atmosphere.

It is plain that the particles are supposed to act at a distance, and that this distance is variable, and that the forces diminish as the distances increase. A very ordinary air-pump will rarefy the air 125 times. The distance of the particles is now 5 times greater than before; and yet they still repel each other; for air of this density will still support the mercury in a syphon-gage at the height of 0·24, or $\frac{24}{100}$ of an inch; and a better pump will allow this air to expand twice as much, and still leave it elastic. Thus we see that whatever is the distance of the particles of common air, they can act five times further off. The question comes now to be, Whether, in the state of common air, they really do act five times further than the distance of the adjoining particles? Whilst the particle *a* acts on the particle *b* with the force 5, does it also act on the particle *c* with the force 2·5, on the particle *d* with the force 1·667, on the particle *e* with the force 1·25, on the particle *f* with the force 1, on the particle *g* with the force 0.833, &c.

Sir Isaac Newton shows in the plainest manner, that this is by no means the case; for if this were the case, he makes it appear that the sensible phenomena of condensation would be totally different from that we observe. The force necessary for a quadruple condensation would be eight times greater, and for a monuple condensation the force must be 27 times greater. Two spheres filled with condensed air must repel each other, and two spheres containing air that is rarer than the surrounding air must attract each other, &c. &c. All this will appear very clearly, by applying to air the reasoning which Sir Isaac Newton has employed in deducing the sensible law of mutual tendency of two spheres, which consist of particles attracting each other with forces proportional to the square of the distance inversely.

If we could suppose that the particles of air repelled each other with invariable forces at all distances within some small and insensible limit, this would produce a compressibility and elasticity similar to what we observe. For if we consider a row of particles, within this limit, as compressed by an external force applied to the two extremities, the action of the whole row on the extreme points would be proportional to the number of particles, that is, to their distance inversely and to their density: and a number of such parcels, ranged in a straight line, would constitute a row of any sensible magnitude having the same law of compression. But this law of corpuscular force is unlike every thing we observe in nature, and to the last degree improbable.

We must therefore continue the limitation of this mutual repulsion of the particles of air, and be contented for the present with having established it as an experimental fact, that the adjoining particles of air are kept asunder by forces inversely proportional to their distances; or perhaps it is better to abide by the sensible law, that the density of air is proportional to the compressing force. This law is abundantly sufficient for explaining all the subordinate phenomena, and for giving us a complete knowledge of the mechanical constitution of our atmosphere.

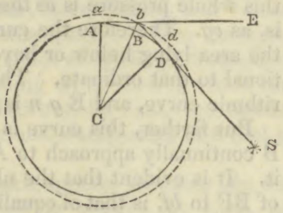
The height of the air investigated.

And, in the first place, this view of the compressibility of the air must give us a very different notion of the height of the atmosphere from what we deduced on a former occasion from our experiments. It is found, that when the air is of the temperature 32° of Fahrenheit's thermometer, and the mercury in the barometer stands at 30 inches, it will descend one-tenth of an inch if we take it to a place 87 feet higher. Therefore, if the air were equally dense and heavy throughout, the height of the atmosphere would be 30 × 10 × 87 feet, or 5 miles and 100 yards. But the loose reasoning adduced on that occasion was enough to

Height of the atmosphere.

show us that it must be much higher; because every stratum as we ascend must be successively rarer as it is less compressed by incumbent weight. Not knowing to what degree air expanded when the compression was diminished, we could not tell the successive diminutions of density and consequent augmentation of bulk and height; we could only say, that several atmospheric appearances indicated a much greater height. Clouds have been seen much higher; but the phenomenon of the twilight is the most convincing proof of this. There is no doubt that the visibility of the sky or air is owing to its want of perfect transparency, each particle, whether of matter purely aerial or heterogeneous, reflecting a little light.

Fig. 71.



Let *b* (fig. 71) be the last particle of illuminated air which can be seen in the horizon by a spectator at A. This must be illuminated by a ray SD *b*, touching the earth's surface at some point D. Now it is a known fact, that the degree of illumination called *twilight* is perceived when the sun is 18° below the horizon of the spectator, that is, when the angle E *b* S or ACD is 18 degrees; therefore *b* C is the secant of 9 degrees (it is less, viz. about 8½ degrees, on account of refraction). We know the earth's radius to be about 3970 miles: hence we conclude *b* B to be about 45 miles; nay, a very sensible illumination is perceptible much farther from the sun's place than this, perhaps twice as far, and the air is sufficiently dense for reflecting a sensible light at the height of nearly 200 miles.

Experiment fixes no limit to the air's expansibility.

We have now seen that air is prodigiously expansible. None of our experiments have distinctly shown us any limit. But it does not follow that it is expansible without end; nor is this at all likely. It is much more probable that there is a certain distance of the parts in which they no longer repel each other; and this would be the distance at which they would arrange themselves if they were not heavy. But at the very summit of the atmosphere they will be a very small matter nearer to each other, on account of their gravitation to the earth. Till we know precisely the law of this mutual repulsion, we cannot say what is the height of the atmosphere.

Further observations.

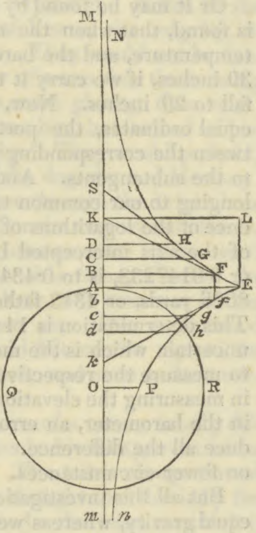
But if the air be an elastic fluid whose density is always proportionable to the compressing force, we can tell what is its density at any height above the surface of the earth: and we can compare the density so calculated with the density discovered by observation: for this last is measured by the height at which it supports mercury in the barometer. This is the direct measure of the pressure of the external air; and as we know the law of gravitation, we can tell what would be the pressure of air having the calculated density in all its parts.

Let us therefore suppose a prismatic or cylindric column of air reaching to the top of the atmosphere. Let this be divided into an indefinite number of strata of very small and equal depths or thickness; and let us, for greater simplicity, suppose at first that a particle of air is of the same weight at all distances from the centre of the earth.

The absolute weight of any one of these strata will on these conditions be proportional to the number of particles or the gravity of air contained in it; and since the depth of each stratum is the same, this quantity of air will evidently be as the density of the stratum. But the density of any stratum is as the compressing force; that is, as the pressure of the strata above it; that is, as their weight; that is, as their quantity of matter: therefore the quantity of air in each stratum is proportional to the quantity of air above it. The quantity in each stratum, however, is the difference between the column incumbent on its bottom and on its top; therefore these differences are proportional to the quantities of which they are the differences. But when there is a series of quantities which are proportional to their own differences, both the quantities and the differences are in continual or geometrical progression: for let a, b, c, be three such quantities that $b : c = a - b : b - c$, then by alternation and composition $a : b = b : c$, therefore the densities of these strata decrease in a geometrical progression; that is, when the elevations above the centre or surface of the earth increase, or their depths under the top of the atmosphere decrease, in an arithmetical progression, the densities decrease in a geometrical progression.

Height of the atmosphere.

Fig. 72.



Let ARQ (fig. 72), represent the section of the earth by a plane through its centre O, and let *m*OAM be a vertical line, and AE perpendicular to OA will be a horizontal line through A, a point on the earth's surface. Let AE be taken to represent the density of the air at A; and let DH, parallel to AE, be taken to AE as the density at D is to the density at A: it is evident, that if a logistic or logarithmic curve EHN be drawn, having AN for its axis, and passing through the points E and H, the density of the air at any other point C, in this vertical line, will be represented by CG, the ordinate to the curve in that point: for it is the property of this curve, that if portions AB, AC, AD, of its axis to be taken in arithmetical progression, the ordinates AE, BF, CG, DH, will be in the geometrical progression.

It is another fundamental property of this curve, that if EK or HS touch the curve in E or H, the subtangent AK or DS is a constant quantity.

And a third fundamental property is, that the infinitely extended area MAEN is equal to the rectangle KAEL of the ordinate and subtangent; and, in like manner, the area MDHN is equal to $SD \times DH$, or to $KA \times DH$; consequently the area lying beyond any ordinate is proportional to that ordinate.

These geometrical properties of this curve are all analogous to the chief circumstances in the constitution of the atmosphere, on the supposition of equal gravity. The area MCGN represents the whole quantity of aereal matter which is above C. For CG is the density at C, and CD is the thickness of the stratum between C and D; and therefore CGHD will be as the quantity of matter or air in it; and in like manner of all the others, and of their sums, or the whole area MCGN; and as each ordinate is proportional to the area above it, so each density, and the quantity of air in each stratum, is proportional to the quantity of air above it; and as the whole area MAEN is equal to the rectangle KAEL, so the whole air of variable density above A might be contained in a column KA, if, instead of being compressed by its own weight, it were without weight, and compressed by an external force equal to the pressure of the air at the surface of the earth. In this case, it would be of the uniform density AE, which it has at the surface of the earth, making what we have repeatedly called the homogeneous atmosphere.

Hence we derive this important circumstance, that the height of the homogeneous atmosphere is the subtangent of that curve, the ordinates of which are as the densities of the air at different heights, on the supposition of equal gravity. This curve may with propriety be called the *atmospherical*

Height of the atmosphere.

logarithmic; and as the different logarithmics are all characterised by their subtangents, it is of importance to determine this one.

It may be done by comparing the densities of mercury and air. For a column of air of uniform density, reaching to the top of the homogeneous atmosphere, is in equilibrio with the mercury in the barometer. Now, it is found, by the best experiments, that when mercury and air are of the temperature of 32° of Fahrenheit's thermometer, and the barometer stands at 30 inches, the mercury is nearly 10440 times denser than air. Therefore the height of the homogeneous atmosphere is 10440 times 30 inches, or 26100 feet, or 8700 yards, or 4350 fathoms, or 5 miles wanting 100 yards.

Or it may be found by observations on the barometer. It is found, that when the mercury and air are of the above temperature, and the barometer on the sea-shore stands at 30 inches, if we carry it to a place 884 feet higher it will fall to 29 inches. Now, in all logarithmic curves having equal ordinates, the portions of the axes intercepted between the corresponding pairs of ordinates are proportional to the subtangents. And the subtangents of the curve belonging to our common tables is 0·4342945, and the difference of the logarithms of 30 and 29, (which is the portion of the axis intercepted between the ordinates 30 and 29), or 0·0147233, is to 0·4342945 as 883 is to 26068 feet, or 8686 yards, or 4343 fathoms, or 5 miles wanting 114 yards. This determination is 14 yards less than the other, and it is uncertain which is the more exact. It is extremely difficult to measure the respective densities of mercury and air; and in measuring the elevation which produces a fall of one inch in the barometer, an error of 1-20th of an inch would produce all the difference. We prefer the last, as depending on fewer circumstances.

But all this investigation proceeds on the supposition of equal gravity, whereas we know that the weight of a particle of air decreases as the square of its distance from the centre of the earth increases. In order, therefore, that a superior stratum may produce an equal pressure at the surface of the earth, it must be denser, because a particle of it gravitates less. The density, therefore, at equal elevations, must be greater than on the supposition of equal gravity, and the law of diminution of density must be different.

$$\text{Make } OD : OA = OA : Od;$$
$$OC : OA = OA : Oc;$$
$$OB : OA = OA ; Ob; \text{ \&c.};$$

so that Od, Oc, Ob, OA, may be reciprocals to OD, OC, OB, OA; and through the points, A, b, c, d, draw the perpendiculars AE, bf, cg, dh, making them proportional to the densities in A, B, C, D: and let us suppose CD to be exceedingly small, so that the density may be supposed uniform through the whole stratum. Thus we have

$$OD \times Od = OA^2, = OC \times Oc$$
$$\text{and } Oc : Od : OD : OC;$$
$$\text{and } Oc : Oc - Od = OD : OD - OC,$$
$$\text{or } Oc : cd = OD : BC;$$
$$\text{and } cd : CD = Oc : OD;$$

or, because OC and OD are ultimately in the ratio o equality, we have

$$cd : CD = Oc : OC = OA^2 : OC^2,$$

and $cd = CD \times \frac{OA^2}{OC^2}$, and $cd \times cg = CD \times cg \times \frac{OA^2}{OC^2}$; but $CD \times cg \times \frac{OA^2}{OC^2}$ is as the pressure at C arising from the absolute weight of the stratum CD. For this weight is as the bulk, as the density, and as the gravitation of each particle jointly. Now CD expresses the bulk, cg the density, and $\frac{OA^2}{OC^2}$, the gravitation of each particle. Therefore, $cd \times cg$ is as the pressure on C arising from the weight of the stratum DC; but $cd \times cg$ is evidently the element of the curvilineal area A$mn$E, formed by the curve E$fghn$ and the ordinates AE, bf, cg, ah, &c. mn. Therefore the sum of all the elements, such as $c\,d\,h\,g$, that is, the area $c\,m\,n\,g$ below cg, will be as the *whole* pressure on C, arising from the gravitation of all the air above it; but, by the nature of air, this whole pressure is as the density which it produces, that is, as cg. Therefore the curve E$g\,n$ is of such a nature that the area lying below or beyond any ordinate cg is proportional to that ordinate. This is the property of the logarithmic curve, and E $g\,n$ is a logarithmic curve.

But farther, this curve is the same with EGN. For let B continually approach to A, and ultimately coincide with it. It is evident that the ultimate ratio of BA to Ab, and of BF to bf, is that of equality; and if EFK, Efk, be drawn, they will contain equal angles with the ordinate AE, and will cut off equal subtangents AK, Ak. The curves EGN, Egn are therefore the same, but in opposite positions.

Lastly, if OA, Ob, Oc, Od, &c. be taken in arithmetical progression decreasing, their reciprocals OA, OB, OC, OD, &c. will be in harmonical progression increasing, as is well known; but, from the nature of the logarithmic curve, when OA, Ob, Oc, Od, &c. are in arithmetical progression, the ordinates AE, bf, cg, dh, &c. are in geometrical progression. Therefore when OA, OB, OC, OD, &c. are in harmonical progression, the densities of the air at A, B, C, D, &c. are in geometrical progression; and thus may the density of the air at all elevations be discovered. Thus, to find the density of the air at K the top of the homogeneous atmosphere, make OK : OA=OA : OL, and draw the ordinate LT, LT is the density at K.

The celebrated Dr. Halley was the first who observed the relation between the density of the air and the ordinates of the logarithmic curve, or common logarithms. This he did on the supposition of equal gravity; and his discovery is acknowledged by Sir Isaac Newton in his *Principia*, ii. *prop.* 22, *schol.* Halley's dissertation on the subject is in No. 185 of the *Philosophical Transactions.* Newton, with his usual sagacity, extended the same relation to the true state of the case, where gravity is as the square of the distance inversely; and showed that when the distances from the earth's centre are in harmonic progression, the densities are in geometric progression. He shows, indeed, in general, what progression of the distance, on any supposition of gravity, will produce a geometrical progression of the densities, so as to obtain a set of lines OA, Ob, Oc, Od, &c. which will be logarithms of the densities.[1]

Finite density of the air at an infinite distance.

An important corollary is deducible from these principles, viz. that the air has a finite density at an infinite distance from the centre of the earth, namely, such as will be represented by the ordinate OP drawn through the centre. It may be objected to this conclusion, that it would infer an infinity of matter in the universe, and that it is inconsistent with the phenomena of the planetary motions, which appear to be performed in a space void of all resistance, and therefore of all matter. But this fluid must be so rare at great

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[1] The subject was afterwards treated in a more familiar manner by Cotes in his *Hydrostatic Lectures*, and in his *Harmonia Mensurarum* by Dr. Brook Taylor, in his *Methodus Increment.*; by Wolf in his *Aerometria*; by Herman in his *Phoronomia*; and by Horsley in the *Philosophical Transactions*, tom. lxiv.

Atmosphere of the other planets.

distances, that the resistance will be insensible, even though the retardation occasioned by it has been accumulated for ages. Even at the very moderate distance of 500 miles, the rarity is so great that a cubic inch of common air expanded to that degree would occupy a sphere equal to the orbit of Saturn; and the whole retardation which this planet would sustain after some millions of years would not exceed what would be occasioned by its meeting one bit of matter of half a grain weight.

This being the case, it is not unreasonable to suppose the visible universe occupied by air, which, by its gravitation, will accumulate itself round every body in it, in a proportion depending on their quantities of matter, the larger bodies attracting more of it than the smaller ones, and thus forming an atmosphere about each. And many appearances warrant this supposition. Jupiter, Mars, Saturn, and Venus, are evidently surrounded by atmospheres. The constitution of these atmospheres may differ exceedingly from other causes. If the planet has nothing on its surface which can be dissolved by the air or volatilized by heat, the atmosphere will be continually clear and transparent, like that of the moon.

The atmosphere of Mars.

Mars has an atmosphere which appears precisely like our own, carrying clouds, or depositing snows; for when, by the obliquity of his axis to the plane of his eliptic, he turns his north pole towards the sun, it is observed to be occupied by a broad white spot. As the summer of that region advances, this spot gradually wastes, and sometimes vanishes, and then the south pole comes in sight, surrounded in like manner with a white spot, which undergoes similar changes. This is precisely the appearance which the snowy circumpolar regions of this earth will exhibit to an astronomer on Mars. It may not, however, be snow that we see; thick clouds will have the same appearances.

Of Jupiter.

The atmosphere of the planet Jupiter is also very similar to our own. It is diversified by streaks or belts parallel to his equator, which frequently change their appearance and dimensions, in the same manner as those tracks of similar sky which belong to different regions of this globe. There is a certain kind of weather that more properly belongs to a particular climate than to any other. This is nothing but a certain general state of the atmosphere which is prevalent there, though with considerable variations. This must appear to a spectator in the moon like a streak spread over that climate, distinguishing it from others. But the most remarkable similarity is in the motion of the clouds on Jupiter. They have plainly a motion from east to west relative to the body of the planet; for there is a remarkable spot on the surface of the planet, which is observed to turn round the axis in 9h. 51′ 16″; and there frequently appear variable and perishing spots in the belts, which sometimes last for several revolutions. These are observed to circulate in 9h. 55′ 0·5″. These numbers are the results of a long series of observations by Dr. Herschel. This plainly indicates a general current of the clouds westward, precisely similar to what a spectator in the moon must observe in our atmosphere arising from the trade winds. Mr. Schroeter has made the atmosphere of Jupiter a study for many years; and deduces from his observations that the motion of the variable spots is subject to great variations, but is always from east to west. This indicates variable winds.

Of Venus.

The atmosphere of Venus appears also to be like ours, loaded with vapours, and in a state of continual change of absorption and precipitation. About the middle of the seventeenth century the surface of Venus was pretty distinctly seen for many years chequered with irregular spots, which are described by Campani, Bianchini, and other astronomers in the south of Europe, and also by Cassini at Paris, and Hooke and Townley in England. But the spots became gradually more faint and indistinct; and, for near a century, have disappeared. The whole surface appears now of one uniform brilliant white. The atmosphere is probably filled with a reflecting vapour, thinly diffused through it, like water faintly tinged with milk. A great depth of this must appear as white as a small depth of milk itself; and it appears to be of a very great depth, and to be refractive like our air. For Sir William Herschel observed, by the help of his fine telescopes, that the illuminated part of Venus is considerably more than a hemisphere, and that the light dies gradually away to the bounding margin. This is the very appearance that the earth would make if furnished with such an atmosphere. The boundary of illumination would have a penumbra reaching about nine degrees beyond it. If this be the constitution of the atmosphere of Venus, she may be inhabited by beings like ourselves. They would not be dazzled by the intolerable splendour of a sun four times as big and as bright, and sixteen times more glaring than ours; for they would seldom or never see him, but instead of him an uniformly bright and white sky. They would probably never see a star or planet, unless the dog-star and Mercury; and perhaps the earth might pierce through the bright haze which surrounds their planet. For the same reason the inhabitants would not perhaps be incommoded by the sun's heat. It is indeed a very questionable thing, whether the sun would cause any heat, even here, if it were not for the chemical action of his rays on our air. This is rendered not improbable by the intense cold felt on the tops of the highest mountains, in the clearest air, and even under a vertical sun in the torrid zone.

Atmosphere of the other planets.

And of comets.

The atmosphere of comets seems of a nature totally different. This seems to be of inconceivable rarity, even when it reflects a very sensible light. The tail is always turned nearly away from the sun. It is thought that this is by the impulse of the solar rays. If this be the case, we think it might be discovered by the aberration and the refraction of the light by which we see the tail; for this light must come to our eye with a much smaller velocity than the sun's light, if it be reflected by repulsive or elastic forces, which there is every reason in the world to believe; and therefore the velocity of the reflected light will be diminished by all the velocity communicated to the reflecting particles. This is almost inconceivably great. The comet of 1680 went half round the sun in ten hours, and had a tail at least a hundred millions of miles long, which turned round at the same time, keeping nearly in the direction opposite to the sun. The velocity necessary for this is prodigious, approaching to that of light. And perhaps the tail extends much farther than we see it, but is visible only as far as the velocity with which its particles recede from the sun is less than a certain quantity, namely, what would leave a sufficient velocity for the reflected light to enable it to affect our eyes. And it may be demonstrated, that although the real form of the visible tail is concave on the anterior side to which the comet is moving, it may appear convex on that side, in consequence of the very great aberration of the light by which the remote parts are seen. All this may be discovered by properly contrived observations: and the conjecture merits attention. But of this digression there is enough; and we return to our subject, the constitution of our air.

The barometer used in measuring heights.

We have shown how to determine *a priori* the density of the air at different elevations above the surface of the earth. But the densities may be discovered in all accessible elevations by experiments; namely, by observing the heights of the mercury in the barometer. This is a direct measure of the pressure of the incumbent atmosphere; and this is proportional to the density which it produces. See Barometer and Barometrical Instruments.[1]

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[1] For a table of the heights of the most remarkable mountains, many of which have been determined by the Barometer, see Physical Geography.

We have thus given an elementary account of the distinguishing properties of air as a heavy and compressible fluid, and of the general phenomena which are immediate consequences of these properties. This we have done in a set of propositions analogous to those which form the doctrines of hydrostatics. It remains to consider it in another point of view, namely, as moveable and inert. The phenomena consequent on these properties are exhibited in the velocities which air acquires by pressure, in the resistance which bodies meet with to their motion through the air, and in the impression which air in motion gives to bodies exposed to its action.

Doctrine of air acted on by equal and parallel gravity.

We shall first consider the motions of which air is susceptible when the equilibrium of pressure, whether arising from its weight or its elasticity, is removed; and, in the next place, we shall consider its action on solid bodies exposed to its current, and the resistance which it makes to their motion through it. In this consideration we shall avoid the extreme of generality, which renders the discussion too abstract and difficult, and adapt our investigation to the circumstances in which compressible fluids, of which air is taken for the representative, are most commonly found. We shall consider air therefore as it is commonly found in accessible situations, as acted on by equal and parallel gravity; and we shall consider it in the same order in which water is treated in a system of hydraulics.

In that science the leading problem is to determine with what velocity the water will move through a given orifice when impelled by some known pressure; and it has been found, that the best form in which this most difficult and intricate proposition can be put, is to determine the velocity of water flowing through this orifice when impelled by its weight alone. Having determined this, we can reduce to this case every question which can be proposed, for in place of the pressure of any piston or other mover, we can always substitute a perpendicular column of water or air whose weight shall be equal to the given pressure.

The velocity with which air ushes into a void.

The first problem, therefore, is to determine with what velocity air will rush into a void when impelled by its weight alone. This is evidently analogous to the hydraulic problem of water flowing out of a vessel. And here we must be contented with referring our readers to the solutions which have been given of that problem, and the demonstration that it flows with the velocity which a heavy body would acquire by falling from a height equal to the depth of the hole under the surface of the water in the vessel. In whatever way we attempt to demonstrate that proposition, every step, nay, every word, of the demonstration applies equally to the air, or to any fluid whatever. Or, if our readers should wish to see the connexion or analogy of the cases, we only desire them to recollect an undoubted maxim in the science of motion, that "when the moving force and the matter to be moved vary in the same proportion, the velocity will be the same." If therefore there be similar vessels of air, water, oil, or any other fluid, all of the height of a homogeneous atmosphere, they will all run through equal and similar holes with the same velocity; for in whatever proportion the quantity of matter moving through the hole be varied by a variation of density, the pressure which forces it out, by acting in circumstances perfectly similar, varies in the same proportion by the same variation of density. We must therefore assume it as the leading proposition, that "air rushes from the atmosphere into a void with the velocity which a heavy body would acquire by falling from the top of a homogeneous atmosphere."

It is known that air is about 840 times lighter than water, and that the pressure of the atmosphere supports water at the height of 33 feet nearly. The height therefore of a homogeneous atmosphere is nearly 33×840, or 27,720 feet. Moreover, to know the velocity acquired by any fall, recollect that a heavy body by falling one foot acquires the velocity of 8 feet per second; and that the velocities acquired by falling through different heights are as the square roots of the heights. Therefore to find the velocity corresponding to any height, expressed in feet per second, multiply the square root of the height by 8. We have therefore in the present instance $V = \sqrt{27,220}$, $= 8 \times 166.493$, $= 1332$ feet per second. This therefore is the velocity with which common air will rush into a void; and this may be taken as a standard number in pneumatics, as 16 and 32 are standard numbers in the general science of mechanics, expressing the action of gravity at the surface of the earth.

It is easy to see that greater precision is not necessary in this matter. The height of a homogeneous atmosphere is a variable thing, depending on the temperature of the air. If this reason seems any objection against the use of the number 1332, we may retain $8\sqrt{H}$ in place of it, where H expresses the height of a homogeneous atmosphere of the given temperature. A variation of the barometer makes no change in the velocity, nor in the height of the homogeneous atmosphere, because it is accompanied by a proportional variation in the density of the air. When it is increased $\frac{1}{10}$, for instance, the density is also increased $\frac{1}{10}$; and thus the expelling force and the matter to be moved are changed in the same proportion, and the velocity remains the same. Observe, we do not here consider the velocity which the air acquires after its issuing into the void by its continual expansion. This may be ascertained by the 39th proposition of Newton's *Principia*, book first. Nay, which appears very paradoxical, if a cylinder of air, communicating in this manner with a void, be compressed by a piston loaded with a weight, which presses it down as the air flows out, and thus keeps it of the same density, the velocity of efflux will still be the same, however great the pressure may chance to be; for the first and immediate effect of the load on the piston is to reduce the air in the cylinder to such a density that its elasticity shall exactly balance the load; and because the elasticity of air is proportional to its density, the density of the air will be increased in the same proportion with the load, that is, with the expelling power, for we are neglecting at present the weight of the included air as too inconsiderable to have any sensible effect. Therefore, since the matter to be moved is increased in the same proportion with the pressure, the velocity will be the same as before.

The velocity with which air rushes into a space containing rarer air.

It is equally easy to determine the velocity with which the air of the atmosphere will rush into a space containing rarer air. Whatever may be the density of this air, its elasticity, which follows the proportion of its density, will balance a proportional part of the pressure of the atmosphere; and it is the excess of this last only which is the moving force. The matter to be moved is the same as before. Let D be the natural density of the air, and δ the density of the air contained in the vessel into which it is supposed to run, and let P be the pressure of the atmosphere, and therefore equal to the force which impels it into a void; and let π be the force with which this rarer air would run into a void. We have $D : \delta = P : \pi$, and $\pi = \frac{P\delta}{D}$. Now the moving force in the present instance is $P - x$, or $P - \frac{P\delta}{D}$. Lastly, let V be the velocity of air rushing into a void, and v the velocity with which it will rush into this rarefied air.

It is a theorem in the motion of fluids, that the pressures are as the squares of the velocities af efflux.

Therefore $P : P - \frac{P\delta}{D} = V^2 : v^2$. Hence we derive $v^2 = V^2$

Air in motion.

$\times\,\overline{1-\frac{\delta}{D}}$, and $v\times V=\sqrt{1-\frac{\delta}{D}}\Big|$. We do not here consider the resistance which the air of the atmosphere will meet with from the inertia of that in the vessel which it must displace in its motion.

Here we see that there will always be a current into the vessel while δ is less than D.

We also learn the gradual diminution of the velocity as the vessel fills; for δ continually increases, and therefore $1-\frac{\delta}{D}$ continually diminishes.

It remains to determine the time t expressed in seconds, in which the air of the atmosphere will flow into this vessel from its state of vacuity till the air in the vessel has acquired any proposed density δ.

For this purpose let H, expressed in feet, be the height through which a heavy body must fall in order to acquire the velocity V, expressed also in feet per second. This we shall express more briefly in future, by calling it the height producing the velocity V. Let C represent the capacity of the vessel, expressed in cubic feet, and O the area or section of the orifice, expressed in superficial or square feet; and let the natural density of the air be D.

Since the quantity of aerial matter contained in a vessel depends on the capacity of the vessel and the density of the air jointly, we may express the air which would fill this vessel by the symbol CD when the air is in its ordinary state, and by Cδ when it has the density δ. In order to obtain the rate at which it fills, we must take the fluxion of this quantity Cδ. This is $C\dot{\delta}$; for C is a constant quantity, and δ is a variable or flowing quantity.

But we also obtain the rate of influx by our knowledge of the velocity, and the area of the orifice, and the density. The velocity is V, or $8\sqrt{H}$, at the first instant; and when the air in the vessel has acquired the density δ, that is, at the end of the time t, the velocity is $8\sqrt{H}\sqrt{1-\frac{\delta}{D}}$, or $8\sqrt{H}\sqrt{\frac{D-\delta}{D}}$, or $8\sqrt{H}\frac{\sqrt{D-\delta}}{\sqrt{D}}$.

The rate of influx therefore (which may be conceived as measured by the little mass of air which will enter during the time $\dot{t}$ with this velocity) will be $\frac{8\sqrt{HOD}\sqrt{D-\delta}\,\dot{t}}{\sqrt{D}}$, or $8\sqrt{H}O\sqrt{D}\sqrt{D-\delta}\,\dot{t}$, multiplying the velocity by the orifice and the density.

Here then we have two values of the rate of influx. By stating them as equal we have a fluxionary equation, from which we may obtain the fluents, that is, the time t in seconds necessary for bringing the air in the vessel to the density δ, or the density δ which will be produced at the end of any time t. We have the equation $8\sqrt{H}O\sqrt{D}\sqrt{D-\delta}\,\dot{t}=C\dot{\delta}$. Hence we derive $\dot{t}=\frac{C}{8\sqrt{H}O\sqrt{D}}\times\frac{\dot{\delta}}{\sqrt{D-\delta}}$.

Of this the fluent is $t=\frac{C}{4\sqrt{H}O\sqrt{D}}\times\sqrt{D-\delta}+A$, in which A is a conditional constant quantity. The condition which determines it is, that t must be nothing when δ is nothing, that is, when $\sqrt{D-\delta}=\sqrt{D}$; for this is evidently the case at the beginning of the motion. Hence it follows, that the constant quantity is $\sqrt{D}$, and the complete fluent, suited to the case, is

$$\frac{C}{4\sqrt{H}O\sqrt{D}}\times\overline{\sqrt{D}-\sqrt{D-\delta}}.$$

The motion ceases when the air in the vessel has acquired the density of the external air; that is, when $\delta=D$, or when $t=\frac{C}{4\sqrt{H}O\sqrt{D}}\times\sqrt{D},=\frac{C}{4\sqrt{H}O}$. Therefore the time of completely filling the vessel is $\frac{C}{4\sqrt{H}O}$.

Air in motion.

Let us illustrate this by an example in numbers.

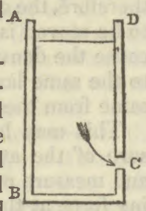
Supposing then that air is 840 times lighter than water, and the height of the homogeneous atmosphere 27,720 feet, we have $4\sqrt{H}=666$. Let us further suppose the vessel to contain 8 cubic feet, which is nearly a wine hogshead, and that the hole by which the air of the ordinary density, which we shall make $=1$, enters, is an inch square, or $\frac{1}{144}$ of a square foot. Then the time in seconds of completely filling it will be $\frac{8'}{\frac{1}{144}666}$, or $\frac{1152''}{666}$, or $1.7297''$. If the hole is only $\frac{1}{100}$ of a square inch, that is, if its side is $\frac{1}{10}$ of an inch, the time of completely filling the hogshead will be 173″ very nearly, or something less than three minutes.

If we make the experiment with a hole cut in a thin plate, we shall find the time greater nearly in the proportion of 63 to 100, for reasons obvious to all who have studied hydraulics. In like manner we can tell the time necessary for bringing the air in the vessel to $\frac{3}{4}$ths of its ordinary density. The only variable part of our fluent is the coefficient $-\sqrt{D-\delta}$, or $\sqrt{1-\delta}$. Let δ be $=\frac{3}{4}$, then $\sqrt{1-\delta}=\sqrt{\frac{1}{4}}=\frac{1}{2}$, and $\sqrt{1-\delta}=\frac{1}{2}$; and the time is $86\frac{1}{2}''$ very nearly when the hole is $\frac{1}{10}$ of an inch wide.

The velocity of air with the impulse of a weight moving down the vessel.

Let us now suppose that the air in the vessel ABCD (fig. 73.) is compressed by a weight acting on the cover AD, which is moveable down the vessel, and is thus expelled into the external air.

Fig. 73.



The immediate effect of this external pressure is to compress the air and give it another density. The density D of the external air corresponds to its pressure P. Let the additional pressure on the cover of the vessel be p, and the density of the air in the vessel be d. We shall have $P:P+p=D:d$; and therefore $p=P\times\frac{d-D}{D}$. Then, because the pressure which expels the air is the difference between the force which compresses the air in the vessel and the force which compresses the external air, the expelling force is p. And because the quantities of motion are as the forces which similarly produce them, we shall have $P:P\times\frac{d-D}{D}=MV:mv$; where M and m express the quantities of matter expelled, V expresses the velocity with which air rushes into a void, and v expresses the velocity sought. But because the quantities of aerial matter which issue from the same orifice in a moment are as the densities and velocities jointly, we shall have $MV:mv=DVV:dvv=DV^2:dv^2$. Therefore $P:p\frac{d-D}{D}=DV^2:dv$. Hence we deduce $V=V\sqrt{\frac{d-D}{d}}\Big|$.

We may have another expression of the velocity without considering the density. We had $P:P+p=D:d$; therefore $d=\frac{D\times\overline{P+p}}{P}$, and $d-D=\frac{D\times\overline{P+p}}{P}-D,=$

Air in motion.

$\frac{D\times P+p-DP}{P}$, and $\frac{d-D}{d}=\frac{D\times\overline{P+p}-DP}{D\times\overline{P+p}},=\frac{P+p-P}{P+p}$ $=\frac{p}{P+p}$; therefore $v=V\times\sqrt{\frac{p}{P+p}}$, which is a very simple and convenient expression.

Hitherto we have considered the motion of air as produced by its weight only. Let us now consider the effect of its elasticity.

The effect of the air's elasticity considered.

Let ABCD (fig. 73) be a vessel containing air of any density D. This air is in a state of compression; and if the compressing force be removed, it will expand, and its elasticity will diminish along with its density. Its elasticity in any state is measured by the force which keeps it in that state. The force which keeps common air in its ordinary density is the weight of the atmosphere, and is the same with the weight of a column of water 33 feet high. If therefore we suppose that this air, instead of being confined by the top of the vessel, is pressed down by a moveable piston carrying a column of water 33 feet high, its elasticity will balance this pressure as it balances the pressure of the atmosphere; and as it is a fluid, and propagates through every part the pressure exerted on any one part, it will press on any little portion of the vessel by its elasticity in the same manner as when loaded with this column.

The consequence of this reasoning is, that if the small portion of the vessel be removed, and thus a passage be made into a void, the air will begin to flow out with the same velocity with which it would flow when impelled by its weight alone, or with the velocity acquired by falling from the top of a homogeneous atmosphere, or 1332 feet in a second nearly.

But as soon as some air has come out, the density of the remaining air is diminished, and its elasticity is diminished; therefore, the expelling force is diminished. But the matter to be moved is diminished in the very same proportion, because the density and elasticity are found to vary according to the same law; therefore the velocity will continue the same from the beginning to the end of the efflux.

This may be seen in another way. Let P be the pressure of the atmosphere, which being the counter-balance and measure of the initial elasticity, is equal to the expelling force at the first instant. Let D be the initial density, and V the initial velocity. Let d be its density at the end of the time t of efflux, and v the contemporaneous velocity. It is plain that at the end of this time we shall have the expelling force $\pi=\frac{Pd}{D}$; for $D:d=P:\pi\left(=\frac{Pd}{D}\right)$.

These forces are proportional to the quantities of motion which they produce; and the quantities of motion are proportional to the quantities of matter M and m and the velocities V and v jointly: therefore we have $P:\frac{Pd}{D}=MV:mv$. But the quantities of matter which escape through a given orifice are as the densities and velocities jointly; that is, $M:m=DV:dv$: therefore $P:\frac{Pd}{D}=DV^2:dv^2$, and $P\times dv^2=\frac{PdDV^2}{D}=PdV^2$, and $V^2=v^2$, and $V=v$, and the velocity of efflux is constant. Hence follows, what appears very unlikely at first sight, that however much the air in the vessel is condensed, it will always issue into a void with the same velocity.

Quantity of air issuing into a void, and density.

In order to find the quantity of aerial matter which will issue during any time t, and consequently the density of the remaining air at the end of this time, we must get the rate of efflux. In the element of time $\dot{t}$ there issues (by what has been said above) the bulk $8\sqrt{HO}t$ (for the velocity V is constant); and therefore the quantity $8\sqrt{HO}d\dot{t}$. On the other hand, the quantity of air at the beginning was CD, C being the capacity of the vessel; and when the air has acquired the density d, the quantity is Cd; therefore the quantity which has run out in the time $\dot{t}$ must be the fluxion of $CD-Cd$, or $-C\dot{d}$. Therefore we have the equation $8\sqrt{HO}d\dot{t}=-C\dot{d}$, and $\dot{t}=\frac{-C\dot{d}}{8\sqrt{HO}d},=\frac{C}{8\sqrt{HO}}\times-\frac{\dot{d}}{d}$.

The fluent of this is $t=\frac{C}{8\sqrt{HO}}\log.d$. This fluent must be so taken that t may be $=o$ when $d=D$. Therefore the correct fluent will be $t=\frac{C}{8\sqrt{HO}}\log.\frac{D}{d}$, for $\log.\frac{D}{D}=\log.1,=o$. We deduce from this, that it requires an infinite time for the whole air of a vessel to flow out of it into a void. N.B. By log. d, &c. is meant the hyperbolic logarithm of d, &c.

When the vessel emits it into rarer air.

Let us next suppose that the vessel, instead of letting out its air into a void, emits it into air of a less density, which remains constant during the efflux, as we may suppose to be the case when a vessel containing condensed air emits it into the surrounding atmosphere. Let the initial density of the air in the vessel be δ, and that of the atmosphere D. Then it is plain that the expelling force is $P-\frac{PD}{\delta}$, and that after the time t it is $\frac{Pd}{\delta}-\frac{PD}{\delta}$. We have therefore $P-\frac{PD}{\delta}:\frac{Pd}{\delta}-\frac{PD}{\delta}=MV:mv,=\delta V^2:dv^2$. Whence we derive $v=V\sqrt{\frac{\delta\,\overline{d-D}}{d\,\overline{\delta-D}}}$.

From this equation we learn that the motion will be at an end when $d=D$: and if $\delta=D$ there can be no efflux.

Relation between the time and density.

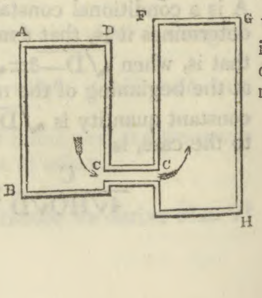
To find the relation between the time and the density, let H, as before, be the height producing the velocity V. The height producing the velocity of efflux v must be $H\times\frac{\delta\overline{d-D}}{d\overline{\delta-D}}$, and the little parcel of air which will flow out in the time t will $=8\sqrt{HO}d\dot{t}\sqrt{\frac{\delta\overline{d-D}}{d\overline{\delta-D}}}$. On the other hand, it is $=-C\dot{d}$.

Hence we deduce the fluxionary equation $\dot{t}=\frac{C\sqrt{\delta-D}}{8\sqrt{HO\sqrt{\delta}}}\times\frac{-\dot{d}}{\sqrt{d^2-Dd}}$. The fluent of this corrected so as to make $t=O$ when $d=\delta$, is $t=\frac{C\sqrt{\delta-D}}{8\sqrt{HO}\sqrt{\delta}}\times\log.\left(\frac{\delta-\frac{1}{2}D+\sqrt{\delta^2-Dd}}{d-\frac{1}{2}D+\sqrt{d^2-Dd}}\right)$.

And the time of completing the efflux, when $d=D$, is $\dot{t}=\frac{C\sqrt{\delta-D}}{8\sqrt{HO}\sqrt{\delta}}\times\log.\left(\frac{\delta-\frac{1}{2}D+\sqrt{\delta^2-D\delta}}{\frac{1}{2}D}\right)$.

When issuing from denser into rarer air.

Fig. 74.



Lastly, let ABCD, CFGH (fig. 74) be two vessels containing airs of different densities, and communicating by the orifice C, there will be a current from the vessel containing the denser air into that containing the rarer; suppose from ABCD into CFGH.

Let P be the elastic force of

Air in motion.

the air in ABCD, Q its density, and V its velocity, and D the density of the air in CFGH. And, after the time t, let the density of the air in ABCD be q, its velocity v, and the density of the air in CFGH be δ. The expelling force from ABCD will be $P-\frac{PD}{Q}$ at the first instant, and at the end of the time t it will be $\frac{Pq}{Q}-\frac{P\delta}{Q}$. Therefore we shall have $P-\frac{PD}{Q}:\frac{Pq}{Q}-\frac{P\delta}{Q}=QV^2:qv^2$, which gives $v=V\times\sqrt{\frac{Q(q-\delta)}{q(Q-D)}}$, and the motion will cease when $\delta=q$.

Let A be the capacity of the first vessel, and B that of the second. We have the second equation $AQ+BD=Aq+B\delta$, and therefore $\delta=\frac{A(Q-q)+BD}{qB(Q-D)}$. Substituting this value of δ in the former value of v, we have $v=\times\sqrt{\frac{Q[B(q-D)-A(Q-q)]}{qB(Q-D)}}$, which gives the relation between the velocity v and the density q.

In order to ascertain the time when the air in ABCD has acquired the density q, it will be convenient to abridge the work by some substitutions. Therefore make $Q(B+A)=M$, $BQD+BQ^2=N$, $BQ-BD=R$ and $\frac{N}{M}=m$. Then, proceeding as before, we obtain the fluxionary equation $8\sqrt{HO}q\frac{\sqrt{Mq-N}}{\sqrt{R}\sqrt{q}}\dot{t}=\dot{\overline{AQ-q}}=-A\dot{q}$, whence $\dot{t}=\frac{A\sqrt{R}}{8\sqrt{HO}\sqrt{M}}\times\frac{q}{\sqrt{q^2-mq}}$ of which the fluent, completed so that $t=o$ when $q=Q$, is $t=\frac{A\sqrt{R}}{8\sqrt{HO}\sqrt{M}}\times\log.\left(\frac{Q-\frac{1}{2}m+\sqrt{(Q^2mQ)}}{q-\frac{1}{2}m+\sqrt{(q^2mq)}}\right)$.

When air s expelled y force.

Some of these questions are of difficult solution, and they are not of frequent use in the more important and usual applications of the doctrines of pneumatics, at least in their present form. The cases of greatest use are when the air is expelled from a vessel by an external force, as when bellows are worked, whether of the ordinary form or consisting of a cylinder fitted with a movement piston. This last case merits a particular consideration; and, fortunately, the investigation is extremely easy.

Let AD (fig. 73) be considered as a piston moving downward with the uniform velocity f, and let the area of the piston be n times the area of the hole of efflux, then the velocity of efflux arising from the motion of the piston be nf. Add this to the velocity V produced by the elasticity of the air in the first question, and the whole velocity will be $V+nf$. It will be the same in the other. The problem is also freed from the consideration of the time of efflux. For this depends now on the velocity of the piston. It is still, however, a very intricate problem to ascertain the relation between the time and the density, even though the piston is moving uniformly; for at the beginning of the motion the air is of common density. As the piston descends, it both expels and compresses the air, and the density of the air in the vessel varies in a very intricate manner, as also its resistance or reaction on the piston. For this reason, a piston which moves uniformly by means of an external force, will never make an uniform blast by successive strokes; it will always be weaker at the beginning of the stroke. The best way for securing an uniform blast is to employ the external force only for lifting up the piston, and then to let the piston descend by its own weight. In this way it will quickly sink down, compressing the air, till its density and corresponding elasticity exactly balance the weight of the piston. After this the piston will descend equably, and the blast will be uniform. These observations and theorems will serve to determine the initial velocity of the air in all important cases of its expulsion. The philosopher will learn the rate of its efflux out of one vessel into another; the chemist will be able to calculate the quantities of the different gases which are employed in the curious experiments of the ingenious but unfortunate Lavoisier on combustion, and will find them extremely different from what he supposed; the engineer will learn how to proportion the motive force of his machine to the quantity of ærial matter which his bellows must supply. But it is not enough, for this purpose, that the air *begin* to issue in the proper quantity; we must see whether it be not affected by the circumstances of its subsequent passage.

Passage of air through pipes, &c.

All the modifications of motion which are observed in water conduits take place also in the passage of air through pipes and holes of all kinds. There is the same diminution of quantity passing through a hole in a thin plate that is observed in water. We know that, abating the small effect of friction, water issues with the velocity acquired by falling from the surface; and yet if we calculate by this velocity and by the area of the orifice, we shall find the quantity of water deficient nearly in the proportion of 63 to 100. This is owing to the water pressing towards the orifice from all sides, which occasions a contraction of the jet. The same thing happens in the efflux of air. Also the motion of water is greatly impeded by all contractions of its passage. These oblige it to accelerate its velocity, and therefore require an increase of pressure to force it through them, and this in proportion to the squares of the velocities. Thus, if a machine working a pump causes it to give a certain number of strokes in a minute, it will deliver a determined quantity of water in that time. Should it happen that the passage of the water is contracted to one half in any part of the machine, a thing which frequently happens at the valves, the water must move through this contraction with twice the velocity that it has in the rest of the passage. This will require four times the force to be exerted on the piston. Nay, if no part of the passage is narrower than the barrel of the pump, but on the contrary a part much wider, and if the conduit be again contracted to the width of the barrel, an additional force must be applied to the piston to drive the water through this passage, which would not have been necessary if the passage had not been widened in any part. It will require a force equal to the weight of a column of water of the height necessary for communicating a velocity, the square of which is equal to the difference of the squares of the velocities of the water in the wide and the narrow part of the conduit.

The same thing takes place in the motion of air, and therefore all contractions and dilatations must be carefully avoided, when we want to preserve the velocity unimpaired.

Air suffers retardation along pipes.

Air also suffers the same retardation in its motion along pipes. By not knowing, or not attending to that, engineers of the first reputation have been prodigiously disappointed in their expectations of the quantity of air which will be delivered by long pipes. Its extreme mobility and lightness hindered them from suspecting that it would suffer any sensible retardation. Dr. Papin, a most ingenious man, proposed this as the most effectual method of transferring the action of a moving power to a great distance. Suppose, for instance, that it was required to raise water out of a mine by a water-machine, and that there was no fall of water nearer than a mile's distance. He employed this water to drive a piston, which should compress the air in a cylinder communicating, by a long pipe, with another cylinder at the mouth of the mine. This second cylinder had a piston in it, whose rod was to give motion to the pumps at the mine. He expected, that as soon as the piston at the water-machine had compressed the air sufficiently, it would cause the air in the cylinder at the mine to force up its piston, and thus work the pumps. Dr. Hooke made many objections to the method, when laid before the Royal Society, and it was much debated there. But dynamics was at this time an infant science, and very little understood. Newton had not then taken any part in the business of the society, otherwise the true objections would not have escaped his sagacious mind. Notwithstanding Papin's great reputation as an engineer and mechanic, he could not bring his scheme into use in England; but afterwards, in France and in Germany, where he settled, he got some persons of great fortunes to employ him in this project; and he erected great machines in Auvergne and Westphalia for draining mines. But, so far from being effective machines, they would not even begin to move. He attributed the failure to the quantity of air in the pipe of communication, which must be condensed before it can condense the air in the remote cylinder. This indeed is true, and he should have thought of this earlier. He therefore diminished the size of this pipe, and made his water-machine exhaust instead of condensing, and had no doubt but that the immense velocity with which air rushes into a void would make a rapid and effectual communication of power. But he was equally disappointed here, and the machine at the mine stood still as before.

Nearly a century after this, a very intelligent engineer attempted a much more feasible thing of this kind at an ironfoundery in Wales. He erected a machine at a powerful fall of water, which worked a set of cylinder bellows, the blowpipe of which was conducted to the distance of a mile and a half, where it was applied to a blast furnace. But notwithstanding every care to make the conducting pipe very air-tight, of great size, and as smooth as possible, it would hardly blow out a candle. The failure was ascribed to the impossibility of making the pipe air-tight. But, what was surprising, above ten minutes elapsed after the action of the pistons in the bellows before the least wind could be perceived at the end of the pipe; whereas the engineer expected an interval of six seconds only.

No very distinct theory can be delivered on this subject; but we may derive considerable assistance in understanding the causes of the obstruction to the motion of water in long pipes, by considering what happens to air. The elasticity of the air, and its great compressibility, have given us the distinctest notions of fluidity in general, shewing us, in a way that can hardly be controverted, that the particles of a fluid are kept at a distance from each other, and from other bodies, by the corpuscular forces.

How fluids are obstructed in moving along canals.

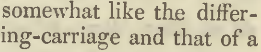
The writers on hydrodynamics have always considered the obstruction to the motion of fluids along canals of any kind, as owing to something like the friction by which the motion of solid bodies on each other is obstructed; but we cannot form to ourselves any distinct notion of resemblance, or even analogy between them. The fact is, however, that a fluid running along a canal has its motion obstructed; and that this obstruction is greatest in the immediate vicinity of the solid canal, and gradually diminishes to the middle of the stream. It appears, therefore, that the parts of fluids can no more move among each other than among solid bodies, without suffering a diminution of their motion. The parts in physical contact with the sides and bottom are retarded by these immoveable bodies. The particles of the next stratum of fluid cannot preserve their initial velocities without overpassing the particles of the first stratum; and it appears from the fact that they are by this means retarded. They retard in the same manner the particles of the third stratum, and so on to the middle stratum or thread of fluid. It appears from the fact, therefore, that this sort of friction is not a consequence of rigidity alone, but that it is equally competent to fluids. Nay, since it is a matter of fact in air, and is even more remarkable there than in any other fluid, as we shall see by the experiments which have been made on the subject; and as our experiments on the compression of air shew us the particles of air ten times nearer to each other in some cases than in others (viz. when we see air a thousand times denser in these cases), and therefore force us to acknowledge that they are not in contact; it is plain that this obstruction has no analogy to friction, which supposes roughness or inequality of surface. No such inequality can be supposed in the surface of an aerial particle; nor would it be of any service in explaining the obstruction, since the particles do not rub on each other, but pass each other at some small and imperceptible distance. We must therefore have recourse to some other mode of explication. We shall apply this to air only in this place; and, since it is proved by the incontrovertible experiments of Canton, Zimmerman, and others, that water, mercury, oil, &c., are also compressible and perfectly elastic, the argument from this principle, which is conclusive in air, must equally explain the similar phenomenon in hydraulics.

Particles of air resist a change from a rectilineal to an undulating motion.

The most highly polished body which we know must be conceived as having an uneven surface when we compare it with the small spaces in which the corpuscular forces are exerted; and a quantity of air moving in a polished pipe may be compared to a quantity of small shot sliding down a channel with undulated sides and bottom. The row of particles immediately contiguous to the sides will therefore have an undulated motion: but this undulation of the contiguous particles of air will not be so great as that of the surface along which they glide; for not only every motion requires force to produce it, but also every change of motion. The particles of air resist this change from a rectilineal to an undulating motion; and, being elastic, that is, repelling each other and other bodies, they keep a little nearer to the surface as they are passing over an eminence, and their path is less incurvated than the surface. The difference between the motion of the particles of air and the particles of a fluid quite unelastic is, in this respect, somewhat like the difference between the motion of a spring-carriage and that of a common carriage. When the common carriage passes along a road not perfectly smooth, the line described by the centre of gravity of the carriage keeps perfectly parallel to that described by the axis of the wheels, rising and falling along with it. Now let a spring body be put on the same wheels and pass along the same road. When the axis rises over an eminence perhaps half an inch, sinks down again into the next hollow, and then rises a second time, and so on, the centre of gravity of the body describes a much straighter line; for upon the rising of the wheels, the body resists the motion, and compresses the springs, and thus remains lower than it would have been had the springs not been interposed. In like manner, it does not sink so low as the axle does when the wheels go into a hollow. And thus the motion of spring-carriages becomes less violently undulated than the road along which they pass. This illustration will, we hope, enable the reader to conceive how the deviation of the particles next to the sides and bottom of the canal from a rectilineal motion is less than that of the canal itself.

It is evident that the same reasoning will prove that the undulation of the next row of particles will be less than that of the first, that the undulation of the third row will be less than that of the second, and so on, as is represented in fig. 75. And thus it appears, that whilst the mass of air has a progressive motion along the pipe or canal, each particle is describing a waving line, of which a line parallel to the direction of the canal is the axis, cutting all these undulations. This axis of each undulated path will be straight or curved as the canal is, and the excursions of the path on each side of its axis will be less and less as the axis of the path is nearer to the axis of the canal.

Fig. 75.



Let us now see what *sensible* effect this will have; for all the motion which we here speak of is imperceptible. It is demonstrated in mechanics, that if a body moving with any velocity be deflected from its rectilineal path by a curved and perfectly smooth channel, to which the rectilineal path is a tangent, it will proceed along this channel with undiminished velocity. Now the path, in the present case, may be considered as perfectly smooth, since the particles do not touch it. It is one of the undulations which we are considering, and we may at present conceive this as without any subordinate inequalities. There should not, therefore, be any diminution of the velocity. Let us grant this of the absolute velocity of the particle; but what we observe is the velocity of the mass, and we judge of it perhaps by the motion of a feather carried along by it. Let us suppose a single atom to be a sensible object, and let us attend to two such particles, one at the side, and the other in the middle: although we cannot perceive the undulations of these particles during their progressive motions, we see the progressive motions themselves. Let us suppose, then, that the middle particle has moved without any undulation whatever, and that it has advanced ten feet. The lateral particle will also have moved ten feet; but this has not been in a straight line. It will not be so far advanced, therefore, in the direction of the canal; it will be left behind, and will appear to us to have been retarded in its motion; and in like manner each thread of particles will apparently be more and more retarded, as it recedes farther from the axis of the canal, or what is usually called the thread of the stream.

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And thus the observed fact is shewn to be a necessary consequence of what we know to be the nature of a compressible or elastic fluid; and that without supposing any diminution in the real velocity of each particle, there will be a diminution of the velocity of the sensible threads of the general stream, and a diminution of the whole quantity of air which passes along it during a given time.

Let us now suppose a parcel of air impelled along a pipe, which is *perfectly* smooth, out of a larger vessel, and issuing from this pipe with a certain velocity. It requires a certain force to change its velocity in the vessel to the greater velocity which it has in the pipe. This is abundantly demonstrated. How long soever we suppose this pipe, there will be no change in the velocity, or in the force to keep it up. But let us suppose that about the middle of this pipe there is a part of it which has suddenly got an undulated surface, however imperceptible. Let us further suppose that the final velocity of the middle thread is the same as before. In this case it is evident that the sum total of the motions of all the particles is greater than before, because the absolute motions of the lateral particles is greater than that of the central particle, which we suppose the same as before. This absolute increase of motion cannot be without an increase of propelling force: the force acting now, therefore, must be greater than the force acting formerly. Therefore, if only the former force had continued to act, the same motion of the central particle could not have been preserved, or the progressive motion of the whole stream must be diminished. And thus we see that this internal insensible undulatory motion becomes a real obstruction to the sensible motion which we observe, and occasions an expense of power.

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Let us see what will be the consequence of extending this obstructing surface further along the canal. It must evidently be accompanied by an augmentation of the motion produced, if the central velocity be still kept up; for the particles which are now in contact with the sides do not continue to occupy that situation. The middle particles moving faster *forward* get over them, and in their turn come next the side; and as they are really moving equally fast, but not in the direction into which they are now to be forced, force is necessary for changing the direction also; and this is in addition to the force necessary for producing the undulations so minutely treated of. The consequence of this must be, that an additional force will be necessary for preserving a given progressive motion in a longer *obstructing* pipe, and that the motion produced in a pipe of greater length by a given force will be less than in a shorter one, and the efflux will be diminished.

There is another consideration which must have an influence here. Nothing is more irrefragably demonstrated than the necessity of an additional force for producing an efflux through any contraction, even though it should be succeeded by a dilatation of the passage. Now both the inequalities of the sides and the undulations of the motions of each particle are equivalent to a succession of contractions and dilatations; although each of these is next to infinitely small; their number is also next to infinitely great, and therefore the total effect may be sensible.

There are other obstructions, as angular asperities.

We have hitherto supposed that the absolute velocity of the particles was not diminished; this we did, having assumed that the interval of each undulation of the sides was without inequalities. But this was gratuitous; it was also gratuitous that the sides were only undulated. We have no reason for excluding angular asperities. These will produce, and most certainly often produce, real diminutions in the velocity of the contiguous particles; and this must extend to the very axis of the canal, and produce a diminution of the sum total of motion; and in order to preserve the same sensible progressive motion, a greater force must be employed. This is all that can be meant by saying that there is a resistance to the motion of air through long pipes.

There remains another cause of diminution, viz. the want of perfect fluidity, whether arising from the dissemination of solid particles in a real fluid, or from the viscidity of the fluid. We shall not insist on this at present, because it cannot be shown to obtain in air, at least in any case which deserves consideration. It seems of no importance to determine the motion of air hurrying along with it soot or dust. The effect of fogs on a particular modification of the motion of air will be considered under another head. What has been said on this subject is sufficient for our purpose, as explaining the prodigious and unexpected obstruction to the passage of air through long and narrow pipes. We are able to collect an important maxim from it, viz. that all pipes of communication should be made as wide as circumstances will permit; for it is plain that the obstruction depends on the internal surface, and the force to overcome it must be in proportion to the mass of matter which is in motion. The first increases as the diameter of the pipe, and the last as the square. The obstruction must therefore bear a greater proportion to the whole motion in a small pipe than in a large one.

The law of retardation unknown.

It were very desirable to know the law by which the retardation extends from the axis to the sides of the canal, and the proportion which subsists between the lengths of the canal and the forces necessary for overcoming the obstructions when the velocity is given; as also whether the proportion of the obstruction to the whole motion varies with the velocity; but all this is unknown. It does not, however, seem a desperate case in air; we know pretty distinctly the law of action among its particles, viz. that their mutual repulsions are inversely as their distances. This promises to enable us to trace the progress of undulation from the sides of the canal to the axis.

The rate of increase not as the square of the velocities.

We can see that the retardations will not increase so fast as the square of the velocity. Were the fluid incompressible, so that the undulatory path of a particle were invariable, the deflecting forces by which each individual particle is made to describe its undulating path would be precisely such as arise from the path itself and the motion in it; for each particle would be in the situation of a body moving along a fixed path. But in a very compressible fluid, such

Air in motion.

as air, each particle may be considered as a solitary body, actuated by a projectile and a transverse force, arising from the action of the adjoining particles. Its motion must depend on the adjustment of these forces, in the same manner as the elliptical motion of a planet depends on the adjustment of the force of projection, with a gravitation inversely proportional to the square of the distance from the focus. The transverse force in the present case has its origin in the pressure on the air which is propelling it along the pipe; this, by squeezing the particles together, brings their mutual repulsion into action. Now it is the property of a perfect fluid, that a pressure exerted on any part of it is propagated equally through the whole fluid; therefore the transverse forces which are excited by this pressure are proportional to the pressure itself; and we know that the pressures exerted on the surface of a fluid, so as to expel it through any orifice, or along any canal, are proportional to the squares of the velocities which they produce. Therefore, in every point of the undulatory motion of any particle, the transverse force by which it is deflected into a curve is proportional to the square of its velocity. When this is the case, a body would continue to describe the same curve as before; but, by the very compression, the curvatures are increased, supposing them to remain similar. This would require an increase of the transverse forces; but this is not to be found; therefore the particle will not describe a similar curve, but one which is less incurvated in all its parts; consequently the progressive velocity of the whole, which is the only thing perceivable by us, will not be so much diminished; that is, the obstructions will not increase so fast as they would otherwise do, or as the squares of the velocities.

This reasoning is equally applicable to all fluids, and is abundantly confirmed by experiments in hydraulics, as we shall see when considering the motion of rivers. We have taken this opportunity of delivering our notions on this subject; because, as we have often said, it is in the avowed discrete constitution of air that we see most distinctly the operation of those natural powers which constitute fluidity in general.

Bossut's experiments on pipes and canals.

We would beg leave to mention a form of experiment for discovering the law of retardation with considerable accuracy. Experiments have been made on pipes and canals. M. Bossut, in his *Hydrodynamique*, has given a very beautiful set made on pipes of an inch and two inches in diameter, and 200 feet in length; but although these experiments are very instructive, they do not give us any rule by which we can extend the result to pipes of greater length and different diameters.

Let a smooth cylinder be set upright in a very large vessel or pond, and be moveable round its axis; let it be turned round by means of a wheel and pulley with an uniform motion and determined velocity. It will exert the same force on the contiguous water which would be exerted on it by water turning round it with the same velocity; and as this water would have its motion gradually retarded by the fixed cylinder, so the moving cylinder will gradually communicate motion to the surrounding water. We should observe the water gradually dragged round by it; and the vortex would extend farther and farther from it as the motion is continued, and the velocities of the parts of the vortex will be less and less as we recede from the axis. Now, we apprehend, that when a point of the surface of the cylinder has moved 200 feet, the *motion* of the water at different distances from it will be similar and proportional to, if not precisely the same with, *retardations* of water flowing 200 feet at the same distance from the side of a canal; at any rate, the two are susceptible of an accurate comparison, and the law of retardation may be accurately deduced from observations made on the motions of this vortex.

Wind.

Air in motion is a very familiar object of observation; and it is interesting. In all languages it has got a name; we call it wind; and it is only upon reflection that we consider air as wind in a quiescent state. Many persons hardly know what is meant when air is mentioned; but they cannot refuse that the blast from a bellows is the expulsion of what they contained; and thus they learn that wind is air in motion.

Velocity o wind.

The velocity of wind not easily discovered.

It is of consequence to know the velocity of wind; but no good and unexceptionable method has been contrived for this purpose. The best seems to be by measuring the space passed over by the shadow of a cloud; but this is extremely fallacious. In the first place, it is certain, that although we suppose that the cloud has the velocity of the air in which it is carried along, this is not an exact measure of the current on the surface of the earth; we may be almost certain that it is greater; for air, like all other fluids, is retarded by the sides and bottom of the channel in which it moves. But, in the next place, it is very gratuitous to suppose, that the velocity of the cloud is the velocity of the stratum of air between the cloud and the earth; we are almost certain that it is not. It is abundantly proved by Dr. Hutton of Edinburgh, that clouds are always formed when two parcels of air of different temperatures mix together, each containing a proper quantity of vapour in the state of chemical solution. We know that different strata of air will frequently flow in different directions for a long time. In 1781, whilst a great fleet rendezvoused in Leith Roads during the Dutch war, there was a brisk easterly wind for about five weeks; and, during the last fortnight of this period, there was a brisk westerly current at the height of about three-fourths of a mile. This was distinctly indicated by frequent fleecy clouds at a great distance above a lower stratum of these clouds, which were driving all this time from the eastward. A gentleman who was present at the siege of Quebec in 1759, stated that one day whilst there blew a gale from the west, so hard that the ships at anchor in the river were obliged to strike their topmasts, and it was with the utmost difficulty that some well-manned boats could row against it, carrying some artillery stores to a post above the town, several shells were thrown from the town to destroy the boats; one of the shells burst in the air near the top of its flight, which was about half a mile high. The smoke of this bomb remained in the same spot for above a qaarter of an hour, like a great round ball, and gradually dissipated by diffusion, without removing many yards from its place. When, therefore, two strata of air come from different quarters, and one of them flows over the other, it will be only in the contiguous surfaces that a precipitation of vapour will be made. This will form a thin fleecy cloud; and it will have a velocity and direction which neither belongs to the upper nor to the lower stratum of air which produced it. Should one of these strata come from the east and the other from the west with equal velocities, the cloud formed between them will have no motion at all; should one come from the east, and the other from the north, the cloud will move from the north-east with a greater velocity than either of the strata. So uncertain then is the information given by the clouds either of the velocity or the direction of the wind. A thick smoke from a furnace will give us a much less equivocal measure; and this, combined with the effects of the wind in impelling bodies, or deflecting a loaded plane from the perpendicular, or other effects of this kind, may give us measures of the different currents of wind with a precision sufficient for all practical uses.

The result of Smeaton's observations.

The celebrated engineer, Mr. John Smeaton, has given, in the 51st volume of the *Philosophical Transactions*, the velocities of wind corresponding to the usual denominations in our language. These are founded on a great number of observations made by himself in the course of his practice in erecting wind-mills. They are contained in the following table:—

elocity of wind.

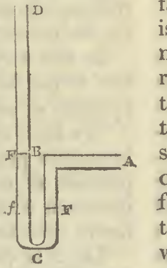
Miles per hour.	Feet per second.	Names.
1	1·47	
2	2·93	Light airs.
3	4·40	
4	5·87	Breeze.
5	7·33	
10	14·67	Brisk gale.
15	22·	
20	29·34	Fresh gale.
25	36·57	
30	44·01	Strong gale.
35	51·34	
40	58·68	Hard gale.
45	66·01	
50	73·35	Storm.
60	88·02	
80	117·36	Hurricane, tearing up trees, overturning buildings, &c.[1]
100	146·70	

ccount of r. Lind's nemome- r.

One of the most ingenious and convenient methods for measuring the velocity of the wind is to employ its pressure in supporting a column of water, in the same way as Mr. Pitot measures the velocity of a current of water. We believe that it was first proposed by Dr. James Lind of Windsor, a gentleman eminent for his great knowledge in all the branches of natural science, and for his ingenuity in every matter of experiment or practical application.

His anemometer consists of a glass tube of the form ABCD (fig. 76), open at both ends, and having the branch AB at right angles to the branch CD. This tube contains a few inches of water or any fluid (the lighter the better); it is held with the part CD upright, and AB horizontal and in the direction of the wind; that is, with the mouth A fronting the wind. The wind acts in the way of pressure on the air in AB, compresses it, and causes it to press on the surface of the liquor; forcing it down to F, whilst it rises to E in the other leg. The velocity of the wind is concluded from the difference E*f* between the heights of the liquor in the legs. As the wind does not generally blow with uniform velocity, the liquor is apt to dance in the tube, and render the observation difficult and uncertain; to remedy this, it is proper to contract very much the communication at C between the two legs. If the tube has half an inch of diameter, and it should not have less, a hole of 1-50th of an inch is large enough; indeed the hole can hardly be too small, nor the tubes too large.

Fig. 76.

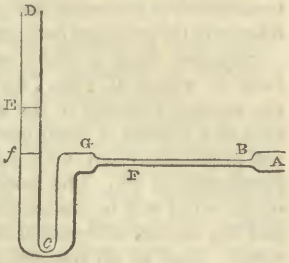


This instrument is extremely ingenious, and will undoubtedly give the proportions of the velocities of different currents with the greatest precision; for in whatever way the pressure of wind is produced by its motion, we are certain that the different pressures are as the squares of the velocities; if, therefore, we can obtain one certain measure of the velocity of the wind, and observe the degree to which the pressure produced by it raises the liquor, we can at all other times observe the pressures and compute the velocities from them, making proper allowances for the temperature and the height of the mercury in the barometer; because the velocity will be in the subduplicate ratio of the density of the air inversely when the pressure is the same.

It is usually concluded, that the velocity of the wind is that which would be acquired by falling from a height which is to E*f* as the weight of water is to that of an equal bulk of air. Thus, supposing air to be 840 times lighter than water, and that E*f* is 9-10ths of an inch, the velocity will be about 63 feet per second, which is that of a very hard gale, approaching to a storm. Hence we see by the bye, that the scale of this instrument is extremely short, and that it would be a great improvement of it to make the leg CD not perpendicular, but very much sloping; or perhaps the following form of the instrument will give it all the perfection of which it is capable. Let the horizontal branch AB (fig. 77) be contracted at B, and continued horizontally for several inches BG of a much smaller bore, and then turned down for two or three inches GC, and then upwards with a wide bore. To use the instrument, hold it with the part DC perpendicular; and (having sheltered the mouth A from the wind) pour in water at D till it advances along GB to the point B, which is made the beginning of the scale; the water in the upright branch standing at F in the same horizontal line with BG. Now, turn the mouth A to the wind; the air in AB will be compressed and will force the water along BG to F, and cause it to rise from *f* to E; and the range *f*E will be to the range BF on the scale as the section of the tube BG to that of CD. Thus, if the width of DC be half an inch, and that of BG 1-10th, we shall have 25 inches in the scale for one inch of real pressure E*f*.

Velocity of wind.

Fig. 77.



But it has not been demonstrated in a very satisfactory manner, that the velocity of the wind is that acquired by falling through the height of a column of air whose weight is equal to that of the column of water E*f*. Experiments made with Pitot's tube in currents of water show that several corrections are necessary for conducting the velocity of the current from the elevations in the tube: these corrections may however be made, and safely applied to the present case; and then the instrument will enable us to conclude the velocity of the wind immediately, without any fundamental comparison of the elevation, with a velocity actually determined upon other principles. The chief use which we have for this information is in our employment of wind as an impelling power, by which we can actuate machinery or navigate ships. These are very important applications of pneumatical doctrines, and merit a particular consideration; and this naturally brings us to the last part of our subject, viz. the consideration of the impulse of air on bodies exposed to its action, and the resistance which it opposes to the passage of bodies through it.

This subject important but difficult.

This is a subject of the greatest importance, being the foundation of that art which has done the greatest honour to the ingenuity of man, and the greatest service to human society, by connecting together the most distant inhabitants of this globe, and making a communication of benefits which would otherwise have been impossible; we mean the art of Navigation or Seamanship. Of all the machines which human art has constructed, a ship is not only the greatest and most magnificent, but also the most ingenious and intricate; and the clever seaman possesses a knowledge founded on the most difficult and abstruse doctrines of mechanics. The seaman probably cannot give any account of his own science; and he possesses it rather by a kind of intuition than by any process of reasoning; but the success and efficiency of all the mechanism of this complicated engine, and the propriety of all the manœuvres which the seaman practises, depend on the invariable laws of mechanics; and a thorough knowledge of these would enable an intelligent person not only to understand the machine and the manner of working it, but to improve both.

Unfortunately this is a subject of very great difficulty; and although it has employed the genius of Newton, who has con-

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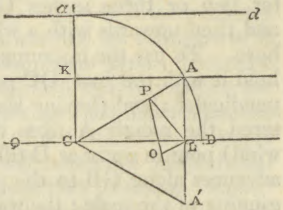
[1] See also some valuable experiments by him on this subject, *Philosophical Transactions*, 1760 and 1761.

Velocity of wind.

sidered it with great care, and his followers have added more to his labours on this subject than on any other, it still remains in a very imperfect state. A minute discussion of this subject cannot therefore be expected in a work like this; we must content ourselves with such a general statement of the most approved doctrine on the subject as shall enable our readers to conceive it distinctly, and judge with intelligence and confidence of the practical deductions which may be made from it.

Fig. 78.



Suppose then a plane surface, of which aC (fig. 78), is the section, exposed to the action of a stream of wind blowing in the direction QC, perpendicular to aC. The motion of the wind will be obstructed, and the surface aC pressed forward. And as all impulse or pressure is exerted in a direction perpendicular to the surface, and is resisted in the opposite direction, the surface will be impelled in the direction CD, the continuation of QC. And as the mutual actions of bodies depend on their relative motions, the force acting on the surface aC will be the same, if we shall suppose the air at rest, and the surface moving equally swift in the opposite direction. The resistance of the air to the motion of the body will be equal to the impulse of the air in the former case. Thus resistance and impulse are equal and contrary.

Air moving with a double velocity generally impels as the square of that velocity.

If the air be moving twice as fast, its particles will give a double impulse; but in this case a double number of particles will exert their impulse in the same time. The impulse will therefore be fourfold, and in general it will be as the square of the velocity; or if the air and body be both in motion, the impulse and resistance will be proportional to the square of the relative velocity. This is the first proposition on the subject, and it appears very consistent to reason. There will therefore be some analogy between the force of the air's impulse or the resistance of a body, and the weight of a column of air incumbent on the surface; for it is a principle in the action of fluids, that the heights of the columns of fluid are as the squares of the velocities which their pressures produce. Accordingly, the second proposition is, that the absolute impulse of a stream of air, blowing perpendicularly on any surface, is equal to the weight of a column of air which has that surface for its base, and for its height the space through which a body must fall in order to acquire the velocity of the air.

Thirdly, Suppose the surface AC equal to aC no longer to be perpendicular to the stream of air, but inclined to it in the angle ACD, which we shall call the *angle of incidence;* then, by the resolution of forces, it follows, that the action of each particle is diminished in the proportion of radius to the sine of the angle of incidence, or of AC to AL, AL being perpendicular to CD.

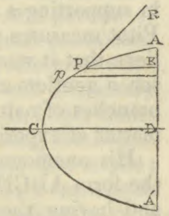
Again: Draw AK parallel to CD. It is plain that no air lying farther from CD than KA is will strike the plane. The quantity of impulse therefore is diminished still farther in the proportion of aC to KC, or of AC to AL. Therefore, on the whole, the absolute impulse is diminished in the proportion of AC^2 to AL^2: hence the proposition, that the impulse and resistance of a given surface are in the proportion of the square of the sine of the angle of incidence.

Fourthly, This impulse is in the direction PL, perpendicular to the impelled surface, and the surface tends to move in this direction: but suppose it moveable only in some other direction PO that we wish to employ this impulse, its action is therefore oblique; and if we wish to know the intensity of the impulse in this direction, it must be diminished still farther in the proportion of radius to the cosine of the angle LPO or sine of CPO. Hence the general proposition: *The effective impulse is as the surface, as the square of the velocity of the wind, as the square of the sine of the angle of incidence, and as the sine of the obliquity jointly,* which we may express by the symbol $R=S\cdot V^{2}\cdot sin.^{2}\cdot I\cdot sin.\ O$; and as the impulse depends on the density of the impelling fluid, we may take in every circumstance by the equation $R=S\cdot D\cdot V^{2}\cdot sin.^{2}\cdot I\cdot sin.\ O$. If the impulse be estimated in the direction of the stream, the angle of obliquity ACD is the same with the angle of incidence, and the impulse in this direction is as the surface, as the square of the velocity, and as the cube of the angle of incidence jointly.

It evidently follows from these premises, that if ACA′ be a wedge, of which the base AA′ is perpendicular to the wind, and the angle ACA′ bisected by its direction, the direct or perpendicular impulse on the base is to the oblique impulse on the sides as radius to the square of the sine of half the angle ACA′.

The same must be affirmed of a pyramid or cone ACA′, of which the axis is in the direction of the wind.

Fig. 79.



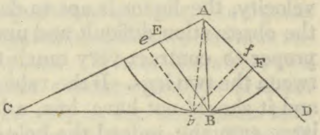
If ACA′ (fig. 79,) represent the section of a solid, produced by the revolution of a curve line APC round the axis CD, which lies in the direction of the wind, the impulse on this body may be compared with the direct impulse on this base, or the resistance to the motion of this body through the air may be compared with the direct resistance of its base, by resolving its surface into elementary planes Pp, which are coincident with a tangent plane PR, and comparing the impulse on P p with the direct impulse on the corresponding part K k of the base.

In this way it follows that the impulse on a sphere is one half of the impulse on its great circle, or on the base of a cylinder of equal diameter.

We shall conclude this sketch of the doctrine with a very important proposition to determine the most advantageous position of a plane surface, when required to move in one direction while it is impelled by the wind blowing in a different direction. Thus,

Inference from this doctrine.

Fig. 80.



Let AB (fig. 80) be the sail of a ship, CA the direction in which the wind blows, and AD the line of the ship's course. It is required to place the yard AC in such a position that the impulse of the wind upon the sail may have the greatest effect possible in impelling the ship along AD.

Let AB, Ab, be two positions of the sail very near the best position, but on opposite sides of it. Draw BE, $b\,e$, perpendicular to CA, and BF, $b\,f$, perpendicular to AD, calling AB radius; it is evident that BE, BF, are the sines of impulse and obliquity, and that the effective impulse is $BE^2\times BF$, or $b\,e^2\times b\,f$. This must be a maximum.

Let the points B, b, continually approach and ultimately coincide; the chord b B will ultimately coincide with a straight line CBD touching the circle in B; the triangles CBE, $c\,b\,e$ are similar, as also the triangles DBF, D $b\,f$: therefore $BE^2 : b\,e^2 = BC^2 : b\,c^2$, and $BF : b\,f = BD : b\,D$; and $BE^2\times BF : b\,e^2\times b\,f = CB^2\times BD : c\,b^2\times bD$. Therefore when AB is in the best position, so that $BE^2\times BF$ is greater than $b\,e^2\times b\,f$, we shall have $CB\times BD$ greater than $Cb^2\times bD$, or $cB^2\times BD$ is also a maximum. This we know to be the case when $CB=2BD$: therefore the sail must be so placed that the tangent of the angle of incidence shall be double of the tangent of the angle of the sail and keel.

In a common windmill the angle CAD is necessarily a right angle; for the sail moves in a circle to which the wind is perpendicular: therefore the best angle of the sail and axle will be 54° 44′ nearly.

Velocity of wind.

Such is the theory of the resistance and impulse of the air. It is extremely simple and of easy application. In all physical theories there are assumptions which depend on other principles, and those on the judgment of the naturalist; so that it is always proper to confront the theory with experiment. There are even circumstances in the present case which have not been attended to in the theory. When a stream of air is obstructed by a solid body, or when a solid body moves along in air, the air is condensed before it and rarefied behind. There is therefore a pressure on the anterior parts arising from this want of equilibrium in the elasticity of the air. This must be superadded to the force arising from the impetus or inertia of the air. We cannot tell with precision what may be the amount of this condensation; it depends on the velocity with which any condensation diffuses itself. Also, if the motion be so rapid that the pressure of the atmosphere cannot make the air immediately occupy the place quitted by the body, it will sustain this pressure on its fore part to be added to the other forces.

The prin- pal expe- ments on is subject

Experiments on this subjects are by no means numerous; at least such experiments as can be dependend on for the foundation of any practical application. The first that have this character are those published by Mr. Robins in 1742, in his *Treatise on Gunnery*. They were repeated with some additions by the Chevalier Borda, and some account of them published in the *Memoirs of the Academy of Sciences in* 1763. In the *Philosophical Transactions of the Royal Society of London*, vol. lxxiii., there are some experiments of the same kind on a larger scale by Mr. Edgeworth. These were all made in the way described in our account of Mr. Robins's improvements in gunnery. Bodies were made to move with determined velocities, and the resistances were measured by weights. In all these experiments the resistances were found very exactly in the proportion of the squares of the velocities; but they were found considerably greater than the weight of the column of air, whose height would produce the velocity in a falling body. Mr. Robins's experiments on a square of 16 inches, describing 25.2 feet per second, indicate the resistance to be to this weight nearly as 4 to 3. Borda's experiments on the same surface state the disproportion still greater.

The resistances are found not to be in the proportion of the surfaces, but increase considerably faster. Surfaces of 9, 16, 36, and 81 inches, moving with one velocity, had resistances in the proportion of 9, $17\frac{1}{2}$, $42\frac{3}{4}$, and $104\frac{3}{4}$.

Now as this deviation from the proportion of the surfaces increases with great regularity, it is most probable that it continues to increase in surfaces of still greater extent; and these are the most generally to be met with in practice in the action of wind on ships and mills.

Borda's experiments on 81 inches show that the impulse of wind moving one foot per second is about $\frac{1}{500}$ of a pound on a square foot. Therefore to find the impulse on a foot corresponding to any velocity, divide the square of the velocity by 500, and we obtain the impulse in pounds. Mr. Rouse of Leicestershire made many experiments, which are mentioned with great approbation by Mr. Smeaton. His great sagacity and experience in the erection of windmills, oblige us to pay a considerable deference to his judgment. These experiments confirm our opinion, that the impulses increase faster than the surfaces. The following table was calculated from Mr. Rouse's observations, and may be considered as pretty near the truth:

Velocity of wind.

Velocity in feet.	Impulse on a foot in pounds.	Velocity in feet.	Impulse on a foot in pounds.
0	0,000	30	2,059
10	0,229	40	3,660
20	0,915	50	5,718
60	8,234	110	27,675
70	11,207	120	32,926
80	14,638	130	38,654
90	18,526	140	44,830
100	22,872	150	51,462

If we multiply the square of the velocity in feet by 16, the product will be the impulse or resistance on a square foot in grains, according to Mr. Rouse's numbers.

The greatest deviation from the theory occurs in the oblique impulses. Mr. Robins compared the resistance of a wedge, whose angle was 90°, with the resistance of its base; and instead of finding it less in the proportion of $\sqrt{2}$ to 1, as determined by the theory, he found it greater in the proportion of 55 to 68 nearly; and when he formed the body into a pyramid, of which the sides had the same surface and the same inclination as the sides of the wedge, the resistance of the base and face were now as 55 to 39 nearly; so that here the same surface with the same inclination had its resistance reduced from 68 to 39 by being put into this form. Similar deviations occur in the experiments of the Chevalier Borda; and it may be collected from both, that the resistances diminish more nearly in the proportion of the sines of incidence than in the proportion of the squares of those sines.

The irregularity in the resistance of curved surfaces is as great as in plane surfaces. In general, the theory gives the oblique impulses on plane surfaces much too small, and the impulses on curved surfaces too great. The resistance of a sphere does not exceed the fourth part of the resistance of its great circle, instead of being its half; but the anomaly is such as to leave hardly any room for calculation. It would be very desirable to have the experiments on this subject repeated in a greater variety of cases, and on larger surfaces, so that the errors of the experiments may be of less consequence. Till this matter is reduced to some rule, the art of working ships must remain very imperfect, as must also the construction of windmills.

The resistance of air in the motion of projectiles.

The case in which we are most interested in the knowledge of the resistance of the air is the motion of bullets and shells. Writers on artillery have long been sensible of the great effect of the air's resistance. It seems to have been this consideration that chiefly engaged Sir Isaac Newton to consider the motion of bodies in a resisting medium. A proposistion or two would have sufficed for showing the incompatibility of the planetary motions with the supposition that the celestial spaces were filled with a fluid matter; but he has with great solicitude considered the motion of a body projected on the surface of the earth, and its deviation from the parabolic track assigned by Galileo. He has bestowed more pains on this problem than any other in his whole work; and his investigation has pointed out almost all the improvements which have been made in the application of mathematical knowledge to the study of nature. Nowhere does his sagacity and fertility of resource appear in so strong a light as in the second book of the *Principia*, which is almost wholly occupied by this problem. The celebrated mathematician John Bernoulli engaged in it as the finest opportunity of displaying his superiority. A mistake committed by Newton in his attempt to a solution was matter of triumph to him; and the whole of his performance, though a piece of elegant and elaborate geometry, is greatly hurt by his continually bringing this mistake, which is a mere trifle, into view. The difficulty of the subject is so great, that subsequent mathematicians seem to have kept aloof from it; and it has been entirely overlooked by the many voluminous writers who have treated professedly on military projectiles. They have spoken indeed of the resistance of the air as affecting the flight of shot, but have

Resistance of air in gunnery.

saved themselves from the task of investigating this effect (a task to which they were unequal), by supposing that it was not so great as to render their theories and practical deductions very erroneous. Mr. Robins was the first who seriously examined the subject. He showed, that even the Newtonian theory, which had been corrected, but not in the smallest degree improved or extended in its principles, was sufficient to show that the path of a cannon ball could not resemble a parabola. Even this theory showed that the resistance was more than eight times the weight of the ball, and should produce a greater deviation from the parabola than the parabola deviated from a straight line.

Ignorance in this respect of writers on artillery.

This simple but singular observation was a strong proof how faulty the professed writers on artillery had been, in rather amusing themselves with elegant but useless applications of easy geometry, than in endeavouring to give their readers any useful information. He added, that the difference between the ranges by the Newtonian theory and by experiment was so great, that the resistance of the air must be vastly superior to what that theory supposed. It was this which suggested to him the necessity of experiments to ascertain this point. We have seen the result of these experiments in moderate velocities; and that they were sufficient for calling the whole theory in question, or at least for rendering it useless. It became necessary therefore to settle every point by means of a direct experiment. Here was a great difficulty. How shall we measure either these great velocities which are observed in the motions of cannon-shot, or the resistances which these enormous velocities occasion? Mr. Robins had the ingenuity to do both. The method which he took for measuring the velocity of a musket-ball was quite original; and it was susceptible of great accuracy. We have already given an account of it under the article GUNNERY. Having gained this point, the other was not difficult. In the moderate velocities he had determined the resistances by the forces which balanced them, the weights which kept the resisted body in a state of uniform motion. In the great velocities, he proposed to determine the resistances by their immediate effects, by the retardations which they occasioned. This was to be done by first ascertaining the velocity of the ball, and then measuring its velocity after it had passed through a certain quantity of air. The difference of these velocities is the retardation, and the proper measure of the resistance; for, by the initial and final velocities of the ball, we learn the time which was employed in passing through this air with the medium velocity. In this time the air's resistance diminished the velocity by a certain quantity. Compare this with the velocity which a body projected directly upwards would lose in the same time by the resistance of gravity. The two forces must be in the proportion of their effects. Thus we learn the proportion of the resistance of the air to the weight of the ball. It is indeed true, that the time of passing through this space is not accurately had by taking the arithmetical medium of the initial and final velocities, nor does the resistance deduced from this calculation accurately correspond to this mean velocity; but both may be accurately found by the experiment by a very troublesome computation, as is shown in the fifth and sixth propositions of the second book of Newton's *Principia*. The difference between the quantities thus found and those deduced from the simple process is quite trifling, and far within the limits of accuracy attainable in experiments of this kind; it may therefore be safely neglected.

Mr. Robins's experiments on this subject.

Mr. Robins made many experiments on this subject; but unfortunately he has published only a very few, such as were sufficient for ascertaining the point he had in view. He intended a regular work on the subject, in which the gradual variations of resistance corresponding to different velocities should all be determined by experiment; but he was then newly engaged in an important and laborious employment, as chief engineer to the East India Company, in whose service he went out to India, where he died in less than two years. It is to be regretted that no person has prosecuted these experiments. It would be neither laborious nor difficult, and would add more to the improvement of artillery than any thing that has been done since Mr. Robins's death, if we except the prosecution of his experiments on the initial velocities of cannon-shot by Dr. Charles Hutton, royal professor at the Woolwich Academy. It is to be hoped that this gentleman, after having with such effect and success extended Mr. Robins's experiments on the initial velocities of musket-shot to cannon, will take up this other subject, and thus give the art of artillery all the scientific foundation which it can receive in the present state of our mathematical knowledge. Till then we must content ourselves with the practical rules which Robins has deduced from his own experiments. As he has not given us the mode of deduction, we must compare the results with experiment. He has indeed given a very extensive comparison with the numerous experiments made both in Britain and on the continent; and the agreement is very great. His learned commentator Euler has been at no pains to investigate these rules, and has employed himself chiefly in detecting errors, most of which are supposed, because he takes for a finished work what Mr. Robins only gives to the public as a hasty but useful sketch of a new and very difficult branch of science.

Resistance of air in gunnery.

General results.

The general result of Robins's experiments on the retardation of musket shot is, that although in moderate velocities the resistance is so nearly in the duplicate proportion of the velocities that we cannot observe any deviation, yet in velocities exceeding 200 feet per second the retardations increase faster, and the deviation from this rate increases rapidly with the velocity. He ascribes this to the causes already mentioned, viz. the condensation of the air before the ball and to the rarefaction behind, in consequence of the air not immediately occupying the space left by the bullet. This increase is so great, that if the resistance to a ball moving with the velocity of 700 feet in a second be computed on the supposition that the resistance observed in moderate velocities is increased in the duplicate ratio of the velocity, it will be found hardly one-third part of its real quantity. He found, for instance, that a ball moving through 1670 feet in a second lost about 125 feet per second of its velocity in passing through 50 feet of air. This it must have done in the $\frac{1}{32}$ of a second, in which time it would have lost one foot if projected directly upwards; from which it appears that the resistance was about 125 times its weight, and more than three times greater than if it had increased from the resistance in small velocities in the duplicate ratio of the velocities. He relates other experiments which show similar results. See GUNNERY.

The discussions of mathematicians not easily applied.

The first mathematicians of Europe have employed themselves in improving the theory of the motion of bodies in a resisting medium; but their discussions are such as few artillerists can understand. The problem can only be solved by approximation, and this by the quadrature of very complicated curves. They have not been able therefore to deduce from them any practical rules of easy application, and have been obliged to compute tables suited to different cases. Of these performances, that of the Chevalier Borda, in the *Memoirs of the Academy of Sciences* for 1769, seems the best adapted to military readers, and the tables are undoubtedly of considerable use; but it is not too much to say, that the simple rules of Mr. Robins are of as much service, and are more easily remembered; besides, it must be observed, that the nature of military service does not give room for the application of any very precise rule. The only advantage that we can derive from a perfect theory would be an improvement in the construction of pieces of ordnance, and a more judicious appropriation of certain velocities to cer-

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tain purposes. The service of a gun or mortar must always be regulated by the eye.

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There is another motion of which air and other elastic fluids are susceptible, viz. an internal vibration of their particles, or undulation, by which any extended portion of air is distributed into alternate parcels of condensed and rarefied air, which are continually changing their condition without changing their places. By this change the condensation which is produced in one part of the air is gradually transferred along the mass of air to the greatest distances in all directions. It is of importance to have some distinct conception of this motion. It is found to be by this means that distant bodies produce in us the sensation of sound. Sir Isaac Newton treated this subject with his accustomed ingenuity, and has given us a theory of it in the end of the second book of his *Principia*. This theory has been objected to with respect to the conduct of the argument, and other explanations have been given by the most eminent mathematicians. Though they appear to differ from Newton's, their results are precisely the same; but, on a close examination, they differ no more than John Bernoulli's theorem of centripetal forces differs from Newton's, viz. the one being expressed by geometry and the other by literal analysis. The celebrated Lagrange reduces Newton's investigation to a tautological proposition or identical equation; but Mr. Young of Trinity College, Dublin, has, by a different turn of expression, freed Newton's method from this objection.

This has een used o explain variety of atural henomena.

But since Newton published this theory of aerial undulations, and of their propagation along the air, and since the theory has been so corrected and improved as to be received by the most accurate philosophers as a branch of natural philosophy susceptible of rigid demonstration, it has been freely resorted to by many writers on other parts of natural science, who did not profess to be mathematicians, but made use of it for explaining phenomena in their own line on the authority of the mathematicians themselves. Learning from them that this vibration, and the *quaquaversum* propagation of the pulses, were the necessary properties of an elastic fluid, and that the rapidity of this propagation had a certain assignable proportion to the elasticity and density of the fluid, they freely made use of these concessions, and have introduced elastic vibrating fluids into many facts, where others would suspect no such thing, and have attempted to explain by their means many abstruse phenomena of nature. Æthers are everywhere introduced, endued with great elasticity and tenuity. Vibrations and pulses are supposed in this æther, and these are offered as explanations. The doctrines of animal spirits and nervous fluids, and the whole mechanical system of Hartley, by which the operations of the soul are said to be explained, have their foundation in this theory of aerial undulations. If these fancied fluids, and their internal vibrations, really operate in the phenomena ascribed to them, any explanation that can be given of the phenomena from this principle must be nothing else then showing that the legitimate consequences of these undulations are similar to the phenomena; or, if we are no more able to see this last step than in the case of sound, (which we know to be *one* consequence of the aerial undulations, although we cannot tell how), we must be able to point out, as in the case of sound, certain constant relations between the general laws of these undulations and the general laws of the phenomena. It is only in this way that we think ourselves entitled to say that the aerial undulations are causes, though not the only causes, of sound; and it is because there is no such relation, but, on the contrary, a total dissimilarity, to be observed between the laws of elastic undulations and the laws of the propagation of light, that we assert with confidence that ethereal undulations are not the causes of vision.

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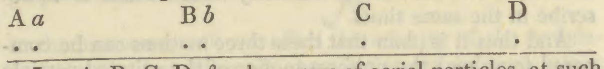
Explanations of this kind suppose, therefore, in the first place, that the philosopher who proposes them understands precisely the nature of these undulations; in the next place, that he makes his reader sensible of those circumstances of them which are concerned in the effect to be explained; and, in the third place, that he makes the reader understand how this circumstance of the vibrating fluid is connected with the phenomenon, either by showing it to be its mechanical cause, as when the philosopher explains the resounding of a musical chord to a flute or pipe which gave the same tone; or by showing that this circumstance of the undulation always accompanies the phenomenon, as when the philosopher shows that 233 vibrations of air in a second, in whatever manner or by whatever cause they are produced, always are followed by the sensation of the tone C in the middle of the harpsichord.

How elastic differ from unelastic fluids.

We propose now to give some account of the motion of elastic fluids; and the first thing incumbent on us is to show how these fluids differ from the unelastic in the propagation of any agitation of their parts. When a long tube is filled with water, and any one part of it pushed out of its place, the whole is instantly moved like a solid mass. But this is not the case with air. If a door be suddenly shut, the window at the farther end of a long and close room will rattle; but some time will elapse between the shutting of the door and the motion of the window. If some light dust be lying on a braced drum, and another be violently beat at a little distance from it, an attentive observer will see the dust dance up from the parchment; but this will be at the instant he hears the sound of the stroke on the other drum, and a sensible time after the stroke. Many such familiar facts show that the agitation is gradually communicated along the air; and therefore that when one particle is agitated by any sensible motion, a finite time, however small, must elapse before the adjoining particle is agitated in the same manner. This would not be the case in water if water be perfectly incompressible. We think that this may be made intelligible with very little trouble.



Let A, B, C, D, &c. be a row of aerial particles, at such distances that their elasticity just balances the pressure of the atmosphere; and let us suppose (as is deducible from the observed density of air being proportional to the compressing force) that the elasticity of the particles, by which they keep each other at a distance, is as their distances inversely. Let us farther suppose that the particle A has been carried, with an uniform motion, to a by some external force. It is evident that B cannot remain in its present state; for being now nearer to a than to C, it is propelled towards C by the excess of the elasticity of A above the natural elasticity of C. Let E be the natural elasticity of the particles, or the force corresponding to the distance BC or BA, and let F be the force which impels B towards C, and let f be the force exerted by A when at a. We have

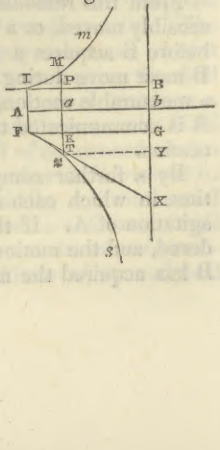
$$\mathrm{E} : f = \mathrm{B}a : \mathrm{BC} = \mathrm{B}a,\ \mathrm{BA};$$

$$\text{and } \mathrm{E} : f - \mathrm{E} = \mathrm{B}a : \mathrm{BA} - \mathrm{B}a = \mathrm{B}a : \mathrm{A}a;$$

$$\text{or } \mathrm{E} : \mathrm{F} = \mathrm{B}a : \mathrm{A}a.$$

Now, in fig. 81, let ABC be the line joining three particles, to which draw FG, PH parallel, and IAF, HBG perpendicular. Take IF or HG to represent the elasticity corresponding to the distance AB. Let the particle A be supposed to have been carried with an uniform motion to a by some external force, and draw RaM perpendicular to RG; and make FI : RM = Ba : BA. We shall then have FI : PM = Ba : Aa; and PM will represent the force

Fig. 81.



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with which the particle B is urged towards C. Suppose this construction to be made for every point of the line AB, and that a point M is thus determined for each of them, mathematicians know that all these points M lie in the curve of a hyperbola, of which FG and GH are the asymptotes. It is also known by the elements of mechanics, that since the motion of A along AB is uniform, A*a* or IP may be taken to represent the time of describing A*a;* and that the area IPM represents the whole velocity which B has acquired in its motion towards C when A has come to *a*, the force urging B being always as the portion PM of the ordinate.

Take GX of any length in HG produced, and let GX represent the velocity which the uniform action of the natural elasticity IF could communicate to the particle B during the time that A would uniformly describe AB. Make GX to GY as the rectangle IFGH to the hyperbolic space IFRM, and draw YS cutting MR produced in S, and draw FX cutting MR in T. It is known to the mathematicians that the point S is in a curve line FS*s*, called the *logarithmic curve;* of which the leading property is, that any line RS parallel to GX is to GX as the rectangle IFGH is to the hyperbolic space IFRM, and that FX touches the curve in F.

This being the case, it is plain, that because RT increases in the same proportion with FR, or with the rectangle IFRP, and RS increases in the proportion of the space IFRM, TS increases in the proportion of the space IPM. Therefore TS is proportional to the velocity of B when A has reached *a*, and RT is proportional to the velocity which the uniform action of the natural elasticity would communicate to B in the same time. Then since FT is as the time, and TS is as the velocity, the area FTS will be as the space described by B, urged by the variable force PM; while A, urged by the external force, describes A*a;* and the triangle FRT will represent the space which the uniform action of the natural elasticity would cause B to describe in the same time.

And thus it is plain that these three motions can be compared together: the uniform motion of the agitated particle A, the uniformly accelerated motion which the natural elasticity would communicate to B by its constant action, and the motion produced in B by the agitation of A. But this comparison, requiring the quadrature of the hyperbola and logarithmic curve, would lead us into most intricate and tedious computations. Of these we need only give the result, and make some other comparisons which are palpable.

Let A*a* be supposed indefinitely small in comparison of AB. The space described by A is therefore indefinitely small; but in this case we know that the ratio of the space FRT to the rectangle IFRP is indefinitely small. There is therefore no comparison between the agitation of A by the external force, and the agitation which natural elasticity would produce on a single particle in the same time, the last being incomparably smaller than the first. And this space FRT is incomparably greater than FTS; and therefore the space which B would describe by the uniform action of the natural elasticity is incomparably greater than what it would describe in consequence of the agitation of A.

From this reasoning we see evidently that A must be sensibly moved, or a finite or measurable time must elapse before B acquires a measurable motion. In like manner, B must move during a measurable time before C acquires a measurable motion, &c.; and therefore the agitation of A is communicated to the distant particles in gradual succession.

By a further comparison of these spaces we learn the time in which each succeeding particle acquires the very agitation of A. If the particles B and C only are considered, and the motion of C neglected, it will be found that B has acquired the motion of A a little before it has described one-third of the space described by A; but if the motion of C be considered, the acceleration of B must be increased by the retreat of C, and B must describe a greater space in proportion to that described by A. By computation it appears, that when both B and C have acquired the velocity of A, B has described nearly one-half of A's motion, and C more nearly one-third. Extending this to D, we shall find that D has described still more nearly one-fourth of A's motion. And from the nature of the computation it appears that this approximation goes on rapidly; therefore, supposing it accurate from the very first particle, it follows from the equable motion of A, that each succeeding particle moves through an equal space in acquiring the motion of A.

The conclusion which we must draw from all this is, that when the agitation of A has been fully communicated to a particle at a *sensible* distance, the intervening particles, all moving forward with a common velocity, are equally compressed as to sense, except a very few of the first particles; and that this communication, or this propagation of the original agitation, goes on with an uniform velocity.

These computations need not be attended to by such as do not wish for an accurate knowledge of the precise agitation of each particle. It is enough for such readers to see clearly that time *must* escape between the agitation of A and that of a distant particle; and this is abundantly manifest from the incomparability (excuse the term) of the nascent rectangle IFRP with the nascent triangle FRT, and the incomparability of FRT with FTS.

Newton's demonstration on this subject.

What has now been shown of the communication of any sensible motion A *a* must hold equally with respect to any change of this motion. Therefore if a tremulous motion of a body, such as a spring or bell, should agitate the adjoining particle A by pushing it forward in the direction AB, and then allowing it to come back again in the direction BA, an agitation similar to this will take place in all the particles of the row one after the other. Now if this body vibrate according to the law of motion of a pendulum vibrating in a cycloid, the neighbouring particle of air *will of necessity* vibrate in the same manner; and then Newton's demonstration in the article Acoustics needs no apology. Its only deficiency was, that it *seemed* to prove that this *would be* the way in which every particle would of necessity vibrate; which is not true, for the successive parcels of air will be differently agitated according to the original agitation. Newton only wants to prove the uniform propagation of the agitations, and he selects that form which renders the proof easiest. He proves, in the most unexceptionable manner, that if the particles of a pulse of air are really moving like a cycloidal pendulum, the forces acting on each particle, in consequence of the compression and dilatation of the different parts of the pulse, are precisely such as are necessary for continuing this motion, and therefore no other forces are required. Then since each particle in a certain part of its path, is moving in a certain direction, and with a certain velocity, and urged by a determined force, it *must* move in that very manner. The objection started by John Bernoulli against Newton's demonstration of the elliptical motion of a body urged by a force in the inverse duplicate ratio of the distance from the focus, is precisely the same with the objection against Newton's demonstration of the progress of aerial undulations, and is equally futile.

It must, however, be observed, that Newton's demonstration proceeds on the supposition that the linear agitations of a particle are incomparably smaller than the extent of an undulation. This is not strictly the case in any instance, and in many it is far from being true. In a pretty strong twang of a harpsichord wire, the agitation of a particle may be near the 50th part of the extent of the undulation. This must disturb the regularity of the motion, and cause the ndulation of air.

agitations in the remote undulations to differ from those in the first pulse. In the explosion of a cannon, the breaking of an exhausted bottle, and many instances which may be given, the agitations are still greater. The commentators on Newton's *Principia*, Le Sueur and Jacquier, have shown, and Euler more clearly, that when the original agitations are very violent, the particles of air will acquire a subordinate vibration compounded with the regular cycloidal vibration, and the progress of the pulses will be somewhat more rapid; but the intricacy of the calculus is so great, that they have not been able to determine with any tolerable precision what the change of velocity will be.

onfirmed experi- ents on unds.

All this, however, is fully confirmed by experiment on sounds. The sound of a cannon at 10 or 20 miles distance does not in the least resemble its sound when near. In this case it is a loud instantaneous crack, to which we can assign no musical pitch. At a distance, it is a grave sound, of which we can tell the note; and it begins softly, swells to its greatest loudness, and then dies away growling. The same may be said of a clap of thunder, which we know to be a loud snap of still less duration. It is highly probable that the appreciable tones which those distant sounds afford are produced by the continuance of these subordinate vibrations which are added together and fortified in the successive pulses, though not perceptible in the first, in a way somewhat resembling the resonance of a musical chord. Newton's explanation gathers evidence therefore from this circumstance. And we must further observe, that all elastic bodies tremble or vibrate almost precisely as a pendulum swinging in a cycloid, unless their vibrations are uncommonly violent; in which case they are quickly reduced to a moderate quantity by the resistance of the air. The only very loud sounds which we can produce in this way are from great bells; and in these the utmost extent of the vibration is very small in comparison with the breadth of the pulse. The velocity of these sounds has not been compared with that of cannon, or perhaps it would be found less, and an objection against Newton's determination removed. He gives 969 feet per second, (experiment 1142.)

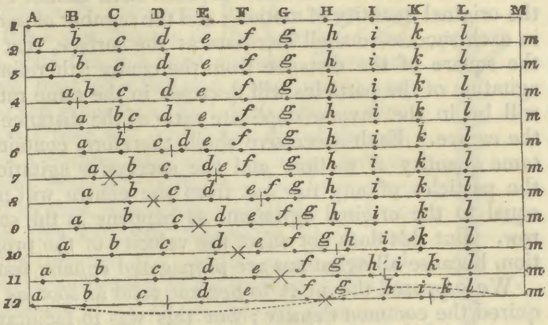
he agita- on in the ccessive ulses pro- ably as- umes a cy- loidal form.

But it is also very probable, that in the propagation through the air, the agitation gradually and rapidly approaches to this regular cycloidal form in the successive pulses, in the same way as we observe that whatever is the form of agitation in the middle of a smooth pond of water, the spreading circles are always of one gentle form without asperities. In like manner, into whatever form we throw a stretched cord by the twang which we give it, it almost immediately makes smooth undulations, keeping itself in the shape of an elongated trochoid. Of this last we can demonstrate the necessity, because the case is simple. In the wave, the investigation is next to impossible; but we see the fact. We may therefore presume it in air. And accordingly we know that any noise, however abrupt and jarring near at hand, is smooth at a distance. Nothing is more rough and harsh than the scream of a heron; but at half a mile's distance it is soft. The ruffle of a drum is also smooth at a distance.

Undulation of air.

Fig. 82, shows the successive situations of the particles of a row. Each line of the figure shows the same particles marked with the same letters; the first particle *a* being supposed to be removed successively from its quiescent situation and back to it again. The mark × is put on that part of each line where the agitated particles are at their natural distances, and the air is of the natural density. The mark | is put where the air is most of all compressed, and : where it is most of all dilated; the curve line drawn through the lowest line of the figure is intended to represent the density in every point, by drawing ordinates to it from the straight line. The ordinates below the line indicate a rarity, and those above the line a density, greater than common. It appears that when *a* has come back to its natural situation, the part of greatest density is between the particles *i* and *k*, and the greatest rarity between *c* and *d*.

Fig. 82.

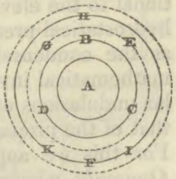


We have only to add, that the velocity of this propagation depends on the elasticity and density of the fluid. If these vary in the same proportion, that is, if the fluid has its elasticity proportional to its density, the velocity will remain the same. If the elasticity or density alone be changed, the velocity of the undulations will change in the direct subduplicate ratio of the elasticity and the inverse subduplicate ratio of the density; or should the elasticity be quadrupled, the quantity of motion produced by it in any given time will be quadrupled. This will be the case if the velocity be doubled; for there would then be double the number of particles doubly agitated. Should the density be quadrupled, the elasticity remaining the same, the quantity of motion must remain the same. This will be the case if the velocity be reduced to one half; for this will propagate half the agitation to half the distance, which will communicate it to twice the number of particles, and the quantity of motion will remain the same. The same may be said of other proportions, and therefore $V=\frac{\sqrt{E}}{\sqrt{D}}$. Therefore a change in the barometer will not affect the velocity of the undulations in air; but they will be accelerated by heat, which diminishes its density, or increases its elasticity. The velocity of the pulses in inflammable air must be at least thrice as great, because its density is but one-tenth of that of air when the elasticity of both are the same.

Further considera- tion of aerial pulses.

Let us now attend a little to the propagation of aerial pulses as they really happen; for this hypothesis of a single row of particles is nowhere to be observed. Suppose a sphere A, fig. 83, filled with condensed air, and that the vessel which contains it is suddenly annihilated. The air must expand to its natural dimensions, suppose BCD. But it cannot do this without pressing aside the surrounding air. We have seen that in any single row of particles this cannot be at once diffused to a distance, but must produce a condensation in the air adjoining; which will be gradually propagated to a distance. Therefore this sphere BCD of the common density will form round it a shell, bounded by EFG, of condensed air. Suppose that at this instant the inner air BCD becomes solid. The shell of condensed air can expand only outwards. Let it expand till it is of the common density, occupying the shell HIK. This expansion must, in like manner, produce a shell of condensed air without it; and at this instant let HIK become solid. The surrounding shell of condensed air can expand only outward, condensing another shell without it. It is plain that this must go on continually, and the central agitation will be gradually propagated to a distance in all directions. But, in this process, it is not the same numerical particles that go to a distance. Those of the original

Fig. 83.



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sphere go no further than BCD, those of the next shall go no further than HIK, &c. Further, the expansion outwards of any particle will be more moderate as the diffusion advances; for the whole motion of each shell cannot exceed the original quantity of motion; and the number of particles in each successive shell increases as the surface, that is, as the square of the distance from the centre; therefore the agitation of the particles will decrease in the same ratio, or will be in the inverse duplicate ratio of the distance from the centre. Each successive shell, therefore, contains the same quantity of motion, and the successive agitations of the particles of any row out from the centre will not be equal to the original agitation, as happens in the solitary row. But this does not affect the velocity of the propagation, because all agitations are propagated equally fast.

We supposed the air A to become solid as soon as it acquired the common density; but this was to facilitate the conception of the diffusion. It does not stop at this bulk; for while it was denser it had a tendency to expand. Therefore each particle has attained this distance with an accelerated motion. It will, therefore, continue this motion like a pendulum that has passed the perpendicular, till it is brought to rest by the air without it; and it is now rarer than common air, and collapses again by the greater elasticity of the air without it. This outward air, therefore, in regaining its natural density, must expand both ways. It expands towards the centre, following the collapsing of the air within it; and it expands outwards, condensing the air beyond it. By expanding inwards, it will again condense the air within it, and this will again expand; a similar motion happens in all the outward shells; and thus there is propagated a succession of condensed and rarefied shells of air, which gradually swell to the greatest distance.

Application of the fact of dropping a pebble into water.

It may be demonstrated, that when the central air has for the second time acquired the natural density, it will be at rest, and be disturbed no more; and that this will happen to all the shells in succession. But the demonstration is much too intricate for this place; and we must be contented with pointing out a fact perfectly analogous. When we drop a small pebble into water, we see it produce a series of circular waves, which go along the surface of smooth water to a great distance, becoming more and more gentle as they recede from the centre; and the middle, where the agitation was first produced, remains perfectly smooth, and this smoothness extends continually; that is, each wave when brought to a level remains at rest. Now these waves are produced and propagated by the depression and elevation made at the centre. The elevation tends to diffuse itself; and the force with which each particle of water is actuated is a force acting directly up and down, and is proportional to the elevation or depression of the particle. This hydrostatical pressure operates precisely in the same way as the condensation and rarefaction of the air; and the mathematical investigation of the propagation of the circular undulations on smooth water is similar in every step to that of the propagation of the spherical waves in still air. For this we appeal to Newton's *Principia*, or to Euler's *Opuscula*, where he gives a very beautiful investigation of the velocity of the aerial pulses; and to some memoirs of Lagrange in the collections of the academies of Berlin and Turin. These two last authors have made the investigation as simple as seems possible, and have freed it from every objection which can be stated against the geometrical one of their greater teacher Newton.

The waves of water are useful in explaining those of air.

Having said this much respecting the similarity between the waves on water and the aerial undulations, we shall have recourse to them, as affording us a very sensible object to represent many affections of the other which it would be extremely difficult to explain. We neither see nor feel the aerial undulations; and they behoved, therefore, to be described very abstractedly and imperfectly. In the watery wave there is no permanent progressive motion of the water from the centre. Throw a small bit of cork on the surface, and it will be observed to popple up and down without the least motion outwards. In like manner, the particles of air are only agitated a very little outwards and inwards, which motion is communicated to the particles beyond them, whilst they themselves come to rest, unless agitated afresh; and this agitation of the particles is inconceivably small. Even the explosion of a cannon at no great distance will but gently agitate a feather, giving it a single impulse outwards, and immediately after another inwards or towards the cannon. When a harpsichord wire is forcibly twanged at a few feet distance, the agitation of the air is next to insensible. It is not, however, nothing; and it differs from that in a watery wave by being *really* outwards and inwards. In consequence of this, when the condensed shell reaches an elastic body, it impels it slightly. If its elasticity be such as to make it acquire the opposite shape at the instant that the next agitation and condensed shell of air touches it, its agitation will be doubled, and a third agitation will increase it, and so on, till it acquire the agitation competent to that of the shell of air which reaches it, and it is thrown into sensible vibration, and gives a sound extremely faint indeed, because the agitation which it acquires is that corresponding to a shell of air considerably removed from the original string. Hence it happens that a musical chord, pipe, or bell, will cause another to resound, whose vibrations are isochronous with its own; or if the vibrations of the one coincides with every second, or third, or fourth, &c. of the other; just as we can put a very heavy pendulum into sensible motion by giving it a gentle puff with the breath at every vibration, or at every second, third, or fourth, &c. A drum struck in the neighbourhood of another drum will agitate it very sensibly; for here the stroke depresses a very considerable surface, and produces an agitation of a considerable mass of air; it will even agitate the surface of stagnant water. The explosion of a cannon will even break a neighbouring window. The shell of condensed air which comes against the glass has a great surface and a great agitation; the best security in this case is to throw up the sash; this admits the condensed air into the room, which acts on the inside of the window, balancing part of the external impulse.

Waves of air and of water in some respects similar.

It is demonstrated in every elementary treatise of natural philosophy, that when a wave on water meets any plane obstacle, it is reflected by it from a centre equally removed behind the obstacle; that waves radiating from the focus of a parabola are reflected in waves perpendicular to its axis; that waves radiating from one focus of an ellipse are made to converge to the other focus, &c. All this may be affirmed of the aerial undulations; that when part of a wave gets through a hole in the obstacle, it becomes the centre of a new series of a waves; that waves bend round the extremities of an obstacle; all this happens in the aerial undulations. And lastly, that when the surface of water is thrown into regular undulations by one agitation, another agitation in another place will produce other regular waves, which will cross the former without disturbing them in the smallest degree. The same thing happens in air; and experiments may be made on water which will illustrate in the most perfect manner many other affections of the aerial pulses, which we should otherwise conceive very imperfectly. We would recommend to our curious readers to make some of these experiments in a large vessel of milk. Take a long and narrow plate of lead, which, when set on the bottom of the vessel, will reach above the surface of the milk; bend this plate into a parabola, elliptical, or other curve. Make the undulations by dropping milk on the focus from a small pipe, which will cause the agitations to succeed with rapidity, and then all that we have said will be most distinctly seen, and the experiment will be

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very amusing and instructive, especially to the musical reader.

We shall now proceed to explain a number of natural appearances, depending on the pressure and the elasticity of the air; appearances not sufficiently general, or too complicated for the purposes of argument, whilst we were employed in the investigation of these properties, but too important to be passed over in silence.

he pres- ure of the ir occa- ions the ohesion of wo sur- aces, &c.

It is owing to the pressure of the atmosphere that two surfaces which accurately fit each other cohere with such force. This is a fact familiarly known to the glass-grinders, polishers of marble, &c. A large lens or speculum, ground on its tool till it becomes very smooth, requires more than any man's strength to separate it directly from the tool. If the surface is only a square inch, it will require fifteen pounds to separate them perpendicularly, though a very moderate force will make them slide along each other. But this cohesion is not observed unless the surfaces are wetted or smeared with oil or grease; otherwise the air gets between them, and they separate without any trouble. That this cohesion is owing to the atmospheric pressure, is evident from the ease with which the plates may be separated in an exhausted receiver. To the same cause we must ascribe the very strong adhesion of snails, periwinkles, limpets, and other univalve shells, to the rocks. The animal forms the rim of its shell, so as to fit the shape of the rock to which it intends to cling. It then fills its shell, if not already filled by its own body, with water. In this condition it is evident that we must act with a force equal to fifteen pounds for every square inch of touching surface before we can detach it. This may be illustrated by filling a drinking-glass to the brim with water, and having covered it with a piece of thin wet leather, whelm it on a table, and then try to pull it straight up; which will require a considerable force. But if we expose a snail adhering to a stone in the exhausted receiver, we shall see it drop off by its own weight. In the same manner do the remora, the polypus, the lamprey, and many other animals, adhere with such firmness. Boys frequently amuse themselves by pulling out large stones from the pavement by means of a circle of stiff wetted leather fastened to a string. It is owing to the same cause that the bivalve shell fishes keep themselves so firmly shut. We think the muscular force of an oyster prodigious, because it requires such force to open it; but if we grind off a bit of the convex shell, so as to make a hole in it, though without hurting the fish in the smallest degree, it opens with great ease, as it does also *in vacuo*.

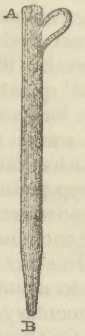
ther ef- cts of the ressure of e air.

The pressure of the air, operating in this way, contributes much to the cohesion of bodies, where we do not suspect its influence. The tenacity of our mortars and cements would frequently be ineffectual without this assistance. It is owing to the pressure of the atmosphere that a cask will not run by the cock unless a hole be opened in some other part of the cask. If the cask is not quite full, some liquor indeed will run out, but it will stop as soon as the diminished elasticity of the air above the liquor is in equilibrio, together with the liquor, with the atmospheric pressure. In like manner, a teapot must have a small hole in its lid to ensure its pouring out the tea. If indeed the hole in the cask is of large dimensions, it will run without any other, because air will get in at the upper side of the hole while the liquor runs out by the lower part of it. On the same principle depends the performance of an instrument used by the spirit-dealers for taking out a sample of their spirits. It consists of a long tinplate tube AB (fig. 84,) open a-top at A, and ending in a small hole at B. The end B is dipped into the spirits, which rises into the tube; then the thumb is clapt on the mouth A, and the whole is lifted out of the cask. The spirit remains in it till the thumb be taken off; it is then allowed to run into a glass for examination.

Effects of the pressure of the air.

Why frosts instantly occasion a scarcity of water.

Fig. 84.



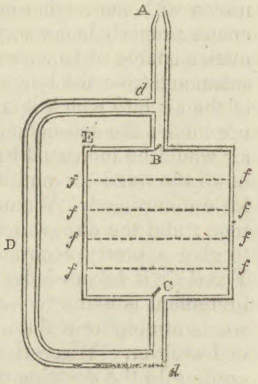
It seems principally owing to the pressure of the air that frosts immediately occasion a scantiness of water in our fountains and wells. This is erroneously accounted for, by supposing that the water freezes in the bowels of the earth. But this is a great mistake. The most intense frost of a Siberian winter would not freeze the ground two feet deep; but a very moderate frost will consolidate the whole surface of a country, and make it impervious to the air; especially if the frost has been preceded by rain, which has soaked the surface. When this happens, the water which was filtering through the ground is all arrested and kept suspended in its capillary tubes by the pressure of the air, in the very same manner as the spirits are kept suspended in the instrument just now described by the thumb's shutting the hole A. A thaw melts the superficial ice, and allows the water to run in the same manner as the spirits run when the thumb is removed.

The necessity of common air to animal life.

Common air is necessary for supporting the lives of most animals. If a small animal, such as a mouse or bird, be put under the receiver of an air-pump, and the air be exhausted, the animal will quickly be thrown into convulsions and fall down dead; if the air be immediately readmitted, the animal will sometimes revive, especially if the rarefaction has been briskly made, and has not been very great. We do not know that any breathing animal can bear the air to be reduced to one-fourth of its ordinary density, nor even one-third; nor have we good evidence that an animal will ever recover if the rarefaction is pushed very far, although continued for a very short time.

But the mere presence of the air is by no means sufficient for preserving the life of the animal; for it is found, that an animal shut up in a vessel of air cannot live in it for any length of time. If a man be shut up in a box, containing a wine hogshead of air, he cannot live in it much above an hour, and long before this he will find his breathing very unsatisfactory and uneasy. A gallon of air will support him about a minute. A box EF (fig. 85,) may be made, having a pipe AB inserted into its top, and fitted with a very light valve at B, opening upwards. This pipe sends off a lateral branch aD, dC, which enters the box at the bottom, and is also fitted with a light valve at C opening upwards. If a person breathe through the pipe, keeping his nostrils shut, it is evident that the air which he expires will not enter the box by the hole B, nor return through the pipe CDd; and by this contrivance he will gradually employ the whole air of the box. With this apparatus experiments can be made without any risk or inconveniency, and the quantity of air necessary for a given time of easy breathing may be accurately ascertained.

Fig. 85.



How the air of our atmosphere produces this effect, is a question which does not belong to mechanical philosophy to investigate or determine. We can, however, affirm, that it is neither the pressure nor the elasticity of the air which is immediately concerned in maintaining the animal functions. We know that we can live and breathe with perfect freedom on the tops of the highest mountains. The valley of Quito in Peru, and the country round Gondar in Abyssinia, are so far elevated above the surface of the ocean, that the pressure and the elasticity of the air are one-third less

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than in the low countries; yet these are populous and healthy places. And, on the other hand, we know, that when an animal has breathed in any quantity of air for a certain time without renewal, it will not only be suffocated, but another animal put into this air will die immediately. And we do not find either the pressure or elasticity of the air remarkably diminished; it is indeed diminished, but by a very small quantity. Restoring the former pressure and elasticity has not the smallest tendency to prevent the death of the animal; for an animal will live no longer under a receiver that has its mouth inverted on water, than in one set upon the pump-plate covered with leather. Now when the receiver is set on water, the pressure of the atmosphere acts completely on the included air, and preserves it in the same state of elasticity.

The nature of air that has been pired, altered.

In short, it is known that the air which has already served to maintain the animal functions has its chemical and alimentary properties completely changed, and is no longer fit for this purpose. So much of any mass of air as has really been thus employed is changed into what is called *fixed air* by Dr. Black, or *carbonic acid* by the chemists of the school of Lavoisier. Any person may be convinced of this by breathing or blowing through a pipe immersed in lime water. Every expiration will produce white clouds on the water, till all the lime which it contains is precipitated in the form of pure chalk. In this case we know that the lime has combined with the fixed air.

Hales's experiments.

The celebrated Dr. Stephen Hales made many experiments, with a view to clear the air from the noxious vapour which he supposed to be emitted from the lungs. He made use of the apparatus which we have been just now mentioning; and he put several diaphragms *ff*, *ff*, &c. of thin woollen stuff into the box, and moistened them with various liquids. He found nothing so efficacious as a solution of potash. We now understand this perfectly. If the solution is not already saturated with fixed air, it will take it up as fast as it is produced, and this will purify the air: a solution of caustic alkali therefore will have this effect till it is rendered quite mild.

How it comes to be changed.

These experiments have been repeated, and varied in many circumstances, in order to ascertain whether this fixed air was really emitted by the lungs, or whether the inspired air was in part changed into fixed air by its combination with some other substance. This is a question which comes properly in our way, and which the doctrines of pneumatics enable us to answer. If the fixed air be emitted in substance from the lungs, it does not appear how a renewal of the air into which it is emitted is necessary, for this does not hinder the subsequent emission; and the bulk of the air would be increased by breathing in it, viz. by the bulk of all the fixed air emitted; but, on the contrary, it is a little diminished. We must therefore adopt the other opinion; and the discoveries in modern chemistry enable us to give a pretty accurate account of the whole process. Fixed air is acknowledged to be a compound, of which one ingredient is found to constitute about three-eighths of the whole atmospheric fluid, we mean vital air or the oxygen of Lavoisier. When this is combined with phlogiston, according to the doctrine of Stahl, or with charcoal, according to Lavoisier, the result is fixed air or carbonic acid. The change therefore which breathing makes on the air is the solution of this matter by vital air; and the use of air in breathing is the carrying off this noxious principle in the way of solution. When therefore the air is already so far saturated as not to dissolve this substance as fast as it is secreted, or must be secreted in the lungs, the animal suffers the pain of suffocation, or is otherwise mortally affected. Suffocation is not the only consequence; for we can remain for a number of seconds without breathing, and then we begin to feel the true pain of suffocation; but those who have been instantaneously struck down by an inspiration of fixed air, and afterwards recovered to life, complained of no such pain, and seemed to have suffered chiefly by a nervous affection. It is said, but we will not vouch for the truth of it, that a person may safely take a full inspiration of fixed air, if the passages of the nose be shut; and that unless these nerves are stimulated by the fixed air, it is not instantaneously mortal. But these are questions out of our present line of inquiry. They belong to physiology, and are treated of in other places of this work. Our business is to explain in what manner the pressure and elasticity of the air, combined with the structure and mechanism of the body, operate in producing this necessary secretion and removal of the matter discharged from the lungs in the act of breathing.

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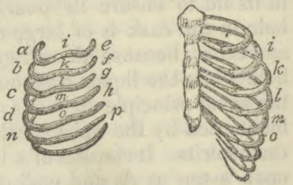
It is well ascertained, that the secretion is made from the mass of blood during its passage through the lungs. The blood delivered into the lungs is of a dark blackish colour, and is there changed into a florid red. In the lungs it is exposed to the action of the air in a prodigiously extended surface; for the lungs consist of an inconceivable number of small vessels or bladders, communicating with each other and with the windpipe. These are filled with air in every inspiration. These vessels are everywhere in contact with minute blood-vessels. The blood does not *in toto* come into immediate contact with the air; and it would seem that it is only the thin serous part of it which is acted on by the air at the mouths of the vessels or pores, where it stands by capillary attraction. Dr. Priestley found, that venous blood inclosed in thin bladders and other membranes was rendered florid by keeping the bladders in contact with abundance of pure vital air. We know also, that breath is moist or damp, and must have acquired this moisture in the lungs. It is immaterial whether this secretion of water or lymph, as the anatomists call it, be furnished by mere exudation through simple pores, or by a vascular and organic secretion; in either case, some ingredient of the blood comes in contact with air in the lungs, and there unites with it. This is farther confirmed, by observing, that all breathing animals are warmer than the surrounding medium, and that by every process in which fixed air is formed from vital air, heat is produced. Hence this solution in air of something from the blood has been assigned by many as the source of animal heat. We touch on these things in a very transitory way in this place, only to prove that, for the support of animal life, there must be a very extensive application of the air to the blood, and that this is made in the lungs.

The question under consideration here is, How is this brought about by the weight and elasticity of the air? The answer is, it is done in two ways; by the action of the muscles of the ribs, and by the action of the diaphragm and other muscles of the abdomen. The thorax or chest is a great cavity, completely filled by the lungs. The sides of this cavity are formed by the ribs. These are crooked or arched, and each is moveable round its two ends, one of them being inserted into the vertebra of the back, and the other into the sternum or breast-bone. The rib turns in a manner resembling the handle of a drawer. The inspection of fig. 86 will illustrate this matter a little. Suppose the curves *a c e*, *b k f*, *c l g*, &c. to represent the ribs moveable round the extremities. Each succeeding rib is more bent than the one above it, and this curvature is both in the vertical and horizontal direction. Suppose each so broad as to project a little over its inferior like the tiles of a roof. It is evident, that if we take the lower one by its middle, and draw it out a little, moving it round the line *np*, it will bring out the next *dmh* along with it. Also, because the dis-

Fig. 86.



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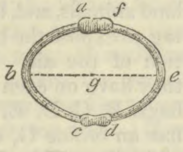
tance of the middle point o from the axis of motion np is greater than the distance of m from the axis dh, and because o will therefore describe a portion of a larger circle than m does, the rib nop will slide up a little under the rib dmh, or the rib dmh will overlap nop a little more than before; the distance om will therefore be diminished. The same must happen to all the superior ribs; but the change of distance will be less and less as we go upwards. Now, instead of this great breadth of the ribs overlapping each other, suppose each inferior rib connected with the one above it by threads or fibres susceptible of contraction at the will of man. The articulations e, a, of the first or upper rib with the spine and sternum are so broad and firm, that this rib can have little or no motion round the line ae; this rib therefore is as a fixture for the ends of all the contracting fibres: therefore, whenever the fibres which connect the second rib with the first rib contract, the second must rise a little, and also go outward, and will carry the lower ribs along with it; the third rib will still rise farther by the contraction of the muscles which connect it with the second, and so on; and thus the whole ribs are raised and thrown outward (and a little forward, because the articulation of each with the spine is considerably higher than that with the sternum), and the capacity of the thorax is enlarged by the contraction of its muscular covering. The direction of the muscular fibres is very oblique to the direction of the circular motion which it produces; from which circumstance it follows, that a very minute contraction of the muscles produces all the motion which is necessary. This indeed is not great; the whole motion of the lowest ribs is less than an inch in the most violent inspiration, and the whole contraction of the muscles of the twelve ribs does not exceed the eighth part of an inch, even supposing the intercostal muscles at right angles to the ribs; and being oblique, the contraction is still less. It would seem, that the intensity of the contractive power of a muscular fibre is easily obtained, but that the space through which it can be exerted is very limited; for in most cases nature places the muscles in situations of great mechanical disadvantage in this respect, in order to procure other conveniences.

But this is not the whole effect of the contraction of the intercostal muscles; since the compound action of the two sets of muscles, which cross each other from rib to rib like the letter X, is nearly at right angles to the rib, but is oblique to its plane, it tends to push the ribs closer on their articulations, and thus to press out the two pillars on which they are articulated. Thus, supposing $a\,f$ (fig. 87) to represent the section of one of the vertebræ of the spine, and $c\,d$ a section of the sternum, and $a\,b\,c$, $f\,e\,d$, two opposite ribs, with a lax thread $b\,e$ connecting them. If this thread be pulled upwards by the middle g till it is tight, it will tend to pull the points b and e nearer to each other, and to press the vertebra $a\,f$ and the sternum $c\,d$ outwards. The spine being the chief pillar of the body, may be considered as immoveable in the present instance. The sternum is sufficiently susceptible of motion for the present purpose. It remains almost fixed a-top at its articulation with the first rib, but it gradually yields below; and thus the capacity of the thorax is enlarged in this direction also. The whole enlargement of the diameters of the thorax during inspiration is very small, not exceeding the fiftieth part of an inch in ordinary cases. This is easily calculated. Its quiescent capacity is about two cubic feet, and we never draw in more than fifteen inches. Two spheres, one of which holds two cubic feet and the other two feet and fifteen inches, will not differ in diameter above the fiftieth part of an inch.

Fig. 87.



The other method of enlarging the capacity of the thorax is very different. It is separated from the abdomen by a strong muscular partition called the diaphragm, which is attached to firm parts all around. In its quiescent or relaxed state it is considerably convex upwards, that is, towards the thorax, rising up into its cavity like the bottom of an ordinary quart bottle, only not so regular in its shape. Many of its fibres tend from its middle to the circumference, where they are inserted into firm parts of the body. Now suppose these fibres to contract. This must draw down its middle, or make it flatter than before, and thus enlarge the capacity of the thorax.

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Physiologists are not well agreed as to the share which each of these actions has in the operation of enlarging the thorax. Many refuse all share of it to the intercostal muscles, and say that it is performed by the diaphragm alone. But the fact is, that the ribs are really observed to rise even while the person is asleep; and this cannot possibly be produced by the diaphragm, as these anatomists assert. Such an opinion shows either ignorance or neglect of the laws of pneumatics. If the capacity of the thorax were enlarged only by drawing down the diaphragm, the pressure of the air would compress the ribs, and make them descend. And the simple laws of mechanics make it as evident as any proposition in geometry, that the contraction of the intercostal muscles must produce an elevation of the ribs and enlargement of the thorax; and it is one of the most beautiful contrivances of nature. It depends much on the will of the animal what share each of these actions shall have. In general, the greatest part is done by the diaphragm; and any person can breathe in such a manner that his rib shall remain motionless; and, on the contrary, he can breathe almost entirely by raising his chest. In the first method of breathing, the belly rises during inspiration, because the contraction of the diaphragm compresses the upper part of the bowels, and therefore squeezes them outwards; so that an ignorant person would be apt to think that the breathing was performed by the belly, and that the belly is inflated with the air. The strait lacing of the women impedes the motion of the ribs, and changes the natural habit of breathing, or brings on an unnatural habit. When the mind is depressed, it is observed that the breathing is more performed by the muscles of the thorax; and a deep sigh is always made in this way.

These observations on the manner in which the capacity of the chest can be enlarged were necessary, before we can acquire a just notion of the way in which the mechanical properties of air operate in applying it to the mass of blood during its passage through the lungs. Suppose the thorax quite empty, and communicating with the external air by means of the trachea or windpipe, it would then resemble a pair of bellows. Raising the boards corresponds to the raising of the ribs; and we might imitate the action of the diaphragm by forcibly pulling outwards the folded leather which unites them. Thus their capacity is enlarged, and the air rushes in at the nozzle by its weight in the same manner as water would do. The thorax differs from bellows only in this respect, that it is filled by the lungs, which is a vast collection of little bladders, like the holes in a piece of fermented bread, all communicating with the trachea, and many of them with each other. When the chest is enlarged, the air rushes into them all in the same manner as into the single cavity of an empty thorax. It cannot be said with propriety that they are inflated; all that is done is the allowing the air to come in. At the same time, as their membranous covering must have some thickness, however small, and some elasticity, it is not unlikely that, when compressed by expiration, they tend a little to recover their former shape, and thus aid the voluntary action of the muscles. It is in this manner that a small bladder of caoutchouc swells again after compression, and fills itself with air or water. But this cannot happen except in the most minute vesicles; those of sensible bulk have not elasticity

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enough for this purpose. The lungs of birds, however, have some very large bladders, which have a very considerable elasticity, and recover their shape and size with great force after compression, and thus fill themselves with air. The respiration of these animals is considerably different from that of land animals, and their muscles act chiefly in expiration. This will be explained by and by as a curious variety in the pneumatic instrument.

Air taken in, not by our own action, but by external pressure.

This account of the manner in which the lungs are filled with air does not seem agreeable to the notions we entertain of it. We seem to suck in the air; but although it be true that we act, and exert force, in order to get air into our lungs, it is not by our action, but by external pressure, that it does come in. If we apply our mouth to the top of a bottle filled with water, we find that no draught, as we call it, of our chest will suck in any of the water, but if we suck in the very same manner at the end of a pipe immersed in water, it follows immediately. Our interest in the thing makes us connect in imagination our own action with the effect, without thinking on the many steps which may intervene in the train of natural operations; and we consider the action as the immediate cause of the reception of the air into the lungs. It is as if we opened the door, and took in by the hand a person who was really pushed in by the crowd without. If an incision be made into the side of the thorax, so that the air can get in by that way, when the animal acts in the usual manner, the air will really come in by this hole, and fill the space between the lungs and the thorax; but no air is sucked into the lungs by this process, and the animal is as completely suffocated as if the windpipe were shut up. And, on the other hand, if a hole be made into the lungs without communicating with the thorax, the animal will breathe through this hole, though the windpipe be stopped. This is successfully performed in cases of patients whose trachea is shut up by accident or by inflammation; only it is necessary that this perforation be made into a part of the lungs where it may meet with some of the great pulmonary passages; for if made into some remote part of a lobe, the air cannot find its way into the rest of the lungs through such narrow passages, obstructed too by blood, &c.

Nature of expiration.

We have now explained, on pneumatical principles, the process of inspiration. The expiration is chiefly performed by the natural tone of the parts. In the act of inspiration the ribs were raised and drawn outwards in opposition to the elasticity of the solids themselves; for although the ribs are articulated at their extremities, the articulations are by no means such as to give a free and easy motion like the joints of the limbs. This is particularly the case in the articulations with the sternum, which are by no means fitted for motion. It would seem that the motion really produced here is chiefly by the yielding of the cartilaginous parts and the bending of the rib; when therefore the muscles which produced this effect are allowed to relax, the ribs again collapse. Perhaps this is assisted a little by the action of the long muscles which come down across the ribs without being inserted into them. These may draw them together a little, as we compress a loose bundle by a string. In like manner, when the diaphragm was drawn down, it compressed the abdomen in opposition to the elasticity of all the viscera contained in it, and to the elasticity and tone of integuments and muscles which surround it. When therefore the diaphragm is relaxed, these parts push it up again into its natural situation, and in doing this expel the air from the lungs.

It requires no effort.

If this be a just account of the matter, expiration should be performed without any effort. This accordingly is the case. We feel that, after having made an ordinary easy inspiration, it requires the continuance of the effort to keep the thorax in this enlarged state, and that all that is necessary for expiration is to cease to act. No person feels any difficulty in emptying the lungs; but weak people often feel a difficulty of inspiration, and compare it to the feeling of a weight on their breast; and expiration is the last motion of the thorax in a dying person. But nature has also given us a mechanism by which we can expire, namely, the abdominal muscles; and when we have finished an ordinary and easy expiration, we can still expel a considerable bulk of air—nearly half the contents of the lungs—by contracting the abdominal muscles. These, by compressing the body, force up its moveable contents against the diaphragm, and cause it to rise further into the thorax, acting in the same manner as when we expel the fæces *per anum*. When a person breathes out as much air as he can in this manner, he may observe that his ribs do not collapse during the whole operation.

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A certain quantity of air necessary to keep the lungs of a natural size.

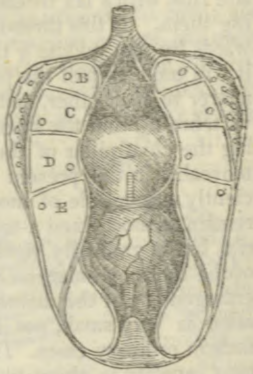
There seems then to be a certain natural unconstrained state of the vesicles of the lungs, and a certain quantity of air necessary for keeping them of this size. It is probable that this state of the lungs gives the freest motion to the blood. Were they more compressed, the blood-vessels would be compressed by the adjoining vesicles; were they more lax, the vessels would be more crooked, and by this means obstructed. The frequent inspirations gradually change this air by mixing fresh air with it, and at every expiration carrying off some of it. In catarrhs and inflammations, especially when attended with suppuration, the small passages into the remote vessels are obstructed, and thus the renewal of air in them will be prevented. The painful feeling which this occasions, causes us to expel the air with violence, shutting the windpipe, till we have exerted strongly with the abdominal muscles, and made a strong compression on the lower part of the thorax. We then open the passage suddenly, and expel the air and obstructing matter by violent coughing.

Process of breathing in birds.

We have said, that birds exhibit a curious variety in the process of breathing. The muscles of their wings being so very great, required a very extensive insertion, and this is one use of the great breast bone. Another use of it is, to form a firm partition to hinder the action of these muscles from compressing the thorax in the act of flying; therefore the form of their chest does not admit of alternate enlargement and contraction to that degree as in land animals. Moreover, the muscles of their abdomen are also very small; and it would seem that they are not sufficient for producing the compression on the bowels which is necessary for carrying on the process of concoction and digestion. Instead of aiding the lungs, they receive help from them.

In the ostrich, the lungs consist of a fleshy part A, A, (fig. 88) composed of vesicles like those of land animals, and, like theirs, serving to expose the blood to the action of the air. Besides these, they have on each side, four large bags, B, C, D, E, each of which has an orifice G, communicating with the trachea; but the second, C, has an orifice, H, by which it communicates with another bag F, situated below the rest in the abdomen. Now, when the lungs are compressed by the action of the diaphragm, the air in C is partly expelled by the trachea through the orifice G, and partly driven through the orifice H into the bag F, which is then allowed to receive it; because the same action which compresses the lungs enlarges the abdomen. When the thorax is enlarged, the bag C is partly supplied with fresh air through the trachea, and partly from the bag F. As the lungs of other animals resemble a common bellows, the

Fig. 88.



lungs of birds resemble the smith's bellows with a partition; and anatomists have discovered passages from this part of the lungs into their hollow bones and quills. We do not know all the uses of this contrivance; and only can observe, that this alternate action must assist the muscles of the abdomen in promoting the motion of the food along the alimentary canal, &c. We can distinctly observe in birds that their belly dilates when the chest collapses, and *vice versa*, contrary to what we see in the land animals. Another use of this double passage may be to produce a circulation of air in the lungs, by which a compensation is made for the smaller surface of action on the blood; for the number of small vesicles, of equal capacity with these large bags, give a much more extensive surface.

If we try to raise mercury in a pipe by the action of the chest alone, we cannot raise it above two or three inches; and the attempt is both painful and hazardous. It is painful chiefly in the breast, and it provokes coughing. Probably the fluids ooze through the pores of the vesicles by the pressure of the surrounding parts. On the other hand, we can by expiration support mercury about five or six inches high; but this also is very painful, and apt to produce extravasation of blood. This seems to be done entirely by the abdominal muscles.

The operation of sucking.

The operation properly termed *sucking*, is totally different from breathing, and resembles exceedingly the action of a common pump. Suppose a pipe held in the mouth, and its lower end immersed in water. We fill the mouth with the tongue, bringing it forward, and applying it closely to the teeth and to the palate; we then draw it back, or bend it downwards from the palate behind, thus leaving a void. The pressure of the air on the cheeks immediately depresses them, and applies them close to the gums and teeth; and its pressure on the water in the vessel causes it to rise through the pipe into the empty part of the mouth, which it quickly fills. We then push forward the tip of the tongue, below the water, to the teeth, and apply it to them all round, the water being above the tongue, which is kept much depressed. We then apply the tongue to the palate, beginning at the tip, and gradually going backward in this application. By this means the water is gradually forced backward by an operation similar to that of the gullet in swallowing. This is done by contracting the gullet above, and relaxing it below, just as we would empty a gut of its contents, by drawing our closed hand along it. By this operation the mouth is again completely occupied by the tongue, and we are ready for repeating the operation. Thus the mouth and tongue resemble the barrel and piston of a pump; and the application of the tip of the tongue to the teeth, performs the office of the valve at the bottom of the barrel, preventing the return of the water into the pipe. Although usual, it is not absolutely necessary, to withdraw the tip of the tongue, making a void before the tongue. Sucking may be performed by merely separating the tongue gradually from the palate, beginning at the root. If we withdraw the tip of the tongue a very minute quantity, the water flows back above the tongue.

The action of the tongue in this operation is very powerful; some persons can raise mercury 25 inches; but this strong exertion is very fatiguing, and the soft parts are prodigiously swelled by it. It causes the blood to ooze plentifully through the pores of the tongue, fauces, and palate, in the same manner as if a cupping-glass and syringe were applied to them; and, when the inside of the mouth is excoriated or tender, as is frequent with infants, even a very moderate exertion of this kind is accompanied with extravasation of blood. When children suck the nurse's breast, the milk follows their exertion by the pressure of the air on the breast; and a weak child, or one that withholds its exertions on account of pain from the above mentioned cause, may be assisted by a gentle pressure of the hand on the breast. The infant pupil of nature, without any knowledge of pneumatics, frequently helps itself by pressing its face to the yielding breast.

In the whole of this operation the breathing is performed through the nostrils; and it is a prodigious distress to an infant when this passage is obstructed by mucus. We beg to be forgiven for observing by the way, that this obstruction may be almost certainly removed for a little while, by rubbing the child's nose with any liquid of quick evaporation, or even with water.

Of drinking.

The operation in drinking is not very different from that in sucking. We have indeed little occasion here to suck, but we must do it a little. Dogs, and some other animals, cannot drink, but only lap the water into their mouths with their tongues, and then swallow it. The gallinaceous birds seem to drink very imperfectly. They seem merely to dip their head into the water, up to the eyes, till their mouth is filled with water, and then holding up the head, it gets into the gullet by its weight, and is then swallowed. The elephant drinks in a very complicated manner. He dips his trunk into the water, and fills it by making a void in his mouth. This he does in the contrary way to man. After having depressed his tongue, he begins the application of it to the palate at the root, and by extending the application forward, he expels the air by the mouth which came into it from the trunk. The process here is not very unlike that of the condensing syringe without a piston valve, in which the external air, corresponding to the air in the trunk, enters by the hole in the side, and is expelled through the hole in the end of the barrel; by this operation the trunk is filled with water; then he lifts his trunk out of the water, and bringing it to his mouth, pours the contents into it, and swallows it. On considering this operation, it appears that, by the same process by which the air of the trunk is taken into the mouth, the water could also be taken in, to be afterwards swallowed; but we do not find, upon inquiry, that this is done by the elephant; we have always observed him to drink in the manner now described. In either way it is a double operation, and cannot be carried on any way but by alternately sucking and swallowing, and while one operation is going on, the other is interrupted; whereas man can do both at the same time. Nature seems to delight in exhibiting to rational observers her inexhaustible variety of resource; for many insects which drink with a trunk, drink without interruption; yet we do not call in question the truth of the aphorism, *Natura maxime simplex et semper sibi consona*, nor doubt but that, if the *whole* of her purpose were seen, we should find that her process is the simplest possible; for Nature, or Nature's God, is wise above our wisest thoughts, and simplicity is certainly the choice of wisdom; but, alas! it is generally but a small and the most obvious part of her purpose that we can observe or appreciate. We seldom see this simplicity of nature stated to us, except by some system-maker, who has found a principle which somehow tallies with a considerable variety of phenomena, and then cries out, *Frustra sit per plura quod fieri potest per pauciora.*

Mode of keeping up a continued blast with a blow-pipe.

There is an operation similar to that of the elephant, which many find a great difficulty in acquiring; namely, keeping up a continued blast with a blow-pipe. We would desire our chemical reader to attend minutely to the gradual action of his tongue in sucking, and he will find it such as we have described. Let him attend particularly to the way in which the tip of the tongue performs the office of a valve, preventing the turn of the water into the pipe; and the same position of the tongue would hinder air from coming into the mouth. Next let him observe, that in swallowing what water he has now got lodged above his tongue, he continues the tip of the tongue applied to the teeth; now let him shut his mouth, keeping his lips firm together, the tip of the tongue at the

Effects of the pressure of the air.

teeth, and the whole tongue forcibly kept at a distance from the palate; bring up the tongue to the palate, and allow the tip to separate a little from the teeth, this will expel the air into the space between the fauces and cheeks, and will blow up the cheeks a little; then, acting with the tip of the tongue as a valve, hinder this air from getting back, and depressing the tongue again, more air from the nostrils will get into the mouth, which may be expelled into the space without the teeth as before, and the cheeks will be more inflated. Continue this operation, and the lips will no longer be able to retain it, and it will ooze through as long as the operation is continued. When this has become familiar and easy, take the blow-pipe, and there will be no difficulty in maintaining a blast as uniform as a smith's bellows, breathing all the while through the nostrils. The only difficulty is the holding the pipe. This fatigues the lips; but it may be removed by giving the pipe a convenient shape, a pretty flat oval, and wrapping it round with leather or thread.

Nature of the land and sea-breeze in warm countries.

Another phenomenon depending on the principles already established, is the land and sea-breeze in the warm countries. We have seen that air expands exceedingly by heat; therefore heated air, being lighter than an equal bulk of cold air, must rise in it. If we lay a hot stone in the sunshine in a room, we shall observe the shadow of the stone surrounded with a fluttering shadow of different degrees of brightness, and that this flutter rises rapidly in a column above the stone. If we hold an extinguished candle near the stone, we shall see the smoke move towards the stone, and then ascend from it. Now, suppose an island receiving the first rays of the sun in a perfectly calm morning; the ground will soon be warmed, and will warm the contiguous air. If the island be mountainous, this effect will be more remarkable; because the inclined sides of the hills will receive the light more directly. The midland air will therefore be most warmed. The heated air will rise, and that in the middle will rise fastest; and thus a current of air upwards will begin, which must be supplied by air coming in from all sides, to be heated and to rise in its turn; so that the morning sea-breeze is produced, and continues all day. This current will frequently be reversed during the night, by the air cooling and gliding down the sides of the hills, and we shall have the land-breeze.

Circulation of air in mines.

It is owing to the same cause that we have a circulation of air in mines which have the mouths of their shafts of unequal heights. The temperature under ground is pretty constant through the whole year, while that of the atmosphere is extremely variable. Now, suppose a mine having a long horizontal drift, communicating between two pits or shafts, and that one of these shafts terminates in a valley, while the other opens on the brow of a hill perhaps 100 feet higher. Let us further suppose it summer, and the air heated to 65°, while the temperature of the earth is but 45°; this last will be also the temperature of the air in the shafts and the drift. Now, since air expands nearly 24 parts in 10,000 by one degree of heat, we shall have an odds of pressure at the bottom of the two shafts equal to nearly the 20th part of the weight of a column of air 100 feet high (100 feet being supposed the difference of the heights of the shafts.) This will be about six ounces on every square foot of the section of the shaft. If this pressure could be continued, it would produce a prodigious current of air down the long shafts, along the drift, and up the short shaft. The weight of air acting through 100 feet would communicate to it the velocity of 80 feet per second: divide this by $\sqrt{20}$, that is, by 4·5, and we shall have 18 feet per second for the velocity: this is the velocity of what is called a brisk gale. This pressure would be continued, if the warm air which enters the long shaft were cooled and condensed as fast as it comes in; but this is not the case. It is however cooled and condensed, and a current is produced sufficient to make an abundant circulation of air along the whole passage; and care is taken to dispose the shafts and conduct the passages in such a manner that no part of the mine is out of the circle. When any new lateral drift is made, the renewal of air at its extremity becomes more imperfect as it advances: and when it is carried a certain length, the air stagnates and becomes suffocating, till either a communication can be made with the rest of the mine, or a shaft be made at the end of this drift.

Effects of the pressure of the air.

As this current depends entirely on the difference of temperature between the air below and that above, it must cease when this difference ceases. Accordingly, in the spring and autumn, the miners complain much of stagnation; but in summer they never want a current from the deep pits to the shallow, nor in the winter a current from the shallow pits to the deep ones. It frequently happens also, that in mineral countries the chemical changes which are going on in different parts of the earth occasion differences of temperature sufficient to produce a sensible current.

The nature of what is called the draught in chimneys.

And this naturally leads us to consider a very important effect of the expansion and consequent ascent of air by heat, namely, the drawing, as it is called, of chimneys. The air which has contributed to the burning of fuel must be intensely heated, and will rise in the atmosphere. This will also be the case with much of the surrounding air which has come very near the fire, although not in contact with it. If this heated air be made to rise in a pipe, it will be kept together, and therefore will not soon cool and collapse: thus we shall obtain a long column of light air, which will rise with a force so much the greater as the column is longer or more heated. Therefore the taller we make the chimney, or the hotter we make the fire, the more rapid will be the current, or the draught or suction, as it is injudiciously called, will be so much the greater. The ascensional force is the difference between the weight of the column of heated air in the funnel and a column of the surrounding atmosphere of equal height. We increase the draught, therefore, by increasing the perpendicular height of the chimney. Its length in a horizontal direction gives no increase, but, on the contrary, diminishes the draught by cooling the air before it gets into the effective part of the funnel. We increase the draught also by obliging all the air which enters the chimney to come very near the fuel; therefore a low mantle-piece will produce this effect; also filling up all the spaces on each side of the grate. When much air gets in above the fire, by having a lofty mantle-piece, the general mass of air in the chimney cannot be much heated. Hence it must happen that the greatest draught will be produced by bringing down the mantle-piece to the very fuel; but this converts a fire-place into a furnace, and by thus sending the whole air through the fuel, causes it to burn with great rapidity, producing a prodigious heat; and this producing an increase of ascensional force, the current becomes furiously rapid, and the heat and consumption of fuel immense. If the fire-place be a cube of a foot and a half, and the front closed by a door, so that all the air must enter through the bottom of the grate, a chimney of fifteen or twenty feet high, and sufficiently wide to give passage to all the expanded air which can pass through the fire, will produce a current which will roar like thunder, and a heat sufficient to run the whole inside into a lump of glass.

All that is necessary, however, in a chamber fire-place, is a current sufficiently great for carrying up the smoke and vitiated air of the fuel. And as we want also the enlivening light and flutter of the fire, we give the chimney-piece both a much greater height and width than what is merely necessary for carrying up the smoke, only wishing to have the current sufficiently determinate and steady for counteracting any occasional tendency which it may sometimes have to come into the room. By allowing a greater quantity of air to get into the chimney, heated only to a mode-ffects of e pres- e of the air.

rate degree, we produce a more rapid renewal of the air of the room: did we oblige it to come so much nearer the fire as to produce the same renewal of the air in consequence of a more rapid current, we should produce an inconvenient heat. But in this country, where pit-coal is in general so very cheap, we carry this indulgence to an extreme; or rather we have not studied how to get all the desired advantages with economy. A much smaller renewal of air than we commonly produce is abundantly wholesome and pleasant, and we may have all the pleasure of the light and flame of the fuel at much less expense, by contracting greatly the passage into the vent. The best way of doing this is by contracting the brick-work on each side behind the mantle-piece, and reducing it to a narrow parallelogram, having the back of the vent for one of its long sides. Make an iron plate to fit this hole, of the same length, but broader, so that it may lie sloping, its lower edge being in contact with the foreside of the hole, and its upper edge leaning on the back of the vent. In this position it shuts the hole entirely. Now let the plate have a hinge along the front or lower edge, and fold up like the lid of a chest. We shall thus be able to enlarge the passage at pleasure. In a fire-place fit for a room of 24 feet by 18, if this plate be about 18 inches long from side to side, and folded back within an inch or an inch and a half of the wall, it will allow passage for as much air as will keep up a very cheerful fire; and by raising or lowering this register, the fire may be made to burn more or less rapidly. A free passage of half an inch will be sufficient in weather that is not immoderately cold. The principle on which this construction produces its effect is, that the air which is in the front of the fire, and much warmed by it, is not allowed to get into the chimney, where it would be immediately hurried up the vent, but rises up to the ceiling and is diffused over the whole room. This double motion of the air may be distinctly observed by opening a little of the door and holding a candle in the way. If the candle be held near the floor, the flame will be blown into the room; but if held near the top of the door, the flame will be blown outward.

escrip- n of a ve-grate chapelle.

But the most perfect method of warming an apartment in the temperate climates, where we can indulge in the cheerfulness and sweet air produced by an open fire, is what we call a stove-grate, and our neighbours on the Continent call a chapelle, from its resemblance to the chapels or oratories in the great churches.

In the great chimney-piece, which, in this case, may be made even larger than ordinary, is set a smaller one fitted up in the same style of ornament, but of a size no greater than is sufficient for holding the fuel. The sides and back of it are made of iron (cast iron is preferable to hammered iron, because it does not so readily calcine), and are kept at a small distance from the sides and back of the main chimney-piece, and are continued down to the hearth, so that the ash-pit is also separated. The pipe or chimney of the stove grate is carried up behind the ornaments of the mantle-piece till it rises above the mantle-piece of the main chimney-piece, and is fitted with a register or damper-plate turning round a traverse axis. The best form of this register is that which we have recommended for an ordinary fire-place, having its axis or joint close at the front; so that when it is open or turned up, the burnt air and smoke striking it obliquely, are directed with certainty into the vent, without any risk of reverberating and coming out into the room. All the rest of the vent is shut up by iron-plates or brick-work out of sight.

The effect of this construction is very obvious. The fuel, being in immediate contact with the back and sides of the grate, heats them to a great degree, and they heat the air contiguous to them. This heated air cannot get up the vent, because the passages above these spaces are shut up. It therefore comes out into the room; some of it goes into the real fire-place and is carried up the vent, and the rest rises to the ceiling and is diffused over the room.

Effects of the pressure of the air.

Effect of its construction.

It is surprising to a person who does not consider it with skill, how powerfully this grate warms a room. Less than one-fourth of the fuel consumed in an ordinary fire-place is sufficient; and this with the same cheerful blazing hearth and salutary renewal of air. It even requires attention to keep the room cool enough. The heat communicated to those parts in contact with the fuel is needlessly great; and it will be a considerable improvement to line this part with very thick plates of cast-iron, or with tiles made of fire-clay which will not crack with the heat. These, being very bad conductors, will make the heat, ultimately communicated to the air, very moderate. If, with all these precautions, the heat should be found too great, it may be brought under perfect management by opening passages into the vent from the lateral spaces. These may be valves or trap-doors moved by rods concealed behind the ornaments.

Thus we have a fire-place under the most complete regulation, where we can always have a cheerful fire without being for a quarter of an hour incommoded by the heat; and we can as quickly raise our fire, when too low, by hanging on a plate of iron on the front, which shall reach as low as the grate. This in five minutes will blow up the fire into a glow; and the plate may be sent out of the room, or set behind the stove-grate out of sight.

The propriety of inclosing the ash-pit is not so obvious; but if this be not done, the light ashes, not finding a ready passage up the chimney, will come out into the room along with the heated air.

Mode of warming apartments by stoves.

Under this head we shall next give a general account and description of the method of warming apartments by stoves. A stove in general is a fire-place shut up on all sides, having only a passage for admitting the air to support the fire, and a tube for carrying off the vitiated air and smoke; and the air of the room is warmed by coming into contact with the outside of the stove and flue. The general principle of construction, therefore, is very simple. The air must be made to come into as close contact as possible with the fire, or even to pass through it, and this in such quantities as just to consume a quantity of fuel sufficient for producing the heat required; and the stove must be so constructed, that both the burning fuel and the air which has been heated by it shall be applied to as extensive a surface as possible of furnace, all in contact with the air of the room; and the heated air within the stove must not be allowed to get into the funnel which is to carry it off till it is too much cooled to produce any considerable heat on the outside of the stove.

In this temperate climate no great ingenuity is necessary for warming an ordinary apartment; and stoves are made rather to please the eye as furniture than as economical substitutes for an open fire of equal calorific power. But our neighbours on the Continent, and especially towards the north, where the cold of winter is intense and fuel very dear, have bestowed much attention on their construction, and have combined ingenious economy with every elegance of form. Nothing can be handsomer than the stoves of Fayencerie that are to be seen in French Flanders, or the Russian stoves at St. Petersburg, finished in stucco. Our readers will not, therefore, be displeased with a description of them. In this place, however, we shall only consider a stove in general as a subject of pneumatical discussion, and refer our readers to the article Stove for stoves as articles of domestic accommodation.

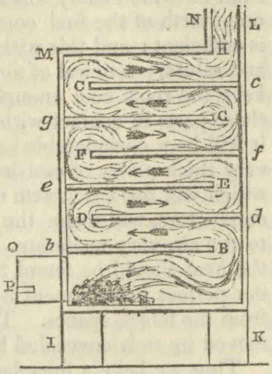
General form of a stove.

The general form, therefore, of a stove, and of which all others are only modifications adapted to circumstances of utility or taste, is as follows:—MIKL (fig. 79.) is a quadrangular box of any size in the directions MILK. The inside width from front to back is pretty constant, never less than 10 inches, and rarely extending to 20;

Effects of the pressure of the air.

the included space is divided by a great many partitions. The lowest chamber B is the receptacle for the fuel, which lies on the bottom of the stove without any grate; this fire-place has a door AO turning on hinges, and in this door is a very small wicket P: the roof of the fire-place extends to within a very few inches of the farther end, leaving a narrow passage B for the flame. The next partition *c* C is about eight inches higher, and reaches almost to the other end, leaving a narrow passage for the flame at C. The partitions are repeated above, at the distance of eight inches, leaving passages at the ends, alternately disposed as in the figure; the last of them H communicates with the room vent. This communication may be regulated by a plate of iron, which can be slid across it by means of a rod or handle which comes through the side. The more usual way of shutting up this passage is by a sort of pan or bowl of earthen ware, which is whelmed over it with its brim resting in sand contained in a groove formed all round the hole. This damper is introduced by a door in the front, which is then shut. The whole is set on low pillars, so that its bottom may be a few inches from the floor of the room. It is usually placed in a corner, and the apartments are so disposed that their chimneys can be joined in stacks as with us.

Fig. 79.



Some straw or wood shavings are first burnt on the hearth at its farther end. This warms the air in the stove, and creates a determined current. The fuel is then laid on the hearth close by the door, and pretty much piled up. It is now kindled; and the current being already directed to the vent, there is no danger of any smoke coming out into the room. Effectually to prevent this, the door is shut, and the wicket P opened. The air supplied by this, being directed to the middle or bottom of the fuel, quickly kindles it, and the operation goes on.

Aim and effects of this construction.

The aim of this construction is very obvious. The flame and heated air are retained as long as possible within the body of the stove by means of the long passages; and the narrowness of these passages obliges the flame to come in contact with every particle of soot, so as to consume it completely, and thus convert the whole combustible matter of the fuel into heat. For want of this, a very considerable portion of our fuel is wasted by our open fires, even under the very best management. The soot which sticks to our vents is very inflammable, and a pound weight of it will give as much if not more heat than a pound of coal. And what sticks to our vents is very inconsiderable in comparison with what escapes unconsumed at the chimney top. In fires of green wood, peat, and some kinds of pit-coal, nearly one-fifth of the fuel is lost in this way; but in these stoves there is hardly ever any mark of soot to be seen; and even this small quantity is produced only after lighting the fires. The volatile inflammable matters are expelled from parts much heated indeed, but not so hot as to burn; and some of it charred or half-burnt cannot be any further consumed, being enveloped in flame and air already vitiated and unfit for combustion. But when the stove is well heated, and the current brisk, no part of the soot escapes the action of the air.

The hot air retained in this manner in the body of the stove is applied to its sides in a very extended surface. To increase this still more, the stove is made narrower from front to back in its upper part; a certain breadth is necessary below, that there may be room for fuel. If this breadth were preserved all the way up, much heat would be lost, because the heat communicated to the partitions of the stove does no good. By diminishing their breadth, the proportion of useful surface is increased. The whole body of the stove may be considered as a long pipe folded up, and its effect would be the greatest possible if it really were so; that is, if each partition *c*C, *d*D, &c. were split into two, and a free passage allowed between them for the air of the room. Something like this will be observed afterwards in some German stoves.

Effects of the pressure of the air.

It is with the same view of making an extensive application of a hot surface to the air, that the stove is not built in the wall, not even in contact with it, nor with the floor; for by its detached situation, the air in contact with the back, and with the bottom, where it is hottest, is warmed, and contributes at least one-half of the whole effect; for the great heat of the bottom makes its effect on the air of the room at least equal to that of the two ends. Sometimes a stove makes part of the wall between two small rooms, and is found sufficient.

It must be remarked, on the whole, that the effect of a stove depends much on keeping in the room the air already heated by it. This is so remarkably the case, that a small open fire in the same room will be so far from increasing its heat, that it will greatly diminish it; it will even draw the warm air from a suite of adjoining apartments. This is distinctly observed in the houses of the English merchants in St. Petersburg; their habits of life in Britain make them uneasy without an open fire in their sitting rooms; and this obliges them to heat all their stoves twice a-day, and their houses are cooler than those of the Russians, who heat them only once. In many German houses, especially of the lower class, the fire-place of the stove does not open into the room, but into the yard or a lobby, where all the fires are lighted and tended; by this means is avoided the expense of warm air which must have been carried off by the stove; but it is evident, that this must be very unpleasant, and cannot be wholesome. We must breathe the same quantity of stagnant air loaded with all the vapours and exhalations which must be produced in every inhabited place. Going into one of these houses from the open air, is like putting one's head into a stew-pan or under a pie-crust, and quickly nauseates us who are accustomed to fresh air and cleanliness. In these countries it is a matter almost of necessity, to fumigate the rooms with frankincense and other gums burnt. The censer in ancient worship was in all probability an utensil introduced by necessity for sweetening or rendering tolerable the air of a crowded place; and it is a constant practice in the Russian houses for a servant to go round the room after dinner, waving a censer with some gums burning on bits of charcoal.

Of hot walls in gardening, &c.

The account now given of stoves for heating rooms, and of the circumstances which must be attended to in their construction, will equally apply to hot walls in gardening, whether within or without doors. The only new circumstance which this employment of a flue introduces, is the attention which must be paid to the equability of the heat, and the gradation which must be observed in different parts of the building. The heat in the flue gradually diminishes as it recedes from the fire-place, because it is continually giving out heat to the flue. It must therefore be so conducted through the building by frequent returns, that in every part there may be a mixture of warmer and cooler branches of the flue, and the final chimney should be close by the fire-place. It would, however, be improper to run the flue from the end of the floor up to the ceiling, where the second horizontal pipe would be placed, and then return it downward again and make the third horizontal flue adjoining to the first, &c. This would make the middle of the wall the coldest. If it is the flue of a greenhouse, this would be highly improper, because the upper part of the wall can be very little employed; and in this case it is bet-ffects of e pres- re of the air.

ter to allow the flue to proceed gradually up the wall in its different returns, by which the lowest part would be the warmest, and the heated air will ascend among the pots and plants; but in a hot wall, where the trees are to receive heat by contact, some approximation to the above method may be useful. In the hypocausta and fudaria of the Greeks and Romans, the flue was conducted chiefly under the floors.

alt-kilns pecies of ove.

Malt-kilns are a species of stove which merit our attention. Many attempts have been made to improve them on the principle of flue stoves; but they have been unsucessful, because heat is not what is chiefly wanted in malting; it is a copious current of very dry air to carry off the moisture.

f the cur- nt of air melting rnaces.

All that is to be attended to in the different kinds of melting furnaces is, that the current of air be sufficiently rapid, and that it be applied in as extensive a surface as possible to the substance to be melted. The more rapid the current it is the hotter, because it is consuming more fuel; and therefore its effect increases in a higher proportion than its rapidity. It is doubly effectual if twice as hot; and if it then be twice as rapid, there is twice the quantity of doubly hot air applied to the subject; it would therefore be four times more powerful. This is procured by raising the chimney of the furnace to a greater height. The close application of it to the subject can hardly be laid down in general terms, because it depends on the precise circumstances of each case.

rrent in erbera- y furna- e.

In reverberatory furnaces, such as refining furnaces for gold, silver, and copper, the flame is made to play over the surface of the melted metal. This is produced entirely by the form of the furnace, by making the arch of the furnace as low as the circumstances of the manipulation will allow. See Furnace. Experience has pointed out in general the chief circumstances of their construction, viz. that the fuel should be at one end on a grate, through which the air enters to maintain the fire; and that the metal should be placed on a level floor between the fuel and the tall chimney which produces the current. But there is no kind of furnace more variable in its effect, and almost every place has a small peculiarity of construction, on which its preeminence is rested. This has occasioned many whimsical varieties in their form. This uncertainty seems to depend much on a circumstance rather foreign to our present purpose; but as we do not observe it taken notice of by mineralogical writers, we beg leave to mention it here. It is not heat alone that is wanted in the refining of silver by lead, for instance. We must make a continual application to its surface of air, which has not contributed to the combustion of the fuel. Any quantity of the hottest air, already saturated with the fuel, may play on the surface of the metal for ever, and keep it in the state of most perfect fusion, but without refining it in the least. Now, in the ordinary construction of a furnace, this is much the case. If the whole air has come in by the grate, and passed through the middle of the fuel, it can hardly be otherwise than nearly saturated with it; and if air be also admitted by the door, which is generally done or something equivalent, the pure air lies above the vitiated air, and during the passage along the horizontal part of the furnace, and along the surface of the metal, it still keeps above it, at least there is nothing to promote their mixture. Thus the metal does not come into contact with air fit to act on the base metal and calcine it, and the operation of refining goes on slowly. Trifling circumstances in the form of the arch or canal may tend to promote the jumbling of the airs together, and thus render the operation more expeditious; and as these are but ill understood, or perhaps this circumstance not attended to, no wonder that we see these considered as so many nostrums of great importance. It were therefore worth while to try the effect of changes in the form of the roof directed to this very circumstance. Perhaps some little prominence down from the arch of the reverberatory would have this effect, by suddenly throwing the current into confusion. If the additional length of passage do not cool the air too much, we should think that if there were interposed between the fuel and the refining floor a passsage twisted like a cork-screw, making just half a turn, it would be most effectual; for we imagine, that the two airs, keeping each to their respective sides of the passage, would by this means be turned upside down, and that the pure stratum would now be in contact with the metal, and the vitiated air would be above it.

Effects of the pressure of the air.

Current in the glass-house furnaces.

The glass-house furnace exhibits the chief variety in the management of the current of heated air. In this it is necessary that the hole at which the workman dips his pipe into the pot shall be as hot as any part of the furnace. This could never be the case, if the furnace had a chimney situated in a part above the dipping-hole; for in this case cold air would immediately rush in at the hole, play over the surface of the pot, and go up the chimney. To prevent this the hole itself is made the chimney; but as this would be too short, and would produce very little current and very little heat, the whole surface is set under a tall dome. Thus the heated air from the real furnace is confined in this dome, and constitutes a high column of very light air, which will therefore rise with great force up the dome, and escape at the top. The dome is therefore the chimney, and will produce a draught or current proportioned to its height. Some are raised above a hundred feet. When all the doors of this house are shut, and thus no supply given except through the fire, the current and heat become prodigious. This, however, cannot be done, because the workmen are in this chimney, and must have respirable air. But notwithstanding this supply by the house-doors, the draught of the real furnace is vastly increased by the dome, and a heat produced sufficient for the work, and which could not have been produced without the dome.

Cotterel's improvement for melting iron from the ore.

This has been applied with great ingenuity and effect to a furnace for melting iron from the ore, and an iron finery, both without a blast. The common blast iron furnace is well known. It is a tall cone with the apex undermost. The ore and fluxes are thrown into this cone mixed intimately with the fuel till it is full, and the blast of most powerful bellows is directed into the bottom of this cone through a hole in the side. The air is thrown in with such force, that it makes its way through the mass of matter, kindles the fuel in its passage, and fluxes the materials, which then drop down into a receptacle below the blast-hole, and thus the passage for the air is kept unobstructed. It was thought impossible to produce or maintain this current without bellows; but Mr. Cotterel, an ingenious founder, tried the effect of a tall dome placed over the mouth of the furnace, and though it was not half the height of many glass-house domes it had the desired effect.

Currents of air applied to free mines, &c. of noxious air.

The last application which we shall make of the currents produced by heating the air is to the freeing mines, ships, prisons, &c. from the damp and noxious vapours which frequently infest them. As a drift or work is carried on in the mine, let a trunk of deal boards, about six or eight inches square, be laid along the bottom of the drift, communicating with a trunk carried up in the corner of one of the shafts. Let the top of this last trunk open into the ash-pit of a small furnace, having a tall chimney. Let fire be kindled in the furnace; and when it is well heated, shut the fire-place and ash-pit doors. There being no other supply for the current produced in the chimney of this furnace, the air will flow into it from the trunk, and will bring along with it all the offensive vapours. This is the most effectual method yet found out. In the same manner may trunks be conducted into the ash-pit of a furnace from the cells of a prison or the wards of an hospital.

In the account which we have been giving of the management of air in furnaces and common fires, we have frequently mentioned the immediate application of air to the burning fuel as necessary for its combustion. This is a general fact.

Air necessary for the combustion of fuel.

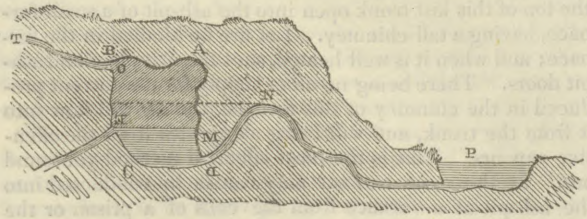
In order that any inflammable body may be readily inflamed, and its combustible matter consumed and ashes produced, it is not enough that the body be made hot. A piece of charcoal inclosed in a box of iron may be kept red hot for ever, without wasting its substance in the smallest degree. It is further necessary that it be in contact with a particular species of air, which constitutes about three-fourths of the air of the atmosphere, viz. the vital air or oxygen of Lavoisier. It was called empyreal air by Scheele, who first observed its indispensable use in maintaining fire; and it appears, that, in contributing to the combustion of an inflammable body, this air combines with some of its ingredients, and becomes fixed air, suffering the same change as by the breathing of animals. Combustion may therefore be considered as a solution of the inflammable body in air. This doctrine was first promulgated by the celebrated Dr. Hooke in his *Micrographia*, published in 1660, and afterwards improved in his *Treatise on Lamps*. It is now completely established, and considered as a new discovery. It is for this reason, that in fire-places of all kinds we have directed the construction, so as to produce a close application of the air to the fuel. It is quite needless at this day to enter into the discussions which formerly occupied philosophers about the manner in which the pressure and elasticity of the air promoted combustion. Many experiments were made in the seventeenth century by the first members of the Royal Society, to discover the office of air in combustion. It was thought that the flame was extinguished in rare air for want of a pressure to keep it together; but this did not explain its extinction when the air was not renewed. These experiments are still retained in courses of experimental philosophy, as they are judiciously styled; but they give little or no information, nor tend to the illustration of any pneumatical doctrine; they are therefore omitted in this place. In short, it is now fully established, that it is not a mechanical but a chemical phenomenon. We can only inform the chemist, that a candle will consume faster in the low countries than in the elevated regions of Quito and Gondar, because the air is nearly one half denser below, and will act proportionally faster in decomposing the candle.

Curious effect of the pressure of the air.

We shall conclude this part of our subject with the explanation of a curious phenomenon observed in many places. Certain springs or fountains are observed to have periods of repletion and scantiness, or seem to ebb and flow at regular intervals; and some of these periods are of a complicated nature. Thus a well will have several returns of high and low water, the difference of which gradually increases to a maximum, and then diminishes, just as we observe in the ocean. A very ingenious and probable explanation of this has been given in No. 424 of the *Philosophical Transactions*, by Mr. Atwell.

Let ABCD (fig. 90,) represent a cavern, into which water is brought by the subterraneous passage OT. Let it have an outlet MNP, of a crooked form, with its highest part N considerably raised above the bottom of the cavern, and thence sloping downwards into lower ground, and terminating in an open well at P. Let the dimensions of this canal be such that it will discharge much more water than is supplied by TO. All this is very natural, and may be very common. The effect of this arrangement will be a remitting spring at P; for when the cavern is filled higher than the point N, the canal MNP will act as a syphon; and, by the conditions assumed, it will discharge the water faster than TO supplies it; it will therefore run it dry, and then the spring at P will cease to furnish water. After some time the cavern will again be filled up to the height N, and the flow at P will recommence.

Fig. 90.



If, besides this supply, the well P also receive water from a constant force, we shall have a reciprocating spring. The situation and dimensions of this syphon canal, and the supply of the feeder, may be such, that the efflux at P will be constant. If the supply increase in a certain degree, a reciprocation will be produced at P with very short intervals; if the supply diminishes considerably, we shall have another kind of reciprocation with great intervals and great differences of water.

If the cavern have another simple outlet R, new varieties will be produced in the spring P, and R will afford a copious spring. Let the mouth of R, by which the water enters into it from the cavern, be lower than N, and let the supply of the feeding spring be no greater than R can discharge, we shall have a constant spring from R, and P will give no water. But suppose that the main feeder increases in winter or in rainy seasons, but not so much as will supply both P and R, the cavern will fill till the water gets over N, and R will be running all the while; but soon after P has begun to flow, and the water in the cavern sinks below R, the stream from R will stop. The cavern will be emptied by the syphon canal MNP, and then P will stop. The cavern will then begin to fill, and when near full R will give a little water, and soon after P will run and R stop as before, &c. Desaguliers shows (vol. ii. p. 177, &c.) in what manner a prodigious variety of periodical ebbs and flows may be produced by underground canals, which are extremely simple and probable.

Account of some pneumatic engines.

We shall conclude this article with the descriptions of some pneumatical machines or engines which have not been particularly noticed under their names in the former volumes of this work.

Bellows are of most extensive and important use; and it will be of service to describe such as are of uncommon construction and power, sufficient for the great operations in metallurgy.

It is not the impulsive force of the blast that is wanted in most cases, but merely the copious supply of air, to produce the rapid combustion of inflammable matter; and the service would be better performed in general if this could be done with moderate velocities, and an extended surface. What are called air-furnaces, where a considerable surface of inflammable matter is acted on at once by the current which the mere heat of the expended air has produced, are found more operative in proportion to the air expended than blast furnaces animated by bellows; and we doubt not but that the method proposed by Mr. Cotterel, which we have already mentioned, of increasing this current in a melting furnace by means of a dome, will in time supersede the blast furnaces. There is indeed a great impulsive force required in some cases; as for blowing off the scoriæ from the surface of silver or copper in refining furnaces, or for keeping a clear passage for the air in the great iron furnace.

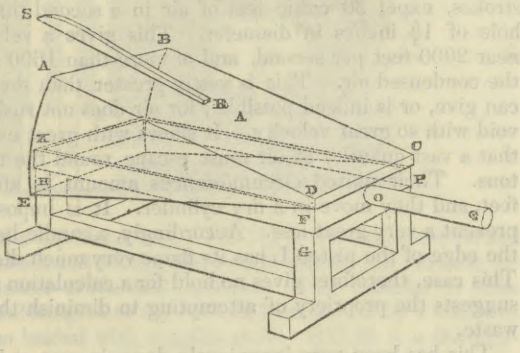
In general, however, we cannot procure this abundant supply of air any other way than by giving it a great velocity by means of a great pressure, so that the general construction of bellows is pretty much the same in all kinds.

eumatic
ngines.

The air is admitted into a very large cavity, and then expelled from it through a small hole.

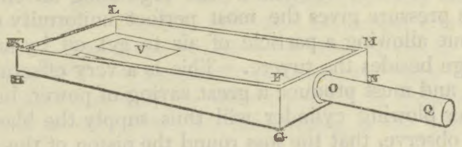
The furnaces at the mines having been greatly enlarged, it was necessary to enlarge the bellows also; and the leathern bellows becoming exceedingly expensive, wooden ones were substituted in Germany about the beginning of the seventeenth century, and from them became general throughout Europe. They consist of a wooden box ABCPFE, fig. 91,

Fig. 91.



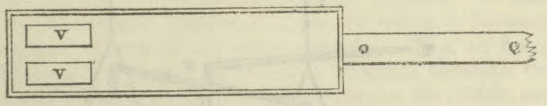
which has its top and two sides flat or straight, and the end BAE formed into an arched or cylindrical surface, of which the line FP at the other end is the axis. This box is open below, and receives within it the shallow box KHGNML, fig. 92, which exactly fills it. The line FP

Fig. 92.



of the one coincides with FP of the other, and along this line is a set of hinges on which the upper box turns as it rises and sinks. The lower box is made fast to a frame fixed in the ground. A pipe OQ proceeds from the end of it, and terminates at the furnace, where it ends in a small pipe called the *tewer* or *tuyere*. This lower box is open above, and has in its bottom two large valves V, V, fig. 93, opening

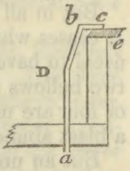
Fig. 93.



inwards. The conducting pipe is sometimes furnished with a valve opening outwards, to prevent burning coals from being sucked into the bellows when the upper box is drawn up. The joint along PF is made tight by thin leather nailed along it. The sides and ends of the fixed box are made to fit the sides and curved end of the upper box, so that this last can be raised and lowered round the point FP without sensible friction, and yet without suffering much air to escape; but as this would not be sufficiently air-tight by reason of the shrinking and warping of the wood, a farther contrivance is adopted. A slender lath of wood, divided into several joints, and covered on the outer edge with very soft leather, is laid along the upper edges of the sides and ends of the lower box. This lath is so broad, that when its inner edge is even with the inside of the box, its outer edge projects about an inch. It is kept in this position by a number of steel wires, which are driven into the bottom of the box, and stand up touching the sides, as represented in fig. 94, where *a b c* are the wires, and *e* the lath, projecting over the outside of the box. By this contrivance the laths are pressed close to the sides and curved end of the moveable box, and the spring wires yield to all their inequalities. A bar of wood RS, fig. 91, is fixed to the upper board, by which it is either raised by machinery, to sink again by its own weight, having an additional load laid on it, or it is forced downward by a crank or wiper of the machinery, and afterwards raised.

Pneumatic
engines.

Fig. 94.



The operation here is precisely similar to that of blowing with a chamber-bellows. When the board is lifted up, the air enters by the valves V, V, fig. 93, and is expelled at the pipe OQ by depressing the boards. There is therefore no occasion to insist on this point.

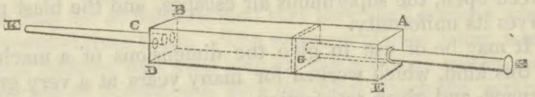
These bellows are made of a very great size, AD being 16 feet, AB five feet, and the circular end AE also five feet. The rise, however, is but about 3 or $3\frac{1}{2}$ feet. They expel at each stroke about 90 cubic feet of air, and they make about 8 strokes per minute.

Such are the bellows in general use on the continent. We have adopted a different form in this kingdom, which seems much preferable. We use an iron or wooden cylinder, with a piston sliding along it. This may be made with much greater accuracy than the wooden boxes, at less expense, if of wood, because it may be of cooper's work, held together by hoops; but the great advantage of this form is its being more easily made air-tight. The piston is surrounded with a broad strap of thick and soft leather, and it has around its edge a deep groove, in which is lodged a quantity of wool. This is called the packing or stuffing, and keeps the leather very closely applied to the inner surface of the cylinder. Iron cylinders may be very neatly bored and smoothed, so that the piston, even when very tight, will slide along it very smoothly. To promote this, a quantity of black lead is ground very fine with water, and a little of this is smeared on the inside of the cylinder from time to time.

The cylinder has a large valve, or sometimes two, in the bottom, by which the atmospheric air enters when the piston is drawn up. When the piston is thrust down, this air is expelled along a pipe of great diameter, which terminates in the furnace with a small orifice.

This is the simplest form of bellows which can be conceived. It differs in nothing but size from the bellows used by the rudest nations. The Chinese smiths have a bellows very similar, being a square pipe of wood ABCDE, fig. 95,

Fig. 95.



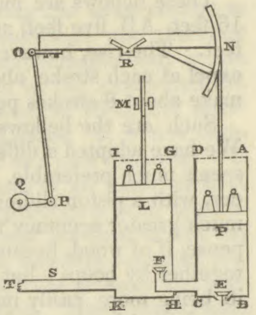
with a square board G which exactly fits it, moved by the handle FG. At the farther end is the blast pipe HK, and on each side of it a valve in the end of the square pipe, opening inwards. The piston is sufficiently tight for their purposes without any leathering.

The piston of this cylinder bellows is moved by machinery. In some blast engines the piston is simply raised by the machine, and then let go, and it descends by its own weight, and compresses the air below it to such a degree, that the velocity of efflux becomes constant, and the piston descends uniformly; for this purpose it must be loaded with a proper weight. This produces a very uniform blast, except at the very beginning, whilst the piston falls suddenly and compresses the air; but in most engines the piston rod is forced down the cylinder with a determined motion, by means of a beam, crank, or other contrivance. This gives a more unequal blast, because the motion of the piston is necessarily slow in the beginning and end of the stroke, and quicker in the middle.

But in all it is plain that the blast must be desultory. It ceases while the piston is rising; for this reason it is usual to have two cylinders, as it was formerly usual to have two bellows which worked alternately. Sometimes three or four are used, as at the Carron iron-works. This makes a blast abundantly uniform.

But an uniform blast may be made with a single cylinder, by making it deliver its air into another cylinder, which has a piston exactly fitted to its bore, and loaded with a sufficient weight. The blowing cylinder ABCD, fig. 96, has its piston P worked by a rod NP, connected by double chains with the arched head of the working beam NO, moving round a gudgeon at R. The other end O of this beam is connected by the rod OP, with the crank PQ of a wheel machine; or it may be connected with a piston of a steam-engine, &c. &c. The blowing cylinder has a valve or valves E in its bottom, opening inwards. There proceeds from it a large pipe CF, which enters the regulating cylinder GHKI, and has a valve at top to prevent the air from getting back into the blowing cylinder. It is evident that the air forced into this cylinder must raise its piston L, and that it must afterwards descend, while the other piston is rising. It must descend uniformly, and make a perfectly equable blast.

Fig. 96.



Observe, that if the piston L be at the bottom when the machine begins to work, it will be at the bottom at the end of every stroke if the *tuyere* T emits as much air as the cylinder ABCD furnishes; nay, it will lie a while at the bottom, for, while it was rising, air was issuing through T. This would make an interrupted blast. To prevent this, the orifice T must be lessened; but then there will be a surplus of air at the end of each stroke, and the piston L will rise continually, and at last get to the top, and allow air to escape. It is just possible to adjust circumstances, so that neither shall happen. This is done easier by putting a stop in the way of the piston, and putting a valve on the piston, or on the conducting pipe KST, loaded with a weight a little superior to the intended elasticity of the air in the cylinder. Therefore, when the piston is prevented by the stop from rising, the snifting valve, as it is called, is forced open, the superfluous air escapes, and the blast preserves its uniformity.

It may be of use to give the dimensions of a machine of this kind, which worked for many years at a very great furnace, and given satisfaction.

The diameter of the blowing cylinder is 5 feet, and the length of the stroke is 6. Its piston is loaded with 3½ tons. It is worked by a steam-engine whose clyinder is 3 feet 4 inches wide, with a six-feet stroke. The regulating cylinder is 8 feet wide, and its piston is loaded with 8½ tons, making about 2.63 pounds on the square inch; and it is very nearly in equilibrio with the load on the piston of the blowing cylinder. The conducting pipe KST is 12 inches in diameter, and the orifice of the tuyere was ⅝ths of an inch when the engine was erected, but it has gradually enlarged by reason of the intense heat to which it is exposed. The snifting valve is loaded with 3 pounds on the square inch.

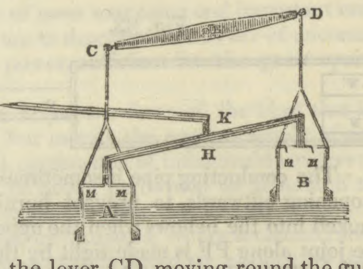
When the engine worked briskly, it made 18 strokes per minute, and there was always much air discharged by the snifting valve. When the engine made 15 strokes per minute, the snifting valve opened but seldom, so that things were nearly adjusted to this supply. Each stroke of the blowing cylinder sent in 118 cubic feet of common air. The ordinary pressure of the air being supposed 14¾ pounds on an inch, the density of the air in the regulating cylinder must be $\frac{14.75+2.63}{14.75}$, =1.1783, the natural density being 1.

This machine gives an opportunity of comparing the expense of air with the theory. It must, at the rate of 15 strokes, expel 30 cubic feet of air in a second through a hole of 1⅝ inches in diameter. This gives a velocity of near 2000 feet per second, and of more than 1600 feet for the condensed air. This is vastly greater than the theory can give, or is indeed possible; for air does not rush into a void with so great velocity. It shows with great evidence, that a vast quantity of air must escape round the two pistons. Their united circumferences amount to above 40 feet, and they move in a dry cylinder. It is impossible to prevent a very great loss. Accordingly, a candle held near the edge of the piston L has its flame very much disturbed. This case, therefore, gives no hold for a calculation; and it suggests the propriety of attempting to diminish this great waste.

This has been very ingeniously done, in part at least, at some other furnaces. At a certain foundery, near Glasgow, the blowing cylinder, also worked by a steam-engine, delivers its air into a chest without a bottom, which is immersed in a large cistern of water, and supported at a small height from the bottom of the cistern, and has a pipe from its top leading to the tuyere. The water stands about five feet above the lower brim of the regulating air-chest, and by its pressure gives the most perfect uniformity of blast, without allowing a particle of air to get off by any other passage besides the tuyere. This is a very effectual regulator, and must produce a great saving of power, because a smaller blowing cylinder will thus supply the blast. We must observe, that the loss round the piston of the blowing cylinder remains undiminished.

A blowing machine was erected many years ago at Chastillon in France on a principle considerably different, and which must be perfectly air-tight throughout. Two cylinders A, B, (fig. 97) loaded with great weights, were suspended at the ends of the lever CD, moving round the gudgeon E. From the top F, G of each there was a large flexible pipe which united in H, from whence a pipe KT led to the tuyere T. There were valves at F and G opening outwards, or into the flexible pipes; and other valves L, M, adjoining to them in the top of each cylinder, opening inwards, but kept shut by a slight spring. Motion was given to the lever by a machine. The operation of this blowing machine is evident. When the cylinder A was pulled down, or allowed to descend, the water, entering at its bottom, compressed the air, and forced it along the passage FHKT. In the mean time, the cylinder B was rising, and the air entered by the valve M. We see that the blast will be very unequal, increasing as the cylinder is immersed deeper. It is needless to describe this machine more particularly, because we shall give an account of one which we think per-

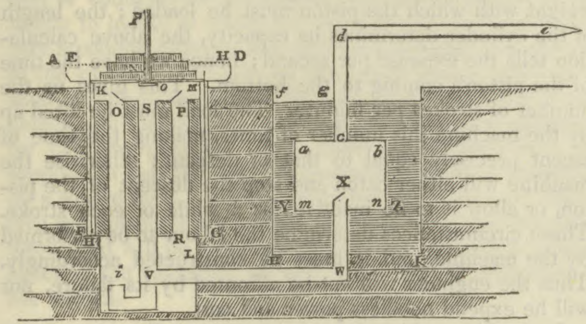
Fig. 97.



fect in its kind, and which leaves hardly any thing to be desired in a machine of this sort.

ABCD (fig. 98) is an iron cylinder, truly bored within, and evasated a-top like a cup. EFGH is another, truly turned both without and within, and a small matter less than the inner diameter of the first cylinder. This cylinder is close above and hangs from the end of a level moved by a machine. It is also loaded with weights at N. KILM is a third cylinder, whose outside diameter is somewhat less than the inside diameter of the second. This inner cylinder is fixed to the same bottom with the outer cylinder. The middle cylinder is loose, and can move up and down between the outer and inner cylinders without rubbing on either of them. The inner cylinder is perforated from top to bottom by three pipes OQ, SV, PR. The pipes OQ, PR have valves at their upper ends O, P, and communicate with the external air below. The pipe SV has a horizontal part VW, which again turns upwards, and has a valve at top X. This upright part WX is in the middle of a cistern of water *fhkg*. Into this cistern is fixed an air-chest *a* YZ *b*, open below, and having at top a pipe *cde* terminating in the tuyere at the furnace.

Fig. 98.



When the machine is at rest, the valves X, O, P, are shut by their own weights, and the air-chest is full of water. When things are in this state, the middle cylinder EFGH is drawn up by the machinery till its lower brims F and G are equal with the top RM of the inner cylinder. Now pour in water or oil between the outer and middle cylinders; and it will run down and fill the space between the outer and inner cylinders. Let it come to the top of the inner cylinder.

Now, let the loaded middle cylinder descend. It cannot do this without compressing the air which is between its top and the top of the inner cylinder. This air being compressed, will cause the water to descend between the inner and middle cylinders, and rise between the middle and outer cylinders, spreading into the cup; and as the middle cylinder advances downwards, the water will descend farther within it, and rise farther without it. When it has got so far down, and the air has been so much compressed, that the difference between the surface of the water on the inside and outside of this cylinder is greater than the depth of water between X and the surface of the water *fg*, air will go out by the pipe SVW, and will lodge in the air-chest, and will remain there if *c* be shut, which we shall suppose for the present. Pushing down the middle cylinder till the partition touch the top of the inner cylinder, all the air which was formerly between them will be forced into the air-chest, and will drive out water from it. Draw up the middle cylinder, and the external air will open the valves O, P, and again fill the space between the middle and inner cylinders; for the valve X will shut, and prevent the regress of the condensed air. By pushing down the middle cylinder a second time, more air will be forced into the air-chest, and it will at last escape by getting out between its brims Y, Z, and the bottom of the cistern; or if we open the passage *c*, it will pass along the conduit *c d e* to the tuyere, and form a blast.

The operation of this machine is similar to Mr. Haskins's quicksilver pump, described by Desaguliers.[1] The force which condenses the air is the load on the middle cylinder. The use of the water between the inner and outer cylinders, is to prevent this air from escaping; and the inner cylinder thus performs the office of a piston, having no friction. It is necessary that the length of the outer and middle cylinders be greater than the depth of the regulator-cistern, that there may be a sufficient height for the water to rise between the middle and outer cylinders, to balance the compressed air, and oblige it to go into the air-chest. A large blast-furnace will require the regulator-cistern five feet deep, and the cylinders about six or seven feet long.

It is in fact a pump without friction, and is perfectly air-tight. The quickness of its operation depends on the small space between the middle cylinder and the two others; and this is the only use of these two. Without these it would be similar to the engine at Chastillon, and operate more unequally and slowly. Its only imperfection is, that if the cylinder begin its motion of ascent or descent rapidly, as it will do when worked by a steam engine, there will be some danger of water dashing over the top of the inner cylinder, and getting into the pipe SV; but should this happen, an issue can easily be contrived for it at V, covered with a loaded valve *v*. This will never happen if the cylinder is moved by a crank. One blowing cylinder only is represented here, but two may be used.

We do not hesitate in recommending this form of bellows as the most perfect of any, and fit for all uses where standing bellows are required. They will be cheaper than any other sort for common purposes. For a common smith's forge they may be made with square wooden boxes instead of cylinders. They are also easily repaired. They are perfectly tight; and they may be made with a blast almost perfectly uniform, by making the cistern in which the air-chest stands, of considerable dimensions. When this is the case, the height of water, which regulates the blast, will vary very little.

This may suffice for an account of blast machines. The leading parts of their construction have been described as far only as was necessary for understanding their operation, and enabling an engineer to erect them in the most commodious manner. Views of complete machines might have amused, but they would not have added to our reader's information.

But the account is imperfect unless we show how their parts may be so proportioned that they shall perform what is expected from them. The engineer should know what size of bellows, and what load on the board or piston, and what size of tuyere, will give the blast which the service requires, and what force must be employed to give them the necessary degree of motion. We shall accomplish these purposes by considering the efflux of the compressed air through the tuyere. The propositions formerly delivered will enable us to ascertain this.

That we may proportion everything to the power employed, we must recollect, that if the piston of a cylinder employed for expelling air, be pressed down with any force p, it must be considered as superadded to the atmospheric pressure P on the same piston, in order that we may compare the velocity v of efflux with the known velocity V with which air rushes into a void. By what has been formerly delivered, it appears that this velocity $v = \mathrm{V} \times \sqrt{\frac{p}{\mathrm{P} \times p}}$,

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[1] *Experimental Philosophy*, vol. ii. p. 491; and *Philosophical Transactions*, 1728, vol. xxxii. p. 5.

Pneumatic engines.

where P is the pressure of the atmosphere on the piston, and p the additional load laid on it. This velocity is expressed in feet per second; and, when multiplied by the area of the orifice (also expressed in square feet) it will give us the cubical feet of condensed air expelled in a second; but the bellows are always to be filled again with common air, and therefore we want to know the quantity of common air which will be expelled; for it is this which determines the number of strokes which must be made in a minute, in order that the proper supply may be obtained. Therefore recollect that the quantity expelled from a given orifice with a given velocity, is in the proportion of the density; and that when D is the density of common air produced by the pressure P, the density d produced by the pressure $P+p$, is $D \times \frac{P+p}{P}$; or if D be made 1, we have $d = \frac{P+p}{P}$.

Therefore, calling the area of the orifice expressed in square feet O, and the quantity of common air, or the cubic feet expelled in a second Q, we have $Q = V \times O \times \sqrt{\frac{p}{P+p}} \times \frac{P+q}{P}$

It will be sufficiently exact for all practical purposes, to suppose P to be 15 pounds on every square inch of the piston; and p is then conveniently expressed by the pounds of additional load on every square inch. We may also take $V=1332$ feet.

As the orifice through which the air is expelled is generally very small, never exceeding three inches in diameter, it will be more convenient to express it in square inches; which being the $\frac{1}{144}$th of a square foot, we shall have the cubic feet of common air expelled in a second, or $Q = \frac{1332}{144} O \sqrt{\frac{p}{P+p}} \times \frac{P+p}{P}, = O \times 9{\cdot}25 \times \sqrt{\frac{p}{P+p}} \times \frac{P+p}{P}$; and this seems to be as simple an expression as we can obtain.

This will perhaps be illustrated by taking an example in numbers. Let the area of the piston be four square feet, and the area of the round hole through which the air is expelled, be two inches, its diameter being 1.6, and let the load on the piston be 1728 pounds; this is three pounds on every square inch. We have $P=15$, $p=3$, $P+p=18$, and $O=2$; therefore we will have $Q = 2 \times 9.25 \times \sqrt{\frac{3}{18}} \times \frac{18}{15}, = 9.053$ cubic feet of common air expelled in a second. This will however be diminished at least one-third by the contraction of the jet; and therefore the supply will not exceed six cubic feet per second. Supposing therefore that this blowing machine is a cylinder or prism of this dimension in its section, the piston so loaded would, after having compressed the air, descend about 15 inches in a second. It would first sink one-fifth of the whole length of the cylinder pretty suddenly, till it had reduced the air to the density $\frac{18}{15}$, and would then descend uniformly at the above rate, expelling six cubic feet of common air in a second.

The computation is made much in the same way for bellows of the common form, with this additional circumstance, that as the loaded board moves round a hinge at one end, the pressure of the load must be calculated accordingly. The computation, however, becomes a little intricate, when the form of the loaded board is not rectangular. It is almost useless when the bellows have flexible sides, either like smith's bellows or like organ bellows, because the change of figure during their motion makes continual variation on the compressing powers. It is therefore chiefly with respect to the great wooden bellows, of which the upper board slides down between the sides, that the above calculation is of service.

The propriety, however, of this piece of information is evident: we do not know precisely the quantity of air necessary for animating a furnace; but this calculation tells us what force must be employed for expelling the air that may be thought necessary. If we have fixed on the strength of the blast, and the diameter of the cylinder, we learn the weight with which the piston must be loaded; the length of the cylinder determines its capacity, the above calculation tells the expense per second; hence we have the time of the piston's coming to the bottom. This gives us the number of strokes per minute. The load must be lifted up by the machine this number of times, making the time of ascent precisely equal to that of descent; otherwise the machine will either catch and stop the descent of the piston, or allow it to lie inactive for a while of each stroke. These circumstances determine the labour to be performed by the machine, and it must be constructed accordingly. Thus the engineer will not be affronted by its failure, nor will he expend needless power and cost.

In machines which force the piston or bellows board with a certain determined motion, different from what arises from their own weight, the computation is extremely intricate. When a piston moves by a crank, its motion at the beginning and end of each stroke is slow, and the compression and efflux is continually changing. We can however approximate to a statement of the force required.

Every time the piston is drawn up, a certain space of the cylinder is filled again with air of the common density; and this is expelled during the descent of the piston. A certain number of cubic feet of common air is therefore expelled with a velocity which perhaps continually varies; but there is a medium velocity with which it might have been uniformly expelled, and a pressure corresponding to this velocity. To find this, divide the area of the piston by the area of the blast-hole (or rather by this area multiplied by 0·613, in order to take in the effect of the contracted jet), and multiply the length of the stroke performed in a second by the quotient arising from this division; the product is the medium velocity of the air (of the natural density). Then find by calculation the height through which a heavy body must fall in order to acquire this velocity; this is the height of a column of homogeneous air which would expel it with this velocity. The weight of this column is the least force that can be exerted by the engine: but this force is too small to overcome the resistance in the middle of the stroke, and it is too great even for the end of the stroke, and much too great for the beginning of it. But if the machine is turned by a very heavy water-wheel, this will act as a regulator, accumulating in itself the superfluous force during the too favourable positions of the crank, and exerting it by its *vis insita* during the time of greatest effort. A force not greatly exceeding the weight of this column of air will therefore suffice. On the other hand, if the strength of the blast be determined, which is the general state of the problem, this determines the degree of condensation of the air, and the load on the square inch of the piston, or the mean force which the machine must exert on it. A table, which will be given presently, determines the cubic feet of common air expelled in a second, corresponding to this load. This combined with the proposed dimensions of the cylinder, will give the descent of the piston or the length of the stroke.

These general observations apply to all forms of bellows; and without a knowledge of them no person can erect a machine for working them without total uncertainty or servile imitation. In order, therefore, that they may be useful to such as are not accustomed to the management of even these simple formulæ, we insert the following short table of the velocity and quantity of air discharged from a cylinder whose piston is loaded with the pounds contained in the first column on every square inch. The second column contains the velocity with which the *condensed air* rushes out through any *small* hole; and the third column is the cubic feet discharged from a hole whose area is a square inch; column fourth contains the mean velocity of air of the common density; and column fifth is the cubic feet of common air discharged; the sixth column is the height in inches at which the force of the blast would support a column of water if a pipe were inserted into the side of the cylinder. This is an extremely proper addition to such machines, showing at all times the power of the machines, and teaching us what intensity of blast is employed for different purposes. The table is computed from the supposition that the ordinary pressure of the air is 15 pounds on a square inch. This is somewhat too great, and therefore the velocities are a little too small; but the quantities discharged will be found about one-third too great, without affecting the velocities, on account of the convergency of the stream.

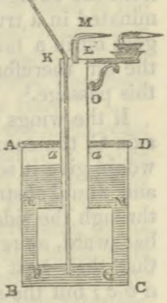
I	II	III	IV	V	VI
½	239	1·66	249	1·72	14
1	333	2·32	355	2·47	27
1½	404	2·79	437	3·05	40
2	457	3·17	518	3·60	54
2½	500	3·48	584	4·2	68
3	544	3·76	653	4·53	82
3½	582	4·03	715	4·98	95
4	611	4·24	774	5·38	109
4½	642	4·46	822	5·75	122
5	666	4·67	888	6·17	136
5½	693	4·84	950	6·49	150
6	711	5·06	997	6·92	163

This table extends far beyond the limits of ordinary use, very few blast-furnaces having a force exceeding 60 inches of water.

We shall conclude this account of blowing machines with a description of a small one for a blow-pipe. ABCD, (fig. 99) is a vessel containing water, about two feet deep. EFGH is the air-box of the blower open below, and having a pipe ILK rising up from it to a convenient height; an arm ON which grasps this pipe carries the lamp N: the blow-pipe LM comes from the top of the upright pipe. PKQ is the feeding-pipe reaching near to the bottom of the vessel.

Water being poured into the vessel below, and its cover being put on, which fits the upright pipe, and touches two studs *a*, *a*, projecting from it, blow in a quantity of air by the feeding pipe PQ; this expels the water from the air-box, and occasions a pressure which produces the blast through the blow-pipe M.

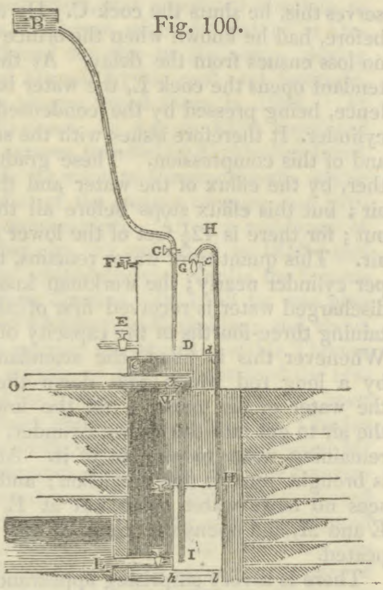
Fig. 99.



In a preceding part of this article, we mentioned an application which has been made of Hero's fountain, at Chemnitz in Hungary, for raising water from the bottom of a mine. We shall now give an account of this very ingenious contrivance.

In fig. 100, B represents the source of water elevated above the mouth of the pit 136 feet. From this there is led a pipe B*b*CD four inches diameter. This pipe enters the top of a copper cylinder *b c d e*, 8½ feet high, five feet diameter, and two inches thick, and it reaches to within four inches of the bottom; it has a cock at C. This cylinder has a cock at F, and a very large one at E. From the top *b c* proceeds a pipe GHH′ two inches in diameter, which goes down the pit 96 feet, and is inserted into the top of another brass cylinder *f g h i*, which is 6½ feet high, four feet diameter, and two inches thick, containing 83 cubic feet, which is very nearly one-half of the capacity of the other, viz. of 170 cubic feet. There is another pipe NI of four inches diameter, which rises from within four inches of the bottom of this lower cylinder, is soldered into its top, and rises to the trough NO, which carries off the water from the mouth of the pit. This lower cylinder communicates at the bottom with the water L which collects in the drains of the mine. A large cock K serves to admit or exclude this water; another cock M, at the top of this cylinder, communicates with the external air.

Fig. 100.



Now, suppose the cock C shut, and all the rest open; the upper cylinder will contain air, and the lower cylinder will be filled with water, because it is sunk so deep that its top is below the usual surface of the mine-waters. Now, shut the cocks F, E, M, K, and open the cock C. The water of the source B must run in by the orifice D, and rise in the upper cylinder, compressing the air above it and along the pipe GHH′, and thus acting on the surface of the water in the lower cylinder. It will therefore cause it to rise gradually in the pipe IN, where it will always be of such a height that its weight balances the elasticity of the compressed air. Suppose no issue given to the air from the upper cylinder, it would be compressed into one-fifth of its bulk by the column of 136 feet high; for a column of 34 feet nearly balances the ordinary elasticity of the air. Therefore, when there is an issue given to it through the pipe GHH′, it will drive the compressed air along this pipe, and it will expel water from the lower cylinder. When the upper cylinder is full of water, there will be 34 cubic feet of water expelled from the lower cylinder. If the pipe IN had been more than 136 feet long, the water would have risen 136 feet, being then in equilibrio with the water in the feeding pipe B*b*CD, by the intervention of the elastic air; but no more water would have been expelled from the lower cylinder than what fills this pipe. But the pipe being only 96 feet high, the water will be thrown out at N with a very great velocity. If it were not for the great obstructions which water and air must meet with in their passage along pipes, it would issue at N with a velocity of more than 50 feet per second. It issues much more slowly, and at last the upper cylinder is full of water, and the water would enter the pipe GH and enter the lower cylinder, and without displacing the air in it, would rise through the discharging pipe IN, and run off to waste. To prevent this there hangs in the pipe HG a cork ball or double cone, by a brass wire which is guided by holes in two cross pieces in the pipe HG. When the upper cylinder is filled with water, this cork plugs up the orifice G, and no water is wasted; the influx at D now stops. But the lower cylinder contains compressed air, which would balance water in a discharging pipe 136 feet high, whereas IN is only 96. Therefore the water will continue to flow at N till the air has so far expanded as to balance only 96 feet of water, that is, till it occupies one-fourth of its ordinary bulk, that is, one-fourth of the capacity of the upper cylinder, or 42½ cubic feet. Therefore 42½ cubic feet will be expelled, and the efflux at N will cease; and the lower cylinder is about one-half full of water. When the attending workman observes this, he shuts the cock C. He might have done this before, had he known when the orifice G was stopped; but no loss ensues from the delay. At the same time the attendant opens the cock E, the water issues with great violence, being pressed by the condensed air from the lower cylinder. It therefore issues with the sum of its own weight and of this compression. These gradually decrease together, by the efflux of the water and the expansion of the air; but this efflux stops before all the water has flowed out; for there is 42½ feet of the lower cylinder occupied by air. This quantity of water remains, therefore, in the upper cylinder nearly; the workman knows this, because the discharged water is received first of all into a vessel containing three-fourths of the capacity of the upper cylinder. Whenever this is filled, the attendant opens the cock E by a long rod which goes down the shaft; this allows the water of the mine to fill the lower cylinder, allows the air to get into the upper cylinder, and this allows the remaining water to run out of it. And thus every thing is brought into its first condition; and when the attendant sees no more water come out at E, he shuts the cock E and M, and opens the cock C, and the operation is repeated.

There is a very surprising appearance in the working of this engine. When the efflux at N has stopped, if the cock F be opened, the water and air rush out together with prodigious violence, and the drops of water are changed into hail or lumps of ice. It is a sight usually shown to strangers, who are desired to hold their hats to receive the blast of air: the ice comes out with such violence as frequently to pierce the hat like a pistol bullet. This rapid congelation is a remarkable instance of the general fact, that air by suddenly expanding, generates cold, its capacity for heat being increased. Thus the peasant cools his broth by blowing over the spoon, even from warm lungs; a stream of air from a pipe is always cooling.

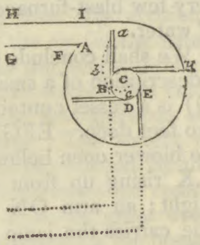
The above account of the procedure in working this engine shows that the efflux both at N and E becomes very slow near the end. It is found convenient therefore not to wait for the complete discharges, but to turn the cocks when about 30 cubic feet of water have been discharged at N: more work is done in this way. A gentleman of great accuracy and knowledge of these subjects took the trouble, at our desire, of noticing particularly the performance of the machine. He observed that each stroke, as it may be called, took up about three minutes and one-eighth; and that 32 cubic feet of water were discharged at N, and 66 were expended at E. The expense, therefore, is 66 feet of water falling 136 feet, and the performance is 32 raised 96, and they are in the proportion of 66×136 to 32×96, or of 1 to 0·3422, or nearly as 3 to 1. This is superior to the performance of the most perfect undershot mill, even when all friction and irregular obstructions are neglected, and is not much inferior to any overshot pump-mill that has yet been erected. When we reflect on the great obstructions which water meets with in its passage through long pipes, we may be assured that, by doubling the size of the feeder and discharger, the performance of the machine will be greatly improved; we do not hesitate to say, that it would be increased one-third: it is true that it will expend more water, but this will not be nearly in the same proportion, for most of the deficiency of the machine arises from the needless velocity of the first efflux at N. The discharging pipe ought to be 110 feet high, and not give sensibly less water. Then it must be considered how inferior in original expense this simple machine must be to a mill of any kind which would raise 10 cubic feet 96 feet high in a minute, and how small the repairs on it need be, when compared with a mill. And, lastly, let it be noticed, that such a machine can be used where no mill whatever can be put in motion. A small stream of water, which would not move any kind of wheel, will here raise one-third of its own quantity to the same height, working as fast as it is supplied.

For all these reasons, we think that the Hungarian machine eminently deserves the attention of mathematicians and engineers, to bring it to its utmost perfection, and into general use. There are situations where this kind of machine may be very useful. Thus, where the tide rises 17 feet, it may be used for compressing air to seven-eighths of its bulk; and a pipe leading from a very large vessel inverted in it, may be used for raising the water from a vessel of one-eighth of its capacity 17 feet high; or if this vessel has only one-tenth of the capacity of the large one set in the tide-way, two pipes may be led from it, one into the small vessel and the other into an equal vessel 16 feet higher, which receives the water from the first. Thus one-sixteenth of the water may be raised 34 feet, and a smaller quantity to a still greater height, and this with a kind of power that can hardly be applied in any other way. Machines of this kind are described by Schottus, Sturmius, Leupold, and other old writers; and they should not be forgotten, because opportunities may offer of making them highly useful. A gentleman's house in the country may thus be supplied with water by a machine that will cost little, and hardly go out of repair.

The last pneumatical engine which we shall speak of at present is the common fanners, used for winnowing grain, and for drawing air out of a room; and we have but few observations to make on them.

The wings of the fanners are enclosed in a cylinder or drum, whose circular sides have a large opening BDE, (fig. 101), round the centre, to admit the air. By turning the wings rapidly round, the air is hurried round along with them, and thus acquires a centrifugal tendency, by which it presses strongly on the outer rim of the drum: this is gradually detached from the circle as at KI, and terminated in a trunk IHGF, which goes off in a tangential direction; the air therefore is driven along this passage.[1]

Fig. 101.



If the wings were disposed in planes passing through the axis C, the compression of the air by the anterior surface would give it some tendency to escape in every direction, and would obstruct in some degree the arrival of more air through the side holes. They are therefore reclined a little backward, as represented in the figure. It may be shown that their best form would be that of a hyperbolic spiral *a b c*; but the straight form approaches sufficiently near to the most perfect shape.

Much labour is lost, however, in carrying the air round those parts of the drum where it cannot escape. The fanners would either draw or discharge almost twice as much air if an opening were made all round one side. This could be gradually contracted, where required for winnowing, by a surrounding cone, and thus directed against the falling grain; as has been verified by actual trial. When used for drawing air out of a room for ventilation, it would be much better to remove the outer side of the drum entirely, and let the air fly freely off on all sides; but the flat sides are necessary, in order to prevent the air from arriving at the fanners any other way but through the central holes, to which trunks should be fitted leading to the apartment which is to be ventilated. (B. B. B.)

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[1] A machine precisely similar is now extensively used instead of bellows by engineers, smiths, &c.

PO, Padus, Eridanus, one of the great rivers of Europe, which traverses the north of Italy from west to east. It has its source in Monte Viso, one of the Cottian Alps, flows north-east to Turin, passes that capital, holds an easterly course throughout the whole length of Lombardy, separating Austrian Italy from Parma, Modena, and the Ecclesiastical States, and discharges itself by a number of mouths into the Adriatic, about thirty miles to the south of Venice. In its course, which, including its windings, is upwards of 500 miles, it receives a great number of rivers, flowing in full current from the Alps on the north, and in less copious but equally rapid streams from the Apennines on the south. Of these tributary waters the principal are, the Dora Riparia, the Dora Baltea, the Stura, the Orco, the Sesia, the Tanaro, the Ticino, the Adda, the Olona, the Oglio, the Mincio, the Crostolo, and the Panaro. The Po, rising in a very mountainous country, soon becomes a large river, and is sufficiently deep to float boats and barges at thirty miles from its source; but its current is often so rapid that the navigation is at all seasons difficult, and not unfrequently hazardous. Hence, though it passes in its progress more than fifty towns, little advantage comparatively is derived from it for the conveyance of merchandise. Its volume of water is subject to sudden increase from the melting of the snows, and from heavy falls of rain, the rivers that flow into it being almost all mountain streams; and in the flat country, in the lower part of its course, this would have been attended with very destructive effects, if great dykes had not been constructed to confine it within its channel. The gravel rolled down from the mountains has progressively raised the bed of the river, and the protecting mounds have also been correspondingly elevated; so that the Po, in the lower part of its course, presents the singular spectacle of a vast body of water, the level of which is higher than that of the adjoining country. Its borders, interspersed with trees and villages, display great luxuriance of vegetation, and are extremely pleasant, though by no means picturesque. This river, like the Rhine, is crossed by flying bridges. A post is fixed in the middle of the stream, and a rope conveyed from it to the passage raft, by means of a number of small boats which form the connecting links; and these boats being pressed on by the current, guide the raft to the opposite side, with no other assistance than that of an oar. The raft usually consists of two barges boarded over, and encompassed with a rail. Lastly, the basin of the Po has been the theatre of some of the most remarkable military operations of modern times; more particularly of the campaigns of Eugene, Napoleon, and Suwarof, who, each in his turn, decided, for the time, the fate of Italy.

POBASSOO'S Island, a small island on the north coast of New Holland; forming, with Cotton's Island, a secure shelter for shipping, which Captain Flinders called Malay Road. Long. of this road 136. 27. E. Lat. 11. 53. S.

POCKLINGTON, a market-town of Yorkshire, in the east riding, and the wapentake of Harthill, 193 miles from London. It is situated on a small stream that falls into the river Derwent, and has a market, which is held on Saturday. The population amounted in 1801 to 1502, in 1811 to 1539, in 1821 to 1962, and in 1831 to 2048; but the whole parish, which comprehends three other townships, had at the last census 2265 inhabitants.

POCOCK'S Island is situated in the Eastern Seas. Long. 118. 12. E. Lat. 6. 2. S.

POCOCK'S Point, on the east coast of New Zealand, was formerly the north-west point of the Bay of Islands. It is four miles west of Cape Brett.

POCOCKE, Dr Edward, a learned English divine, and the first oriental scholar of his time, was the eldest son of Edward Pococke; and born in November 1604, at Oxford, where he was also educated. In 1628 he was admitted probationer-fellow of his college, and about the same time he had prepared an edition of the second Epistle of St Peter, the second and third of St John, and the Epistle of St Jude, in Syriac and Greek, with a Latin translation and notes. In 1629 he was ordained priest, and appointed chaplain to the English merchants at Aleppo, where he arrived in October 1630, and continued for five or six years, during which he distinguished himself by his zeal and fortitude, particularly whilst the plague raged there in 1634. At length returning to England, he was in 1636 appointed reader of the Arabic Lectures, founded by Archbishop Laud. Three years afterwards he went to Constantinople, where he prosecuted his studies of the eastern tongues, and procured many valuable manuscripts. After a residence of nearly four years in that city, he embarked in 1640; and taking Paris in his way, visited Gabriel Sionita the famous Maronite, and also Hugo Grotius. In 1643 he was presented to the rectory of Childrey, in Berkshire; and about three years afterwards married the daughter of Mr Thomas Burdett. About the middle of 1647 he obtained the restitution of the salary of his Arabic Lecture, which had been detained from him about three years. In 1648, Charles I., being then prisoner in the Isle of Wight, nominated Mr Pococke to the professorship of Hebrew, and the canonry of Christ-Church annexed to it; but in 1650 he was ejected from his canonry for refusing to take the engagement, and soon afterwards a vote passed for depriving him of his Hebrew and Arabic professorships. But several governors of houses, and others, having presented a petition in his favour, he was suffered to enjoy both these places. He had some years before published his *Specimen Historiæ Arabum*, a very learned work, and now appeared his *Porta Mosis;* and soon afterwards the English Polyglot edition of the Bible, to which he had largely contributed, and also Eutychius's Annals, with a Latin version, gave evidence of his industry and learning. At the Restoration he was reinstated in the canonry of Christ-Church, and also received the degree of doctor of divinity. He then published his Arabic version of Grotius's Treatise of the Truth of the Christian Religion; and an Arabic poem entitled *Lamiato l'Ajam* or *Carmen Abu-Ismaelis Tograi*, with a Latin translation and notes. Soon afterwards he published Gregory Abulfaragius's *Historia Dynastiarum;* but this work did not meet with much encouragement from the public, a circumstance which his biographer accounts for in a manner not very creditable to the reign of Charles II. as compared with the protectorate, when solid learning was appreciated and rewarded. The fact seems to be, that the love of Arabic learning was now growing cold; and Pococke himself, in his correspondence with Mr Thomas Greaves, appears to be not only sensible that such was the case, but very much hurt by the decline of sound literary taste. The same circumstance also may in some measure account for this distinguished scholar not having obtained higher preferment at the period of the Restoration, when such numbers of vacant dignities were conferred on far inferior men. Perhaps he was almost the only instance of a clergyman, then at the highest pitch of eminence for learning, and every other merit proper to his profession, who lived throughout the reign of Charles II. without the least regard from the court, except the favour sometimes done him of being called upon to translate Arabic letters from the princes of the Levant, or the credentials of ambassadors coming from thence; a service for which we do not find that he obtained any recompense, besides fair words and hollow compliments. But his modesty equalled his merit; and after presenting Abulfaragius to the king, he ceased to obtrude his claims on the attention of royalty. In 1674 he published an Arabic version of the principal parts of the Liturgy of the Church of England; and a few years afterwards appeared his Commentary on the Prophecies of Micah, Malachi, Hosea, and Joel. This truly great man died in 1691, after having been for many years confessedly the first orientalist in Europe; and he was no less worthy of admiration for his uncommon modesty and humility, and all the virtues which can adorn a Christian. His theological works were republished at London in 1740, in two volumes folio.

Pococke, *Richard*, distantly related to the preceding, was the son of Mr Richard Pococke, head master of the free-school at Southampton, where he was born in the year 1704. He received his school-learning under his father, and his academical education at Corpus Christi College, Oxford, where he took his various degrees. He commenced his travels in the East in 1737, and returned in 1742. In 1743, he published his Observations on Egypt, under the general title of a Description of the East and some other Countries. In 1744, he was made precentor of Waterford; and in 1745, he printed the second volume of his Travels, under the title of Observations on Palestine or the Holy Land, Syria, Mesopotamia, Cyprus, and Candia, which he dedicated to the Earl of Chesterfield, then lord-lieutenant of Ireland, whom he attended in the capacity of domestic chaplain. In 1756, Dr Pococke was promoted to the bishopric of Ossory, vacant by the death of Dr Edward Maurice; in July 1765, he was translated to the see of Meath, which had been originally intended for the Bishop of Elphin, who, however, declined taking out his patent; and he died suddenly in September following, having been carried off by apoplexy, whilst engaged in visiting his diocese. As a traveller Dr Pococke was equally distinguished for research, learning, and accuracy, to which ample justice has indeed been done by Jablonski, in the preface to part third of his *Pantheon Ægyptiorum*. He penetrated no farther up the Nile than the island of Philæ, called by the Arabs the Temple Island; whereas Norden, in 1737, proceeded as far as Derré, between the first and second cataract. The two travellers are supposed to have met on the Nile, in the neighbourhood of Esneh, in January 1738; but, according to another account, they passed in the night without recognition.

Bishop Pococke visited other parts besides the East, and described some remarkable objects both in Scotland and Ireland. According to Cumberland, he was a man of mild but peculiar manners, and of primitive simplicity. "Having given the world," says this writer, "a full detail of his researches in Egypt, he seemed to hold himself excused from saying anything more about them, and observed, in general, an obdurate taciturnity. In his carriage and deportment he appeared to have contracted something of the Arab character; yet there was no austerity in his silence, and though his air was solemn, his temper was serene." Cumberland adds: "When we were on our road to Ireland, I saw from the windows of the inn at Daventry a cavalcade of horsemen approaching on a gentle trot, headed by an elderly chief in clerical attire, who was followed by five servants at distances geometrically measured and most precisely maintained, and who, upon entering the inn, proved to be this distinguished prelate conducting his horde with the phlegmatic patience of a scheik." Cumberland's delineation, however, must be received with some caution, particularly in the latter part, which bears evident marks of exaggeration.

PODALIRIUS, son of Æsculapius and Epione, was one of the pupils of the centaur Chiron, under whom he made himself such a master of medicine, that during the Trojan war the Greeks invited him to their camp to check a pestilence which had baffled the skill of all their physicians. On his return Podalirius was shipwrecked upon the coast of Caria, where he cured of epilepsy a daughter of the king of the place. He fixed his habitation there; and built two towns, one of which he called after his wife *Syrna*. On his death, the Carians built him a temple, and paid him divine honours.

PODGORODKOI, a fortress of Asiatic Russia, in the government of Oufa, on the Oural. It is ninety-two miles east of Orenburg.

PODEM, a village of Asiatic Turkey, in Trebisond, thirty miles east of Trebisond.

PODEMNO, a village of Tobolsk, in Asiatic Russia, forty-four miles east of Kemskoi.

PODENDA, a village of Asia Minor, at the junction of the Sihoun with the Adana, thirty-three miles north of Adana.

PODOL, a town of Russia, in the province of Moskau, the capital of a circle of the same name, which extends over 590 square miles, and contains 58,800 inhabitants. The town is situated on the river Pochra, 508 miles from St Petersburg, and contains only 1100 inhabitants, who carry on some silk manufactures. Long. 37. 25. E. Lat. 55. 25. N.

PODOLIA, a province or government of the Russian empire, formerly a part of Poland, acquired by Russia at the first dismemberment of that unfortunate kingdom. It extends in north latitude from 47. 23. to 49. 44., and in east longitude from 26. 16. to 30. 41.; and it is bounded on the north by Volhynia, on the north-east by Kiew, on the east and south-east by Cherson, on the south by Bessarabia, and on the west by the Austrian kingdom of Gallicia. It is 20,796 miles in extent, is divided into twelve circles, and contains 121 towns, 2429 villages, with 1,450,000 inhabitants, a great part of whom are Poles, but many are Russians; and the Jews are numerous. The majority are of the Greek church, but the nobility and higher classes commonly adhere to the Roman Catholic worship.

The province is situated on the northern slope of the Carpathian Mountains, several of the spurs of which project into it, but none are more than 500 feet in height. It is a well-watered district, part of the streams of which fall into the Dniester, and part into the Bug; the former of which is at all seasons navigable, but the latter only one portion of the year. The climate is pure and healthy, but it is not productive of wine, which is supposed to arise from the want of calcareous earth. Mulberry-trees have been lately planted, and seem hitherto to have succeeded. The soil is generally fertile, yielding always a great surplus of grain, especially of wheat, some of which finds a vent at Odessa, and some at Dantzig. It is peculiarly adapted to pasture, and feeds numerous horses, and a breed of cows, which are highly prized, and supply a large extent of country with young cattle and fat oxen, even as far as a part of Germany. The sheep are abundant, but their wool is coarse; and few merinos have hitherto been introduced to improve the breed. Flax and hemp are raised to an extent equal to the consumption of the inhabitants. The manufactures are chiefly for domestic use; but some potash, pitch, and tar, are made for exportation. Though possessing a fruitful soil, and means of communication with both the north and the south, there is little trade, except occasionally that of corn.

PODSTEPNOI, a fortress of Asiatic Russia, in the government of Kolivan, on the Irtisch, two hundred miles south-east of Omsk.

PODSPUSKNOI, a fortress of Asiatic Russia, in the government of Kolivan, 220 miles south-west of Kolivan.

PŒCILE was a famous portico at Athens, which received its name from the variety (ποικιλος) of paintings which it contained. Zeno kept his school there; and there also the Stoics received their lessons; whence their name, from *στοα, a porch.* Amongst other things, the Pœcile was adorned with a picture of the siege and sacking of Troy, another of the battle of Theseus with the Amazons, and a third of the fight between the Lacedæmonians and Athenians at Œnoe in Argolis. It was also accounted a great distinction to have one's portrait placed in this national gallery. In fact, the only reward which Miltiades obtained after the battle of Marathon, was to have his picture drawn more conspicuously than those of the rest of the officers who fought with him on that occasion, in the representation which was made of the engagement, and to have it hung up in the Pœcile in commemoration of that celebrated victory. This was accounted glory enough for so great and memorable an achievement.

PŒSTUM, or Pæstum, a celebrated city of Italy, now in ruins, but anciently a place of great opulence and magnitude. Its remains stand on a fertile plain, considerably to the south of the city of Salerno, being bounded on the west by the Tyrrhenian Sea, and about a mile distant by five hills, amongst which the town of Acropoli is embosomed; on the north by the Bay of Salerno; and on the east by two hills, which still retain their ancient names of Callimara and Cantena. The walls of the city remain. In some places they are five, and in others twelve feet in height. They are formed of solid blocks of stone, and appear to have been furnished with towers at intervals; but the archway of only one gate stands entire. This rampart encloses a space of about four miles in circumference; but of the splendid cluster of buildings which it once enclosed, only three temples rise, like the mausoleums of the ruined city, dark, silent, and majestic, to attest the ancient magnificence of the place. They are the admiration of all who visit them, and are considered as the purest and most perfect specimen in existence of the foreign Doric order of architecture. The first temple which presents itself to the view of the traveller is the smallest. It consists of six pillars at each end, and thirteen at each side, counting the angular pillars in both directions; and it is one hundred and seven feet in length, by forty-seven feet in breadth. The architrave is pretty entire, as is the pediment at the west end, with the exception of the corner stones and triglyphs, which are fallen, and the first cornice, which is worn away. At the east end, part of the pediment remains, and also much of the frize and cornice. The cella occupied more than one third of the length, and had a portico of two rows of columns, the ruins of which, now overgrown with vegetation, encumber the area of the temple.

The second edifice has six columns at each end, and fourteen on each side, including those of the angles. The entablature and the pediments are entire. A double row of columns adorned the interior of the cella, and supported each another row of small pillars; the upper being separated from the lower by an architrave only, without frize or cornice. A number of these pillars on each side remain standing. The cella had two entrances, one at each end, with a portico formed of two pillars and two antæ. The foundation and part of the wall of this cella still remain: underneath it there was a vault. The third edifice is the largest, being one hundred and ninety-five feet four inches in length, by seventy-eight feet ten inches in breadth. It has nine pillars at each end, and eighteen on each side, including the angular columns as before. Nor is its size its only claim to distinction. A row of pillars, extending from the middle pillar at one end to the middle pillar at the other, divides it into two equal parts, and is considered as a proof that it was not a temple. What it was intended for is yet a disputed point amongst the learned. In the centre there appears to have been an aperture in the pavement, and at some distance another, both leading, it is said, to subterranean vaults.

Such appear to be the peculiar features of each of these edifices. They are all raised upon substructions forming three gradations (for they are too high to be called steps), intended solely to give due elevation and relief to the building; the columns of all rise without bases from the uppermost of these degrees. They are all fluted, between four and five diameters in height, and taper as they ascend about one fourth; the capitals of the whole are very flat and prominent; the intercolumniation is a little more than one diameter; the order and the ornaments in all are the same; the pediment is almost invariably low; and, finally, they are all built of a porous stone, of a light or rather yellow-grey colour, and in many places perforated and worn away. In the open space between the first and second temple there were two other large edifices, built of the same stone, and of nearly the same size; but they are totally overthrown. All these temples stand in a line, and border a street which ran from gate to gate, and divided the town into two nearly equal parts. A hollow space, scooped out in a semicircular form, seems to be the traces of a theatre; and as it lies in front of the temples, gives reason to suppose that other public buildings might have ornamented the same side, and made it correspond in grandeur with that opposite; in which case few cities could have surpassed Pœstum in the splendour of its appearance.

Although the city has left such magnificent monuments of its existence, considerable obscurity hangs over its origin and general history. According to the learned Mazzochi, Pœstum was founded by a colony of Dorians, from Dora, a city of Phœnicia. It was first called Posetan or Postan, which in Phœnician signifies Neptune, to whom it was dedicated; but it was afterwards invaded, and its primitive inhabitants expelled, by the Sybarites. This event is supposed to have taken place about five centuries before the Christian era. Under its new possessors the city assumed the Greek appellation Posidonia, of the same import as its Phœnician, because it was a city of great opulence and magnitude, and is supposed to have extended from the present ruin southward to the hill on which stands the little town of Acropoli. The Lucanians afterwards expelled the Sybarites, and checked the prosperity of Posidonia, which was in its turn deserted and left to moulder imperceptibly away. Vestiges of it are still visible all over the plain of Spinazzo or Saracino. The original city then recovered its ancient name, and not long afterwards it was taken and colonized by the Romans. From this period Pœstum is mentioned almost solely by the poets; indeed, from Virgil to Claudian, they all delight to expatiate upon the beauty of its gardens, and to celebrate the bloom, the sweetness, and the fertility of its roses; and to this day the roses are remarkable for their fragrance. A few bushes, the remnants of *biferi rosaria Pœsti*, flourish here and there neglected, and still blossom twice a year, in May and December, as if to support their ancient fame, and justify the descriptions of the poets.[1] Pœstum was subsequently plundered by the Saracens and the Normans; and its remaining inhabitants were at length compelled to flee for refuge to the mountains. The Dorians appear to have the fairest claim to the erection of the majestic monuments which we have described. "But at what period were they erected?" says Mr Eustace. "To judge from their form, we must conclude that they are the oldest specimens of Grecian architecture now in existence. In beholding them and contemplating their solidity, bordering upon heaviness, we are tempted to consider them as an intermediate link between the Egyptian and Grecian manner, and the first attempt to pass from the immense masses of the former to the graceful proportions of the latter. In fact, the temples of Pœstum, Agrigentum, and Athens, seem instances of the commencement, the improvement, and the perfection of the Doric order." (R. R. R.)

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[1] Virgil and Ovid just mention the Pœstan roses; Propertius introduced them as an emblem of mortality; Claudian employs them to grace a complimentary comparison. Ausonius alone presents them in all their beauty and freshness.

Vidi Pœstano gaudere rosaria cultu
Exoriente novo roscida Lucifero.

POETRY.

Definition.

THE difficulty of giving a definition of poetry, which shall include all that essentially belongs to it, and exclude all that is foreign or accidental to it, has been long felt and admitted. The definition of the ancients, which makes poetry "an imitative art," is obviously exposed to the double objection of being at once too comprehensive, since it would equally apply to the other imitative arts of painting and sculpture; and too limited, since it would exclude many departments of poetry, in which, as in the lyrical, the art is not properly *imitative*, but *expressive;* not copying in any sense the thoughts and actions of others, but presenting to the sympathy of the reader the emotions of the poet himself. Not less objectionable is the definition, that poetry is "the art of expressing our thoughts by fiction;" which, while it is equally applicable to the novel and the romance, is, in fact, not necessarily true of poetry at all, except in this sense, that in all high poetry a certain transforming and beautifying power of imagination is excited, which in some measure transmutes the forms of things from their actual prosaic aspect,

> Clothing the palpable and the familiar
> With golden exhalations of the dawn.

Still less can verse or metrical form be regarded as constituting the essence, or even one of the essentials, of poetry. It no doubt heightens its effect; it increases its charm and power of pleasing, by enlisting the aid of musical sound and cadence on the side of imaginative language or touching sentiment; but it must yet be regarded as amongst the externals of poetry,—something which will never make poetry of itself, and without which poetry is not only conceivable, but has in fact existed, and that in very striking and impressive forms.

Object of poetry the communication of intellectual pleasure.

Poetry may perhaps be defined to be an art which has the creation of intellectual pleasure for its object, which attains its end by the use of language natural in an excited state of the imagination and the feelings, and generally, though not necessarily, formed into regular numbers. The proper antithesis, therefore, to poetry, as Mr Coleridge has remarked, is not prose, but science. The proper antithesis to prose is verse. Science seeks to instruct, to discover and to communicate truth; "the proper and immediate object of poetry is the communication of immediate pleasure." Poetry may indeed incidentally instruct, as science may indirectly communicate pleasure; but the object of each must be gathered from its main direction and bearing, and in this sense the production of intellectual *enjoyment* is unquestionably the aim and the proper province of poetry.

This a pleasure conducive to morality.

But so closely are the intellectual and refined pleasures of man connected with his moral qualities; so much does his relish for the higher and more spiritual pleasures of the imagination depend on a sound and healthy state of morality in the first instance, and so much is this state in turn promoted and encouraged by stimulating and keeping alive the activity of the imagination and the sensibilities of the heart, that poetry, though generally avoiding the form of direct instruction, may yet be said, with justice, to be the most important handmaid and assistant of moral education, by its appeals to those affections which are apt to become indolent and dormant amidst the commerce of the world, and the revival of those purer and more enthusiastic feelings which are associated with the earlier and least selfish period of our existence. Immersed in business, which, if it sharpen the edge of intellect, leaves the heart barren; toiling after material wealth or power, or struggling with fortune for existence; seeing selfishness reflected all around us from the hard and glittering surface of society, as from a cold and polished mirror; it would go hard with man in adversity, perhaps still more in prosperity, if some resource were not provided for him, which, under the form of an amusement and a recreation, administered a secret but powerful balm in the one case, and an antidote in the other. This resource is afforded us by the influences of poetry. "Whatever withdraws us from the power of the senses; whatever makes the past, the distant, and the future, predominate over the present, advances us in the dignity of human beings." Sometimes, no doubt, poetry openly assumes the garb of morality, but it is generally least instructive when most directly *didactic*, and practically attains the end of instruction with most success when the instructor is himself unconscious of the lesson he conveys. In an indirect form, however, and through the medium of the feelings and the imagination rather than the mere reason, its efficiency as a moral agent is great and undeniable. And as upon the intellectual worth and nobleness of individuals depends the standard of a national morality, it may with truth be said that the fame and character of nations,—those qualities the presence of which makes the smallest state conspicuous in the world's eye, and the absence of which renders the widest empire, on which the sun never sets, insignificant; namely, national pride, honour, fidelity to engagements, courage to act, fortitude to suffer, a generous and far-seeing policy, disdaining all mean or questionable advantages; are to some extent derived, and, at all events, continually cherished and fostered, by the influence of a pure and ennobling national poetry. If Plato had succeeded in banishing poets from his ideal republic, he would assuredly have conferred no benefit upon morals. He would have created a hard and utilitarian frame of society, inaccessible to generous feeling, and incapable of those great efforts, either of action or of endurance, which have their source only in enthusiasm, and cannot be suggested by any principle of expediency, however enlarged may be the basis of calculation.

No poetry permanently popular which is of an immoral nature.

It is the conviction of this intimate though indirect connection between poetry and morality, and the consequent bearing of the former upon human welfare, that explains the veneration which mankind have always felt for those poets who, acting under an impression of the sacredness of the task committed to them, and of the power of the talisman which genius has placed in their hands, have devoted their labours to the purest forms of poetry, and to the excitement of emotions, either virtuous in themselves, or conducive to virtue. It is this conviction which accounts for the aversion which they have never failed in the end to manifest against all those who have made the fascinations of poetry and wit subservient to the gratification of baser feelings or meaner propensities. For men taken in the mass judge rightly, even when they act wrongly; and moral opinion, so variable and wavering when applied to our own case or that of our friends, is found a safe and steady guide when applied to the mere *representation* of human thought and action in the forms with which they are invested by the poet. Hence the feelings of all men are enlisted and warmly excited on the side of virtue in fictitious composition, and still more in the most fascinating form of fictitious composition, poetry. For here the *tendency* of the poem is felt to be no mere speculative question, but a real dispute "pro aris et focis;" a contest whether, as is said to be often the case in India, poison is to be conveyed into the wells from which pure and refreshing water ought to be drawn. And this practical bearing upon important interests, of the abuse of a fine art, is more felt, and justly, in poetry than in any other. In painting, for instance, Parrhasius, Julio Romano, Annibal Caracci, and Titian, have ministered by their pictures to the promotion of vice; some have even endeavoured to pervert the pure marble into a vehicle of impure representations: but the circle of their operation is limited; to the mass of men their iniquities of this nature are even unknown: but poetry, multiplied indefinitely by printing, finding its way into every quarter of the globe, and penetrating into the humblest as well as the highest class of society, has a sphere of operation bounded only by the globe itself, and a practical influence, through their sympathies, upon men's habits of thought, and consequently upon their morality and their happiness, which is not the less certain and extensive, that its limits do not admit of any precise or distinct determination.

Hence it is a remarkable fact in the history of poetry, that no work essentially immoral, or even exhibiting a mere indifference to moral feeling, has ever maintained a permanent popularity. The low ribaldry which deforms the splendid talents of Aristophanes will always render the perusal of his plays a painful task; the witty licentiousness of the Pucelle is already all but forgotten; and the next generation, while they treasure the better parts of Byron, will assuredly consign to oblivion much of his gloomy reasonings, his contempt for human nature, and his ridicule of generous feelings. The poets who are found to retain their hold over all hearts, and whose influence even appears to extend with the progress of ages, Homer, Shakspeare, Milton, Spenser, Calderon, Tasso, are those who have done their utmost to elevate rather than to depress the spirit and the hopes of men; to make existence brighter about us, and to embody in their strains the principles of faith and hope, of purity and universal charity. For it need hardly be observed, that we are not to condemn a work as immoral on account of a few brief passages, in which the poet, led away by a too lively imagination, has admitted scenes or images of an objectionable kind. Such, indeed, are to be found in Shakspeare, and in the pure and religious poems of Spenser; more rarely also in Tasso; but the general strain of the poem, and the obvious aim of the poet, being to promote the cause of virtue, the few objectionable particulars are lost in the general effect, and cease to be dangerous from their proximity to so much that is calculated to purify and to elevate the mind.

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If it be difficult to give an accurate definition of poetry, it is still more difficult to describe that precise combination of mental and moral qualities which are required for its production, so as to distinguish these from the qualities required for perfection in the other imitative arts. The sensibility to natural and moral beauty; the study both of the outward world and of the mind of man; imagination and fancy to furnish the materials; judgment and taste to select and arrange them; these are common to the great poet and the great painter. What determines these energies and capabilities to the one direction more than to the other, and makes one man paint to the bodily eye in cólours, the other to the eye of the mind in words, is that secret undefinable instinct which we call genius, which it is impossible to resolve into any mere result of the force of circumstances, and which, all experience teaches us, is born with the artist, and, like an instinct, directs his after-course. A genius for poetry or for painting is as certainly dependent on an organization mental and physical, with which we come into the world, as a musical ear; no education can give them; no general superiority of intellect will enable a man to turn with equal success to either; nature made him with the elements of a poet or a painter, and what she has so framed, art and education will never alter.

But though it is difficult to enumerate any quality requisite to form a great poet which is not necessary also to form a great painter, it is easy to see, that from the nature of the materials with which they deal, as well as their modes of operation; the one producing its effects by a momentary impression, the other by a continuous exertion; the degree in which the different component qualities of mind are employed in these respective arts is materially different.

Imagination.

Foremost amongst the qualities that constitute the poet is imagination, that creative principle of the mind which forms new conceptions out of previously existing materials; "conceptions not absolutely justifiable by the rules of logic, but quite intelligible to the mind when duly elevated; intelligible through our sympathies or sensibilities, though not sufficiently definite nor strictly coherent to stand the cold survey of our reason." This is indeed the most essential gift of the poet, "where either he must live or have no life;" with it, he may triumph over every other defect; without it, no combination of qualities will ever render him a great poet. This is the power which emancipates the poet from the trammels of space and time; carries him back into the spirit of past ages; enables him to create and to endow with coherent attributes beings of a nature different from our own, and yet having for us a real existence, so far as our sympathies are concerned: to conceive and consistently to follow out the thoughts, and words, and passions of imaginary actors, and all this not by a metaphysical analysis of the emotions or passions, nor by a course of induction from actual observation in the world about him, but by a secret consciousness, flashing upon his mind, in a concentrated shape, the result of all philosophy, embodying all, which conception, abstraction, and judgment would have separately furnished. It supersedes the necessity of observation in every special case, because it furnishes him with those primary elements of our nature which give the formula for the solution of all. The value of patient observation and study of life and character, in addition to the suggestions of the imagination, we do not dispute; we shall afterwards see, that within certain limits, and for certain departments of poetry, they are indispensable. But we may be assured, that for those elemental conceptions of character which are unmodified by mere manners, local position, or age; the conception, for instance, of a Lear or a Miranda, a Caliban, an Ariel, or a Hamlet; no observation of human character in the actual world, nor dissection of the component passions and sympathies that make up character, would have sufficed. We have but to look at the range of Shakspeare's characters to be at once satisfied of this. Pre-eminent amongst these are his characters of women; and yet from what analysis of character, or observation of society, could these have been drawn? Where could a youth, whose chief companions had been deer-stalkers, actors, or play-writers of no high repute, and to whom female society, at least in its most refined form, must have been unknown, have gleaned the materials which enable him to pourtray, with equal mastery, the fierce overbearing spirit of Lady Macbeth and Constance, the tranquil regal dignity of Hermione and Katharine of Aragon, or the totally dissimilar aspect of female character presented in the passion of Juliet, the purity of Miranda, the simplicity of Ophelia, or the tender submission and wife-like confidence of Imogen and Desdemona? No prototypes existed in the society around him from which these could be drawn. The streets and taverns of London might indeed furnish him with Bardolphs and Pistols; his acquaintance with Lord Southampton, or with the other gallants of the court, might afford the outlines of his Prince Henry or Hotspur; but his female creations are obviously drawn from no other sphere but his own breast. They are the offspring of an imagination "all compact," not elaborately constructing, but almost unconsciously creating.

The power of imagination is shown in its most imposing form in the conception of character, incident, situation, and scenery,—in the general scope and design of the poem; but its value and importance as an element of poetry is scarcely less felt in the details, in the manner in which it informs and transforms the whole language of the poem; studding it with imagery, simple or complex, often making a single word act like a spell, and conjure up a host of magical associations. Its province in this respect is not to be confounded with that lower department of the poetical art which is called diction, and which, when the idea is formed, simply dictates the selection of the *word* most appropriate to express the precise *idea* to be conveyed. Imagination supplies the idea itself, or fasciculus of ideas, to be embodied in the word; and in the number, novelty, and judicious selection of associations which can be suggested to the mind within any equal space, lies the chief difference between the work of a great poet and an inferior one, between an original or an imitative mind.

The images suggested by the imagination, we have said, are frequently complex. It seems to fuse many in one, to divide one into many, and to present the mass to the mind in a form which suggests all the particulars of which it is composed. It is certain, too, that many of the images which it suggests, and the effect of which upon the mind is immediately felt by all lovers of poetry to be beautiful, can by no means be justified upon the principles of logic, or their coherence made clear to the understanding. "When Milton tells us of 'darkness visible,'" says a writer on poetry, "we feel that he has uttered a fine paradox; we *feel* its truth, but cannot prove it. And when in that appalling passage where the poet stands face to face with Night and Chaos in their dark pavilion, 'spread wide on the wasteful deep,' and says that

> By them *stood*
> Orcus and Ades, and the dreaded *name*
> Of Demogorgon,

how is it possible to reconcile such expressions to a mere prosaic understanding? Darkness is, strictly speaking, absence of light. How then shall we say that it is visible, when we see only by the aid of light? And with respect to the '*name*' of Demogorgon, which *stands* by Orcus and Ades, how can such a phrase be justified by the rules of reason? Nevertheless it is as magnificent as words can make it. It is clothed in a dark and spectral grandeur, and presses upon our apprehensions like a mighty dream."[1] Take another instance also from Milton, where he speaks of music

> At every fall smoothing the raven down
> Of darkness till it smiled.

Here also it is impossible to perceive the mere logical connection of the images; for, allowing darkness to be embodied under the notion of some bird with glossy and raven plumage, it would certainly puzzle any critic to show how musical sounds could smooth such plumage; and yet we should have little hesitation in putting this passage to any one as a test whether he possessed a feeling or sense of poetry, or whether his mind was entirely of a prosaic character. In these, and a thousand similar instances, particularly in Shakspeare, it is clear that the poetical effect can be explained upon no ordinary principle of reason. The metaphors are what are called broken; they cannot logically be united, and yet they have a sufficient poetical coherence. How this result is produced we shall only be enabled to explain when the whole laws which govern the faculty of imagination, as yet most imperfectly understood, shall be discovered.

It is somewhat difficult to establish a plain and practical distinction between fancy and imagination, so far as regards the imagery or ornaments of poetry; though, as we have already said, the higher efforts of conception, and the general design, fall almost entirely, in serious and heroic poetry, under the province of imagination. From Milton's line, "Sweetest Shakspeare, Fancy's child," it would seem that the words fancy and imagination had then been used as having the same meaning; for certainly any one now endeavouring to describe the most remarkable of Shakspeare's qualities would refer to his imagination rather than his fancy. Yet fancy may perhaps be said to be imagination at a lower point of excitement; not dealing with passions, or creating character; nor pouring out unconsciously, under the influence of strong feeling, images as they arise massed and clustered; but going in search of comparisons and illustrations, and when it invests them with personality, as in metaphors, still adhering much more closely to the logical fitness and sequence which govern similar ornaments in prose. It seems to act like a colder and weaker species of imagination, furnishing the thoughts which "play round the head, but do not touch the heart;" pleasing the eye and the ear; creating or heightening the idea of the beautiful, much more than of the sublime. It is not careful, like imagination, to make the whole bear on the general design, and heighten the main impression sought to be produced, but rather strives to excite our pleasure, and to bespeak our admiration for the images themselves which it suggests. Its natural field, so far as regards the general design, is in poems like the Rape of the Lock, or the Lutrin, where the object is to give a poetical dress to a subject essentially prosaic, and excluding passion or high imagination. To these it lends an airy machinery, ingenious comparisons, imagery of a lively and pleasing cast in harmony with the level tone of the subject, and thus brings them within the domain of poetry. Some have represented the distinction between the effects of imagination and fancy to consist in this, "that the former altogether changes and remodels the original idea, impregnating it with something extraneous; the latter leaves it undisturbed, but associated with things to which, in some view or other, it bears a resemblance." But this distinction cannot be admitted; fancy, though in a less degree, does create, or change and remodel ideas; the difference between them must be sought more in the sort of ideas on which they operate, and the purposes to which they apply them, than in the plastic power supposed to be exercised in the one case and not in the other. "Fancy," says Mr Wordsworth, in a fine passage in his preface, "depends upon the rapidity and profusion with which she scatters her thoughts and images, trusting that their number, and the felicity with which they are linked together, will make amends for the want of individual value; or she prides herself upon the curious subtilty and the successful elaboration with which she can detect their lurking affinities. If she can win you over to her purpose, and impart to you her feelings, she cares not how mutable and transitory may be her influence, knowing that it will not be out of her power to resume it upon an apt occasion. But the imagination is conscious of an indestructible dominion; the soul may fall away from it, not being able to sustain its grandeur; but if once felt and acknowledged, by no act of any other faculty of the mind can it be relaxed, impaired, or diminished. Fancy is given to quicken and to beguile the temporal part of our nature, imagination to incite and support the eternal. Yet it is not the less true, that fancy, as she is an active, is also, under her own laws and in her own spirit, a creative faculty. In what manner fancy ambitiously aims at a rivalship with the imagination, and imagination stoops to work with the materials of fancy, might be illustrated from the compositions of all eloquent writers, whether in prose or verse, and chiefly from those of our own country. Scarcely a page of the impassioned parts of Bishop Taylor's works can be opened that shall not afford examples. Referring the reader to these inestimable volumes, we will content ourselves with placing a conceit, ascribed to Lord

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[1] Edinburgh Review, 1825.

Chesterfield, in contrast with a passage from the Paradise Lost.

> The dews of the evening most carefully shun ;
> They are tears of the sky for the loss of the sun.

After the transgression of Adam, Milton, with other appearances of sympathizing nature, thus marks the immediate consequence.

> Sky lowered, and, muttering thunder, some sad drops
> Wept at completion of the mortal sin.

The associating link is the very same in each instance ; dew and rain, not distinguishable from the liquid substance of tears, are employed as indications of sorrow. A flash of surprise is the effect in the former case ; a flash of surprise and nothing more ; for the nature of things does not sustain the combination. In the latter, the effects of the act, of which there is this immediate consequence and visible sign, are so momentous, that the mind acknowledges the justice and reasonableness of the sympathy in nature so manifested; and the sky weeps drops of water, as if with human eyes, as earth had before trembled from her entrails, and nature given a second groan." It is evident, that in the parallel passages thus opposed to each other by Wordsworth, the creative or remodelling operation produced by fancy in the former case, and by imagination in the latter, is the same ; in both the sky is endowed with personality and human feeling ; it is the propriety of the action attributed to the imaginary being in the one case, and its unreasonableness in the other, which makes the former merely fanciful, the latter highly imaginative.

Danger of an excess of fancy.

It will readily be perceived, from what has here been said of the nature of fancy, that when unregulated by a strong judgment, and unwarmed by strong passion, it is one of the most dangerous qualities which a poet can possess. To the predominance of this quality, indeed, to the consciousness of a facility of finding ingenious analogies or subtile distinctions, of conjuring up a multitude of fantastic resemblances, pleasing in themselves, but in no way heightening the leading impression sought to be conveyed, are to be ascribed many of the errors of taste by which modern poetry has been deformed. To this must be ascribed those conceits, from which scarcely a single Italian writer prior to the eighteenth century is free, and which reached their consummation in Marino ; to this the similar extravagancies of Gongora, Quevedo, and their followers in Spain ; the affected taste introduced by Voiture and Balzac in France, and exploded by the good sense of Molière ; and the similar extravagancies of our own metaphysical poets. An excess of imagination cannot lead to bad taste in style ; an excess of fancy is but too apt to produce that effect.

Judgment.

Of judgment, which is the regulating and controlling power by which the active and creative faculties of imagination and fancy are guided, checking the too daring flight of the one, and pruning the excesses of the other, it is needless to speak ; since it is a quality not more peculiarly requisite in poetry than in oratory, or any of those departments of intellectual exertion which depend not on demonstration, but on the balance of probabilities. In fact, the highest range of imagination has invariably been found to be accompanied by a corresponding depth and comprehensiveness of judgment ; or rather, perhaps, it would be more philosophical to say, that judgment is involved and constitutes one of the component parts of high imagination. For the imagination, as is justly remarked by Mr Stewart, is a *complex* power. " It includes conception or simple apprehension, which enables us to form a notion of those former objects of perception or knowledge, out of which we are to make a selection (in the fine arts) ; abstraction, which separates the selected materials from the qualities and circumstances which are connected with them in nature ; and judgment or taste, which selects the materials, and directs their combination." It is only in minds where imagination is limited, and where its possessor tries by effort and straining to enlarge it beyond its appointed bounds, that the judgment is generally found defective. Homer and Shakspeare, the most inventive and imaginative of poets, are also the most sagacious, the most practical, the most abounding in wisdom, both of a worldly and of a higher kind.

Study necessary to form a poet.

But, in addition to the natural gifts of sensibility to feel, memory to retain impressions, imagination and fancy to fashion new conceptions, and judgment to blend in harmony all the materials which have been thus accumulated, study is just as essential for the formation of the poet as for the acquisition and practice of the most mechanical art. That study regards both the materials of poetry and the language by which they are to be communicated in a sensible form to others. Study of men in the different conditions of life, and the habit of observing and systematising these observations ; study of external nature, so as to mark the peculiarities which escape common eyes ; the accustoming the mind to search for resemblances among things different, and to lay them up in the memory as in a treasury ; these are assistances which no poet can overlook, and without which the imaginative faculty is deprived of its due nourishment, and of half its power. For even imagination does not strictly create out of nothing ; it must be quickened and set in motion by something external, and demands materials on which it can try its processes of change or recombination. All great poets, therefore, have steadily pursued this course of study of nature, both moral and physical ; though, after the habit is once formed, these mental operations are carried on almost unconsciously, and the treasures of poetical observation grow upon their possessor, without his being conscious of any effort in their accumulation. A remarkable instance of the attention paid by great poets to the minutest peculiarities of external nature, and of course equally applicable to the study of mental phenomena, is afforded by the case of Sir Walter Scott. Every one knows the graphic truth as well as the wonderful variety of his descriptions of scenery, which, by their selection of every thing that is characteristic, embody the very spirit of the place, and call back to our minds the impression with which we had first viewed it, and which had faded away and become forgotten. It is evident that in such descriptions Scott trusted little to the imagination, as able to compensate the observation of reality. Mr Morritt mentions, that whilst he was engaged in the composition of Rokeby, he observed him noting down even the peculiar little wild flowers and herbs that accidentally grew round and on the side of a crag near his intended cave of Guy Denzil ; and on his saying that he need not have taken the trouble, since daisies, violets, and primroses, would have suited his purpose as well as the humble plants he was examining, the poet replied, " that in nature herself no two scenes are exactly alike, and that whoever copied truly what was before his eyes, would possess the same variety in his descriptions, and exhibit apparently an imagination as boundless as the range of nature in the scenes he recorded ; whereas, whoever trusted to imagination would soon find his own mind circumscribed and contracted to a few favourite images, and the repetition of these would, sooner or later, produce that very monotony and barrenness which had always haunted descriptive poetry in the hands of any but the patient worshippers of truth."

Diction.

The other department of the poet's study relates to the use of the medium through which his ideal creations are to be conveyed to others ; in other words, diction, or the choice and arrangement of the words most appropriate to convey the precise shade of meaning, and to convey it divested of all those associations of a low or ludicrous character, which usage sometimes connects with words, and assisted by all the charms of musical sound. All men who seek to command the minds of others through speech must by study learn to apprehend the power and perfect force, as affecting thought, imagination, and passion, of every word which his fellow-men have used for ages as the vivid image of some conception of the soul. They must acquire a perception of the value of words, at once exact, delicate, and passionate. This careful and fond study of language, however, is peculiarly requisite to the poet, and has been carried to higher perfection by them than by prose writers; "because, in the composition of poetry, the mind, attempered to delight, feels more sensitively the exquisite form into which the material expression of its conception is wrought." The very shackles imposed by metre and rhyme, though they may occasionally tempt an inferior poet into the use of a word which is not the one most apt to express his conception, unquestionably only operate as a stimulus to the great poet to make himself master of all the resources of words which the language supplies, so as to comply with the necessities of rhyme and musical sound without sacrificing any portion of the substance of his conception. Without this thorough command of the whole armament of language, and the utmost patience and perseverance in its use, we may be assured that no poet has ever succeeded in attaining a general and permanent popularity. Verse cannot leap full armed from the brain of the poet. The steps which lead from the rudeness of the first conception to the elegance of the last, though they cannot be seen, are undoubtedly many. The ideas must be patiently wrought into shape; words weighed and rejected; shades of meaning of the nicest kind discriminated; associations foreseen and guarded against; and an arrangement of words throughout preserved, which, while it differs from that of prose, never allows the inversions which are admitted in poetry to obscure the meaning. The practice of the greatest poets we know to have been in conformity to these rules. We find Virgil dictating a number of verses in the morning, spending the day in revising, correcting, and reducing them, and comparing himself, as Aulus Gellius mentions, to a she-bear licking her misshapen offspring into shape. We see Petrarch returning day after day to his sonnets, to alter some single word, or make some trifling change in the arrangement of a line. The manuscripts of Ariosto, whose style appears the very perfection of ease, and an almost spontaneous emanation, still exist at Ferrara, and show that many of the favourite passages in the Orlando were written eight times over. Scarcely less attention was bestowed upon the stanzas of the Gerusalemme by Tasso. Milton's study of English speech, and mastery of the artifice of language, as well as the critical care with which he built up "the lofty rhyme," are well known.

> He with difficulty and labour hard
> Moved on; with difficulty and labour he.

The specimens of Pope's Iliad given in Johnson's Life, exhibiting the successive changes which the lines underwent before they assumed that compact and harmonious form in which they appeared before the public, must be in the recollection of every reader. And we see from the letters of Lord Byron, that the same laborious process of polishing was not disdained even by his impetuous mind. It is indeed scarcely too much to say, that no composition of any length, which has attained a permanent popularity, was ever thrown off at a heat; and that the nearer the work approaches to the appearance of spontaneity, the greater has in general been the extent of the labour which has been employed upon it.

Qualities common to all good poetry.

Such being the qualities and habits of mind that make the poet, it may be asked what are the common qualities to be found in all poetry which has permanently commanded the admiration of mankind. Milton has endeavoured to condense these into a sentence. Poetry, he says, must be "simple, sensuous, passionate."

Poetry must be simple.

By the first quality, simplicity, which applies both to the matter and the language, he seems to indicate the necessity of dealing in poetry with the simple elements of human nature; keeping the broad highways of feeling, avoiding affectation of sentiment, over-refinement, or morbid peculiarity of any kind. "It distinguishes poetry from the arduous processes of science labouring towards an end not yet arrived at, and supposes a smooth and finished road on which the reader is to walk onward easily, with streams murmuring by his side, and trees, and flowers, and human dwellings, to make his journey as delightful as the object of it is desirable, instead of having to toil with the pioneers, and painfully to make the road on which others are to travel."[1] And unquestionably it is the fact, that the works of the greatest poets are the simplest, the most level to ordinary apprehension, the most adapted to ordinary sympathies. Homer, in whose works nature is reflected without change, is understood and relished equally by the youth and the man, by nations the most distant from each other both in space and time. Shakspeare, in like manner, in whose works we can detect no subjective influence produced by his own mind, and who seems to range like the universal sun over the provinces of emotion, enlightening all alike, produces the same deep impression on the learned and the unlearned. Both concur in this, that they do not paint the exceptional, but the customary; not the peculiarities, but the common features of humanity; and that they paint these broadly and simply, instead of endeavouring, by a complex apparatus of singular traits and colours, to display their own artistic skill.

Sensuous.

The second of the qualities enumerated by Milton is, that poetry must be "sensuous;" that is, that it shall have that character of sensible reality, which shall prevent its degenerating into mere dreams and abstractions; that it shall be so far connected with the world about us, and with our actual interests and pursuits, as not to appear altogether the creature of another sphere; and this both as to the nature of the subject and the definite nature of the imagery employed upon it. The right understanding and application of this rule would have saved the world from many of those hazy poetical abstractions, or attempts to transmute political or metaphysical theories into poetry, with which, in the present age in particular, the public has been inundated. It is the neglect of it which renders the metaphysical poetry of the sixteenth century, with all its grandeur and force of thought, so often unreadable; which has made the poetry of Keats, abounding, as it does, in exquisite beauties of conception, a sealed book to the mass of readers; and which, more even than its irreligious tendency, has obstructed the popularity of the poems of Shelley.

Passionate.

The third requisite of poetry is that it be passionate. It is not enough that thought and imagery be sensuous, or objective and definite; the *passio vera* of humanity, as Coleridge remarks, must animate both. It is by our sympathies that poetry lays its strongest hold on us; and it is by the representation of passion that these must be set in motion. Even the lower and more level departments of poetry must be warmed by it; of the epic, and still more the dramatic, it constitutes the mainspring. Didactic and descriptive poetry would become wearisome were they not enlivened by the occasional introduction of scenes awakening the feelings of love or pity. In lyric poetry, the song constantly exhibits its condensed expression; in fact, so powerful is its influence, that genuine passion will often support a poem which has but slender claims to fancy or imagination. The mere literal and truthful exhibition of the greater passions of our nature so stirs within us the sense of the sublime or the terrible, so rouses our curiosity and suspense, that for a time we are willing to dispense with the more ethereal colouring which imagination might impart to them. We say, however, for a time only; for a literal picture of human passions, if prolonged through a whole drama, and unrelieved by imagery, or the expression of calmer thought, is felt to be painful and harrowing to the mind. Such is the effect produced by the Newgate Calendar dramas of Lillo, George Barnwell, Arden of Feversham, and the Fatal Curiosity, and by the similar tragedy of Werner, the Twenty-Ninth of February. So great was the effect produced by the scene in Lillo's play representing the murder of Arden, that the audience, unable to endure the excitement of the representation, rose up with one accord and interrupted it. Appeals to our passions, presented in this bleak and naked reality, have the same painful effect upon the mind which exhibitions of crime and suffering have in real life. To make them produce a pleasing effect in poetry, at least for any length of time, they must be blended with associations of a less vulgar and less agitating kind; and the pain which attends our sympathy must be tempered by the soothing imagery suggested by the imaginative and reflective faculties.

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[1] Coleridge's Literary Remains, vol. ii. p. 10.

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The qualities enumerated by Milton may be considered as fixed and inherent in all good poetry; beyond these it is difficult to point out any which are of permanent and universal necessity. That poetry which seeks to please through our sympathies must shift and vary, both in its themes and in the manner of treating them, with the changes of society, is a truism on which it is needless to enlarge. If the opinions of men change, if their habits and the objects and associations which interest them alter, poetry must adapt itself to this altered state of things. It does so indeed unconsciously; it cannot avoid doing so, for the poet's own nature has partaken of the change.

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poetry.

It is a more important question, whether the progress of society, the advancement in civilization, and the moral habits and intellectual constitution which accompany it, operate favourably or unfavourably on poetry; in other words, Is there reason to believe that the imaginative faculty in poets, and the sensibilities of their readers, decline with the progress of refinement in the arts; or that the imagination no longer finds the same materials in actual life on which its plastic power can be excited?

The tendency of most of the late inquiries into the question has been towards the opinion of its unfavourable influence. The faculty of imagination is supposed to decline as knowledge becomes more exact; the turn for analysis, which is the characteristic of advancing civilization, and which shows itself in the philosophical character which language assumes, is maintained to be destructive of that individuality and distinctness which is the life of poetry; substituting general abstractions for particulars, vague phrases instead of images, and personified qualities instead of men. In a half-civilized state of society, too, life is a romance, a tissue of adventures, powerfully exciting the feelings of fear, wonder, and enthusiasm. In more refined periods these sources of excitement cease; and, even where they exist, they are veiled by the caution which the fear of ridicule produces, a restraint which in the ruder periods of society is comparatively unknown. Hence both the imagination of the poet and the sensibilities of the reader of poetry are chilled. "Poetry," says one of the ablest exponents of this unfavourable view of the effects of civilization on the arts, "produces an illusion on the eye of the mind, as a magic lantern produces an illusion on the eye of the body. And as the magic lantern acts best in a dark room, poetry effects its purpose most completely in a dark age. As the light of knowledge breaks in upon its exhibitions—as the outlines of certainty become more and more definite, and the shades of probability more and more distinct—the hues and lineaments of the phantoms which it calls up grow fainter and fainter. We cannot unite the incompatible advantages of reality and deception, the clear discernment of truth and the exquisite enjoyment of fiction."

Yet these observations, though true to some extent, must be received also with some qualification. If language loses something in picturesqueness, it becomes far more pliant, far better adapted to convey the exact idea intended; if phrases which originally conveyed images have by long use ceased to be metaphorical, we see that genius is constantly creating and giving currency to new combinations. Knowledge and learning and mechanical improvements, if they tend to repress enthusiastic feeling, at least supply poetry with a host of illustrations unknown to earlier periods; but, above all, it may be doubted whether the enthusiastic and imaginative faculties within us can ever be materially affected by the changes of society, however their outward manifestations may be repressed. Whilst men feel that they are connected with eternity, mysteriously surrounded by influences which they feel and acknowledge though they cannot account for them; whilst love still holds a place in the heart, and carries the spirit of romance into the barest realities of existence; whilst men have a country to honour and defend; whilst they can still be animated to enthusiastic concert in the cause of humanity; whilst the strange accidents by which even our decorous and conventional course of life is at times broken, still present to them a thousand scenes of joy or calamity; there seems little reason to apprehend that the imaginative faculty can ever be so impaired from want of external nutriment or inward vigour, but that a truly great poet will always find the means of speaking to the hearts and sympathies of men, in different language it may be, but with undiminished power.

Still less reason is there for the apprehension, that the materials for description and illustration which external nature offers to the poet are likely to be in time exhausted, or even materially encroached upon. Certainly the first and the more obvious of its features are caught by the first labourers in the field of poetry, with a truth and liveliness which no subsequent efforts are likely to surpass; and if poetical imitation were, like literal landscape or portrait painting, a mere transcript of the scene before us, there might be reason to think that all the more striking aspects and points of view would, in the course of time, come to be exhausted, and the poet driven either to mere repetition in a feebler form, or to seek for novelty by endeavouring to turn to account the materials which his predecessors had thrown aside as least fit for their purposes. But when it is recollected how infinite are the varieties and combinations of which the objects of moral and material nature are susceptible, how largely, too, a creative and changing power is exercised in poetical imitation; and in how many different lights, independently of this process of imaginative change, the objects around us are placed by natural differences of associations in the person who contemplates them; it may be safely assumed that the materials of poetry are inexhaustible.

That poetry must have existed from the very earliest periods is undoubted. As the expression in language, of that feeling of excitement and elevation produced either by moral or material grandeur or beauty, it had its seat and origin in human nature itself, and in its simplest form must necessarily have existed as soon as man felt the desire of recording his impressions, or communicating them to others. In its first shape it may have been destitute either of rhythm or metre; although so close is the connection between that state of the imagination which gives birth to poetical conceptions, and a tendency to assist the effect of these by certain intonations of the voice approaching to musical sounds, that it is far more probable that even from the first something of measure was imparted to it, probably without effort or consciousness on the part of the reciter. At any rate, the power of measure as an assistant to memory, and as furnishing a species of gratification to the ear, apart from the mere effect of the ideas upon the mind, could not fail to be soon perceived and acted upon. At first, in fact, poetry and music seem to have been constantly associated; for the study of music, as something separate from the accompaniment of words, is one which arises only at a later period; and in all the poetical compositions which have descended to us, the elements of versification, or division of lines into certain measures, are discernible.

HEBREW POETRY.

The poetry of the Hebrews is the oldest in the world. It stands apart from all the rest, in solitary grandeur, like a pillar of fire in the poetical wilderness. The poetry of Greece, for instance, only begins to exist centuries after the noblest efforts of the Hebrew muse had been produced and committed to writing. Even the oldest poetry of the Arabians, whose language is a kindred one to the Hebrew, is of far more recent date than the Jewish Scriptures, in fact not much older than the time of Mahommed. The Hebrew poetry, as it has come down to us, seems limited in its field, though within that field it has attained a mastery never excelled. Almost all its compositions are lyrical, and chiefly in the highest department of the lyric, resembling, though in a less regular and artful form, the ode of the classical poetry. Its characteristics appear to be unequalled majesty of thought and expression, a fervour and flow which, more than in any other poetry in existence, suggest the idea of an inspiration or divine afflatus, dictating, through the poet as a mere organ, the sublimest ideas in words of corresponding weight and grandeur; a profusion of imagery and illustration, which, though it at first appears excessive and overpowering to the critic of modern times, and colder climes, is seen upon further study to be in the closest harmony with the Hebrew character, and that of all the oriental nations, and is remarkable for the absence of any thing farfetched or elaborate; a rapid desultory movement from one train of thought or illustration to another, without formally supplying the links in the chain of association which have led to the new topic,—as if the poet relied upon a corresponding excitement in his readers or hearers to supply that elevation and reach of poetical vision necessary for tracing the chain of ideas from first to last. It is certain, however, that to the Hebrews themselves there was much less of abruptness and want of connection in their lyrics than at first sight appears to us; and that slight hints were sufficient to awaken trains of associations to which, from our altered circumstances and character of mind, we have now no clue; and this observation, in fact, applies equally to the Hebrew and to great part of the classical poetry of Greece and Rome.

Circumstances from which it derived its peculiar character.

When we look to the Hebrew character and poetry, and to the local situation and manners of the country, we perceive a combination of circumstances highly favourable to the growth and development of that department of poetry in which alone they can be said to have attained distinguished eminence. All the elements out of which a great national lyric poetry is formed existed amongst the Hebrews, both as regarded the impulses of the mind and the external influences by which they were surrounded and daily acted on. They had been selected as God's peculiar people from among the nations; they held as it were a commission from heaven, giving them authority over the world; they looked upon themselves as the race from which its Saviour was to spring. They had triumphed, by the divine aid, over the kings, and princes, and Pharaohs of the earth; they had the recollection of all their strange wanderings, their miraculous deliverances, their acquisition of the promised land, and their law given amidst audible thunders and visible smoke from Mount Sinai, in the presence of assembled myriads. They had a religion which, excluding the worship of the Deity under visible symbols, only made the image of the Deity more deeply and impressively worshipped within the temple of the heart and the imagination: while the connection of religion with all the affairs of life; the constant rites and ceremonies and festivals of rejoicing or humiliation; the presence of the Deity, kept before their thoughts by the ark, which was supposed to be his peculiar seat, and the sacredness of which had been more than once guarded or avenged by prodigies; prevented that religion from becoming a mere abstraction, and gave to their conceptions of the Deity a warmth and life peculiarly suited to the poetry of devotion, as blending the ideas of the visible and the spiritual, without any admission of those palpable, material, and degrading conceptions which mingle with and deform, to our associations, the mythological or religious poetry of Grecian polytheism. No commercial pursuits tended to excite among the earlier Hebrews the prosaic love of gain. They were shepherds, husbandmen, or warriors, deriving subsistence from the soil, and attached to it by a train of recollections. Frequent public ceremonies, festivals, jubilees, gave occasion for the assemblage of the people in large masses, for a common purpose; the occasion of all others most likely to call forth, by a common sympathy, the enthusiasm which stimulates the imagination into poetical activity. Add to these a climate bright and cheerful, but admitting also of every variation and interchange of serenity or tempest; a country, the external aspect of which presented the strongest contrasts of barrenness and luxuriance; fertile plains, with mountain ranges of the most bleak and desolate grandeur; gardens like those of Damascus, with dreary lakes like the Dead Sea, whose stagnant waters still spoke of the fall of the cities of the plain, or wildernesses haunted by the lion, the rhinoceros, and the serpent; and it would indeed be matter of surprise if the Hebrew sacred poetry were not characterized by a remarkable feeling of national pride, of sublimity, simplicity, and natural pathos in its sentiment, and by a peculiar freshness, truth, and boldness in its pictures of nature, or illustrations derived from external scenery. The parched plains of Judæa, the rocky top of Sinai, the towers of Damascus, and the gardens of Lebanon and Carmel, supply them with figures or allusions which have an unspeakable charm of picturesqueness and beauty. The climate is vividly brought before us in the allusions to the wellsprings that water the desert, and to the shadow of the great rock in a weary land. We see the simple character of their life in their pastoral images, so constantly derived from the tending of flocks and herds; imagery so congenial to their minds, that it is employed by the Author of our faith in some of the most touching passages of the New Testament. Such is the character of those books of the Hebrew Scriptures which are on all hands admitted to be poetical, though we know too little of the laws of Hebrew prosody to be able to say whether they are written in verse, though a species of rhythm, and apparent equality in the divisions of portions of the sentences, appear to indicate that they are. Such are the Book of Psalms; one of which (the ninetieth) is even ascribed to Moses, whilst several others were the production of predecessors or contemporaries of David. It is certain, however, that those ascribed to him are the finest and the most affecting of the whole, though perhaps not the most magnificent in point of stateliness of diction and imagery. "Nor is it in tragic so much as in joyous expression," says Mr Campbell, "that I conceive the power of his genius to consist. Its most inspired aspect appears to present itself when he looks abroad on the universe with the eye of a poet and with the breast of a glad and grateful worshipper. When he looks up to the starry firmament, his soul assimilates to the splendour and serenity which he contemplates. His lofty but bland spirit of devotion peculiarly reigns in the eighth and in the nineteenth psalms. But, above all, it expands itself in the 104th into a minute and richly diversified picture of the creation. Verse after verse in that psalm leads on the mind through the various objects of nature, as through a mighty landscape; and the atmosphere of the scene is coloured, not with a dim or mystic, but with a warm and clear light of religious feeling. He spreads his sympathies over the face of the world, and rejoices in the power and goodness of its protecting Deity. The impressions of that exquisite ode dilate the heart with a pleasure too instinctive and simple to be described."[1] Such also are the Song of Solomon, the Proverbs, Ecclesiastes, the Lamentations, and the Book of Job, with large portions of the prophetic books, and occasional passages even in the narrative books, such as the Song of Moses and Miriam, Jacob's dying prophecies to his sons, the triumphal chant of Deborah, Balak's involuntary blessing on the people whom he came to curse, and, above all, the exquisitely pathetic and beautiful lamentation of David over Saul and Jonathan. Amongst the Hebrew prophets, viewing their writings apart from their divine inspiration, and merely in the light of poetical compositions, the highest rank is universally ascribed to Isaiah; and that on account of the union of excellencies which his sacred poetry exhibits. Deeply pathetic in some portions, as in those where he paints the destruction which is about to fall upon Judah; awfully sublime in others, as where he describes the descent of the Assyrian king into the regions of hell, while all the dead monarchs of the earth rise up to greet him with reproaches; he rises with equal ease to themes of rapturous exultation, or spreads out in minute portraiture all the tranquil and soothing images of a coming millennium. "Joel," says Mr Campbell, "may be deemed to surpass him in continuity, and both Joel and Habakkuk are at moments more sublime. But their compositions are much shorter than his, and give us not the same conception of copious and unwearied inspiration. Isaiah's genius goes farther on an even wing, and burns longer with an unwavering fire. When he has merely to relate, his language has the utmost plainness; and his expositions are remarkably clear, considering the nature of oracular poetry. He unites the same simplicity with his rich and high visionary scenes, which are neither meagre like Jeremiah's, nor ambitiously overwrought and complex like Ezekiel's. A deliberate air, a divine self-possession, turns the very scorn and wrath of his spirit into movements of grace and beauty."

Jeremiah and Ezekiel belong to the declining period of Hebrew literature. They had fallen upon the evil days of their country, and the influence which its misfortunes and degradation produced on the mind, is peculiarly visible in the melancholy strains of Jeremiah. "His genius seems to bend, his voice to falter, under the burden of prophecy; and though sometimes pleasingly affecting, he generally prolongs the accents of grief to monotony, and seldom avoids tautology except where he abridges the works of other prophets." Ezekiel is the last great prophetic poet of the Hebrew line; and opinions have been divided as to the poetical rank to which he is entitled. Dr Lowth thinks that he is not excelled in sublimity even by Isaiah himself; Michaelis, on the contrary, that he displays more luxuriance in amplifying and decorating his subject than is consistent with true poetical fervour. Mr Campbell adopts the view of Michaelis, but adds, that the fancy of Ezekiel is daring and ingenious. Ingenious hardly appears to be the term applicable to the imagination of Ezekiel, which revels with peculiar pleasure in visions of a mystical, and, it must be admitted, somewhat confused sublimity. Some passages, however, are most powerfully impressive, such as the vision of the four cherubims in the first chapter, and the resurrection of the dry bones in the thirty-seventh, when there was "a noise and a shaking, and the bones came together, bone unto his bone;" and the prophet calls unto the wind, "Come from the four winds, O breath, and breathe upon these slain, that they may live; and they stood up on their feet, an exceeding great army."

But whilst the Hebrew poetry equals, and indeed far excels, that of any other nation in the sacred lyric, it is singularly defective in the other departments. The Song of Solomon, laying aside its spiritual meaning, may be admitted to be a fine specimen of the pastoral: but of dramatic and narrative poetry the Hebrews have left no specimens; for, though the book of Job has to a certain extent a dramatic form, it has clearly nothing of the essential qualities of the drama. This has been ascribed mainly to the theocratic nature of the Jewish constitution, in which the Levites or priesthood formed the sole and literary aristocracy; thus devoting poetry exclusively to religious themes. But, considering the ample field which the Jewish national religious history afforded, it is not easy to see why, if the genius of the people had inclined toward narrative or dramatic poetry, the Exodus, the wanderings in the desert, the wars carried on under the judges, and the many other striking events which gave interest to their annals, should not have been embodied in verse, as they were in prose, in the narrative books of the Old Testament.

But, though the poetry of the Hebrews is the first in the order of time, it cannot properly be regarded as the fountain-head of that literature, the course and connection of which we trace in an unbroken series of great works down to the present time.

The sacred poetry of the Hebrews, no doubt, impressed upon the literature of Christianity some strong and remarkable features; but it was from the fountain of classical literature that the genius of modern Europe first drew its inspiration. It is therefore to Greece that we must turn, as the head of that great family of literature with which we feel ourselves connected by relationship of thought and association.

Greek Poetry.

On turning from the poetry of the Hebrews to that of Greece, we are immediately struck with one distinctive feature, which, as applicable to the whole of its poetry, we may notice before adverting to the different departments into which it is subdivided, viz. the more palpable, material, and distinct character of all its conceptions and imagery. This immaterial, vague, and spiritual character of the Hebrew poetry, dwelling more on emotions of the mind than on actions, and on the invisible rather than the outward and visible, is unquestionably to be ascribed in a great measure to the predominance, in the national mind, of a pure and elevating religious creed. On the other hand, the Grecian mind, formed under the influence of a mythology which was in fact a mere deification of the material world, and which certainly exercised no strong influence save on the fancy, banished those themes and trains of thought which led beyond the visible diurnal sphere, and, concentrating its attention upon the present, gave to all its imagery a distinctness of outline, a simplicity and pellucid clearness in the thought, which, if less suited than the Hebrew to the excitement of the evidences of the sublime, was certainly in a corresponding degree favourable to the creation of beauty. The Hebrew poetry, therefore, is contemplative and subjective; the Grecian plastic and objective.

In an outline like the present, of the progress of poetry, it is needless to dwell upon the subject of the anti-homeric poets of Greece. That there were poets before Homer, we know; and this is really the extent of what is known on the subject. That the *art* of poetry had been cultivated to a considerable extent, that its principles had been subjected to reflection and experiment, when Homer lived, is as clear as internal evidence in any case can make it..

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[1] Campbell's Lectures on Poetry, i.

Poetry improves only as painting and sculpture rise to perfection. "In sculpture," says Herder, "what a track must it have travelled over in passing from the figures on the chest of Cypselus to the decorations of the Propyleia and the Minerva of Phidias, or from the sculptures of Dædalus to the Olympic Jupiter. A like track was travelled by poetry in advancing from the rude lays in honour of gods and chiefs to the Homeric Epos." We know, indeed, that many of the minstrels before Homer had sung theogonies and cosmogonies, the adventures of Titans and heroes, of Hercules, Theseus, and the Argonauts; and in all probability the legends of the siege of Troy, and the return of the chiefs engaged in that enterprise, had formed the subject of many a ballad or rhapsody, ere a Homer arose to give them unity, proportion, and poetic life. All these have faded and been forgotten, for the tablet of human memory is narrow, and, to give room for the last and best, the older and ruder inscriptions must be erazed. Not one of these, accordingly, has descended to us in any authentic form; whilst the spuriousness of most of the Orphic poetry is unquestionable. Whether even an Orpheus ever existed, was doubted by Aristotle; and Herodotus distinctly states his belief, that the poets given out as older than Homer were in fact of more recent date.

We do not enter into the details of the question whether the works which bear the name of Homer were the productions of one man, and written in their present form at the period commonly ascribed to them, namely, nine hundred years before Christ, or whether they were originally the work of many rhapsodists, in portions separate and distinct, and afterwards woven together in a collected form about the time of Solon and Pisistratus. The question is, in fact, of less importance in reference to the history of poetry than might at first sight appear. For whatever view may be adopted, it is clear that the spirit, the tone, and the manners which are described in the separate lays, supposed to have been ultimately incorporated in one, are those of the earlier and not of the later period, and that the Iliad paints the Grecian mind and character as it appeared three or four hundred years before the time of Solon, and that from draughts made at the time. If so, the only way in which the adoption of the modern theory of Wolff affects the question is, that it deprives Homer of the merit of one grand general design, consistently followed out. It is certain, however, that whatever difficulties may attend the supposition of the Iliad and Odyssey being written by one man, in their present form, and at the early date ascribed to them, and preserved in the absence of writing by mere oral tradition, the difficulties on the other side are infinitely greater. To suppose that a set of scattered lays, composed by a number of unconnected minstrels, should ever have been made to cohere so smoothly and compactly, evincing such perfect unity of plot and purpose; that they should have been confined to so small a portion of the Trojan legendary history, and have given such prominence to a single Thessalian hero; seems a supposition far more startling than any that attends the belief that the Iliad is the work of a single author. "For inspiration is a solitary creative spirit; and it is not to knots and groups, or accidental fabricators, that she has ever intrusted those great conceptions in poetry or painting, or the fine arts, that have commanded the permanent homage of mankind." Many smaller additions, by other hands, in the same spirit and style, may have been afterwards superinduced upon the original work of Homer. (See the article HOMER.)

Epic poetry.

The two great poems of Homer are the first specimens of *The Epic*, or narrative poem. It is, in fact, from the Iliad in particular that our conceptions of an epic poem have been derived, and its canons deduced. What Homer has done has been consecrated as establishing inviolable rules to be observed by his successors. The epic is, upon the whole, the noblest form of poetry; that which demands the highest and most sustained power of imagination, combined with the simplest and purest taste. The power of tragedy is greater for the moment; for its presentations, assisted by action and visible form, are more vivid; but the epic, possessing a wider compass, and painting only by words to the eye of the mind, has a more diversified, enduring, and tranquil operation. Rapidity, strength of passion, vehement and animated dialogue, are the essential requisites of tragedy; a calm, sustained, progressive, and sober majesty the characteristic of the epic. "Of dramatic pieces," says Herder, "we remember sentences; the characters move before our eyes, we feel their emotions with them. But this emotion being stronger, is also briefer; it passes away. The epopee, with its more quiet working, with its proportions too vast for any stage to compass, fills the soul, and there abides." The other points noticed by Aristotle, "revolutions of fortune, recognitions, characters, passions," are common to both, as well as to fictitious composition in prose. Every romance written on any high principle is, in fact, a prose epic; the epopee in verse merely adds to the other sources of interest the charm of poetical diction, and of those elaborate ornaments of figures and similes, which, though stately and appropriate in verse, only produce a bombastic and ridiculous effect in the prose of Fenelon, or still more in that of Macpherson.

Essentials of the epic.

An epic, then, is the poetical development, in narrative, of some great and interesting event, or series of events, sufficiently separate from what goes before or follows, to possess the character of a whole; having, therefore, a clear and distinct beginning, middle, and end; an action simple at first, leading into a complication of plot, and terminating in a natural and soothing solution. These are its essentials; amongst its accidental features are the employment of supernatural agency as a medium either of heightening emotion or of conducting the plot; the introduction of episodes, of formal addresses, invocations, and similes; matters which have no essential connection with epic poetry, and the propriety of the introduction of which varies with the theme, the age, and the national associations of the poet.

How far suited to modern times.

To the confusion of these accidental qualities, many of which are certainly quite unsuited to the taste of modern times, with those essential features which must have an equal interest for all time, must be ascribed the numerous failures which in modern times have thrown a certain discredit and air of ridicule upon the epic poem; as well as the belief that appears to prevail, that the time for epic poetry is past. Unquestionably any epic now written which deals with fabulous mythologies or exploded superstitions, and employs in the nineteenth century the long elaborate speeches, the minutely touched similes, the formal enumeration of ships, and muster-rolls of regiments, which suited the primitive times of Homer, when description was new, will probably share the fate of Leonidas or the Epigoniad. But in the hands of a poet selecting a theme of sufficient natural and human interest, remote enough to allow play for the imagination, yet near enough to make us understand and sympathise with his actors, and treating it, not in a slavish spirit of imagination, but with the vigour and independence of original thought, we are persuaded that the epic would be found to have lost none of its power. It seems to be an entirely mistaken opinion, that the epic is only the production of an early and comparatively simple state of society, and therefore unlikely to harmonize with the more complex nature and critical taste of more advanced civilization. On the contrary, the Jerusalem of Tasso, the Paradise Lost of

Milton, and the Lusiad of Camoens, the only three modern epics which deserve the name, are the productions of what may be termed the golden age in point of taste in each country, and of individuals uniting to poetical inspiration all the stores which the widest reading and most sedulous cultivation of learning could supply.

The Homeric epics, and their characteristics.

The great powers of Homer are distinguished from all modern epics, by their wonderful air of truth, their broad clear portraiture of character, infinitely varied, and yet not antithetically contrasted; their perfect absence of all affectation, false sentiment, or exaggeration, either in character or sentiment; their calm and impartial spirit; their serenity, cheerfulness, and good sense. Such a union is indeed not to be expected in a modern state of society; after poetical description has already traced all the leading outlines both of moral and material nature, and when men, insensibly and unavoidably subjecting the influences from things without to a process of intellectual chemistry from within, and thus, connecting them with peculiar associations, cease to have either the power or the inclination of simply reflecting back on their verses, as in a mirror, the impressions of nature as they fall upon the mind. Neither, although the power of delineation existed, can it ever be expected that such materials for broad, simple, and effective painting can be found in modern times, when differences of character are veiled, if not in a great measure obliterated, by community of education and habits, or are converted into mere humours or peculiarities, to which the shades of distinction are too minute for any grand poetical effect.

Even the greatest of our modern epic poets, in painting the manners and the moral habitudes to which chivalry gave birth, laboured under the disadvantages of pourtraying feelings which, springing, as they had done, out of a visionary and unreal, because exaggerated, sentiment, had a tendency to run into caricature, and to give a monotonous and hyperbolical cast to their delineations of human character. The beings painted by Homer, who himself lived upon the outskirts of the heroic times of Greece, were in their features the men whom he saw around him; beings natural, open, and unsophisticated, both in their good and bad qualities: the manners simple, primitive, and homely, yet not without a touch of grave courtesy and refinement; the scenery which forms the foreground or background of his human groups as yet undepicted, the incidents through which they pass unhackneyed; all nature was before him where to choose: while the language which was to be employed as the medium of his art, neither debased by vulgar associations, nor diluted from its original freshness and strength by metaphysical refinements, which diminish its picturesqueness, in proportion as they render it more complex and philosophical, affected the mind with all the distinctness of sounds and colours, and stamped upon it an impression fresh and immediate, as from the signet of nature.

The power of invention displayed by Homer in his two great poems, in the conception of character, can only be fully appreciated when we recollect, that the germ or outline of almost every character which has since figured in epic poetry is to be found in the Iliad. Now, though the wonderful variety of his incidents, his battles, sieges, and storms, his nocturnal adventures, his combats of gods and men, and his scenes of enchantment, may have been in a considerable degree derived from his predecessors, and, in fact, the hereditary and traditional *properties* of the ballad minstrels of Greece, it is impossible to conceive that he could have derived much aid from this source in giving individuality and life to character. And yet, with the exception of characters under the influence of the passion of love, such as Dido, Armida, and Erminia, scarcely any substantial addition has been made to the picture gallery of Homer by later epic poets. His characters, in fact, have been like stereotypes, from which new impressions are constantly reproduced. Achilles, with his union of ferocity and gentleness, generosity and vindictive feeling, has been the model of all our mixed characters of passion since, and reappears in Turnus and Rinaldo; just as the kingly Agamemnon, with his grave dignity, has formed the archetype of those which represent the ascendency of reflection, and the moral power of sustained and tranquil grandeur, as in the Godfrey of Tasso's poem.

The Iliad.

The characters of the Iliad are naturally the more varied, because its subject was a great public event, and the actors were the congregated princes and heroes of Greece and Asia; the Odyssey is the poem of domestic life, the tale of the fortunes of a single hero, to whom all the other personages are purposely placed in subordination, but whose character, by this isolation, gains a degree of distinctness and natural truth absolutely unequalled in fiction, save in some of the creations of Shakspeare. The remarks of Mr Campbell on the characters of the Iliad are so just and beautiful, that we cannot deny ourselves the pleasure of quoting them.

"Achilles, in the centre, is of the order of spirits that electrify and command mankind. His alarming and sensitive being is the soul of the Iliad, and his very absence and repose are the causes of its disastrous action. He is unquestionably ferocious, but his quarrel is just; he is wronged, high minded, hating falsehood like the gates of hell, young, beautiful, and predestined to fall. Casual glimpses of his manners are also given, that interestingly soften our conception of him. He is the only hero of the Iliad who amuses himself with music and poetry. The deputies of the army find him in his tent playing on his lyre, and chanting heroic songs; and, though he knows their hateful errand, he receives them with a calm and manly benignity. Horace does him injustice when he calls him a disclaimer of laws, and inexorable; for he melts into tears at the prostrate gray hairs of Priam, the father of the slayer of his friend, though he had lately withstood all the eloquence of Nestor.

"It shows the security of Homer in his inspiration to have introduced such an opponent to Achilles as Hector. But when he leads us to Troy, he makes us Trojans in our affections, and almost seems to become so himself. Prodigal in sympathy with the events and agents which he conjures up, his imagination as tenderly conceives the lamentations of Hecuba, and the heart-sick swoon of Andromache, as it makes itself impetuously congenial with the vengeance of Achilles. Like nature, he is fruitful in creating characters, and, like her, impartial in distributing and intrusting virtues to contending parties. Conscious that Achilles could shine by his own light, he fears not to show us his image through tears for the fate of Hector. In delineating Hector by the eulogies of his weeping country and friends, the climax is exquisitely perfected by Helen. All others who had bewailed him, she says, were bound to him by reciprocal ties; but hers was the grief of gratitude for the undeserved and gratuitous kindness of his mighty heart. He had interposed when others had reproached her; he had soothed her when her tears flowed at their reproaches.

"Æneas creates a less ardent, though still respectable interest; and it is increased by a hint, which is thrown out with an air of minute historical probability, that Priam was jealous of his greatness, and that his virtues had been partially thrown into the shade. What expression in every figure of this mighty tablet! What diversity even between men incompetent to great actions; as between the abject coward and vulgar braggart Thersites, and the gay good-natured Paris, whose spirit, though sunk in luxury, still shows some traces of his noble breed! The stout heart and arm of Ajax stand him in lieu of all piety, craft, or sensibility; whilst Sarpedon, bleeding in warfare not his own, spends his last generous breath in exhorting the brave to rally the battle. Homer is above all artificial antithesis in the painting of character; but in describing natures remotely different, he could not avoid exhibiting contrasts; and that which is visible between Achilles and Ulysses is as perfect as heroic nature can afford.

“The youthful Diomed is, among the Greeks, next to Achilles, the apparent favourite of the poet: all spirit and lustre, his valour burns like ‘the unwearied fire that plays on his shield and crest.’ Like Achilles, he is insulted by Agamemnon, who charges him with cowardice on the eve of battle; but he is wise as well as warlike, and it is not till his actions have belied the imputation, that he retaliates upon his commander. When the Greeks have been worsted, and when Agamemnon proposes abandoning the siege, Diomed, the youngest of all the chiefs, rises in the council, and gives him a dignified rebuke. Agamemnon himself is not without the virtues of fraternal affection, and willingness to listen to able counsellors. He has also his day of distinction in the field. But his importance altogether is more royal than personal, and his faults are made conspicuous by his supremacy. Alternately presumptuous and despondent, he is the readiest to tax others with deficient courage, and the first himself to despair under public reverses. He is also unmerciful in victory. The cry for quarter is addressed to him in vain, and he makes two of the most atrocious refusals to spare that occur in the Iliad. It has been remarked, that Homer speaks as a friend to royal government; but still he describes it as too limited, or rather as too undefined, to be despotic; and the chiefs in the councils of the Iliad present us with a sort of Greek picture of Gothic feudalism. And if he shows respect for monarchy, he makes his kings no monopolists of virtue. In poetical justice, he seems to have thought it sufficient to give Agamemnon the diadem, and a few good qualities, as his share of importance in the poem, leaving brighter heroic endowments to chiefs subordinate in political power.

“Amidst these forms which the Iliad exhibits in the bloom or strength of heroism, the aged characters are no less happily distinguished. Nestor looks back on a life of greatness and wisdom:—he has no rival in venerable years; his powers have reached the last ripeness of experience, but they have also something of the mellow tint that precedes decay. He dwells on his own exploits with an egotism and fulness that could only be endured in the most ancient of men. Phœnix, the friend of Achilles, on the other hand, is also old, but his youth had been embittered by misery and vindictive passions; and when he comes to exhort the hero against excessive resentment, he confesses his early errors in a tone very different from the self-complacency of Nestor.

“Priam is neither very wise nor energetic; but his heart is warm with natural affections, and his woes and years sustain our reverence and solicitude. When the wail of the Trojans bursts from their walls, at the sight of Hector dragged in triumph by his conqueror, when the frantic father implores his friends to let him go forth and implore the pity of the destroyer, the struggle of his people to detain him, and the voice of his instinctive agony, surpass almost everything in the pathos of poetry, and affect us more like an event passing before our eyes, than a scene of fictitious calamity. Never was the contrast of weakness and strength more fearful, than when he throws himself at the feet of Achilles, whilst his feeble perspicacity makes us tremble at every moment, lest he should light up the inflammable temper of Achilles, fluctuating between wrath and compassion. Yet, hallowed by paternal sorrow, age and weakness prevail. The old man accomplishes his point, and the terrific victor condescends to the delicacy of even veiling Hector's corpse from his view.”

The Od sey.

The Odyssey, with certain common resemblances to the Iliad, is marked also by striking differences; so great, indeed, as to afford room for believing, not that it was the work of several hands, but that it may be the work of a different poet from the author of the Iliad. None of the gods and goddesses who play a part both in the Iliad and Odyssey appear the same in the latter poem as in the former. Jupiter, the representative of force or power, and the arbiter of all things in the Iliad, resigns the conduct of the hero to Minerva, the personification of wisdom. Menelaus, Helen, and Ulysses himself, leave a different impression on the mind. Manners and morals have changed. There is a perceptible advance in knowledge and the mechanical arts. There seems a decline in physical strength. The chivalrous spirit of the Iliad is exchanged for a more prudential and calculating one. Voyaging and wandering come in place of warfare. The qualities most valued are no longer the wild strength and energy of Achilles, but the self-possession, energy, forecast, invention, and eloquence of Ulysses. The agency of Magic, in room of a purely divine agency, a power of which we have no hint in the Iliad, finds a place. Wonders and prodigies are scattered with a profusion unknown to the Iliad. Many portions of the Odyssey have an air of resemblance to the Arabian Nights; and Sinbad would seem to have borrowed more than one of his adventures from Ulysses. It is not even difficult to perceive that the vocabulary and syntax of the language have in some measure altered. Each poem seems, as Herder remarks, to have its peculiar atmosphere, its sky, its panorama of objects in the upper, the middle, and the nether world.

Ulysses, the hero of the latter poem, is a conception more in harmony with ancient than modern views of heroism. Our ideas on the subject have been so strongly influenced by those notions of the point of honour introduced by chivalry, that we do not easily sympathize with a hero who, though not deficient in bravery, is always more ready to employ craft than courage, and only appeals to arms when artifice is found to be ineffectual. The character embodies, as Mr Coleridge observes, the idea of an accomplished man of the world, after the manner of ancient paganism; and it is therefore with some effort that we, whose ideal of such a personage is so different, interest ourselves in his fate. Yet he does make his way at last into our affections. His character grows upon us like the gradual influence of good sense. Human traits peep forth under the guise of impassive constancy and caution. His home-sick longings for Ithaca, his abandonment to the power of love under the influence of Circe, remind us of our common humanity. He bears his trials so firmly, he steers through difficulties with such tact and skill, and meets danger, when it must be met, with such self-reliance and courage, that he gradually acquires our admiration; and when we become more familiar with the kindly and warm affections which, after all, burn on in his breast beneath the crust of stoicism, he at last engages our sympathy and our love.

Hesiod.

The poems of Homer are at once the first and the last great specimens of heroic song in Grecian poetry; for it were out of place, in an outline like this, to allude to the middle school of the epic, while even the attempt to revive heroic poetry in the Alexandrian period only proved that its life and soul was extinct. Even in the Odyssey, as already mentioned, we perceive a decline of the enthusiastic and chivalrous spirit, a tendency towards the commercial and the peaceful. Imagination is gradually “fading into the light of common day.” This tendency appears, however, far more remarkable in the works of Homer's immediate successor, Hesiod. We say successor, because, although some authorities represent him as older than Homer, and Herodotus speaks of him as Homer's contemporary, the balance of evidence is clearly in favour of the superior antiquity of Homer. The precise date of his appearance, however, cannot be fixed with more precision than as having been between eight and nine hundred years before Christ. The works which bear his name consist of the Weeks and Days, the Theogony, and the Shield of Hercules, of which the latter is generally regarded as spurious. Looking to the subjects and character of his poems, which are of a domestic and peaceful character; to his style, which, though highly natural and simple, is, in the main, flat, level, and uninspired by high imagination; we should almost imagine that a full century must have elapsed between the Odyssey and the Weeks and Days. The time, adventures, battles, moving accidents by flood and field, and expeditions undertaken to recover some fair runaway "that enchants the world," seem to be for ever gone. In their stead we have an account how labour fell to the lot of man, the story of Pandora, our gradual degeneracy from the gold to the iron age, precepts of agriculture and commerce, moral and religious admonitions, which have much the air of trite proverbs and commonplaces of what deserves no better name than cunning and worldly wisdom; every thing, in short, indicates the triumph of the spirit of peace over that of war. The Theogony is in a somewhat more ambitious style; and, as a catalogue or muster-roll of the Grecian divinities, with a regular deduction of their genealogies, is curious. Unfortunately, however, its finest passage, the battle of the gods and Titans, a piece of genuine vigour and sublimity, appears so different from the style of Hesiod, that it would rather seem interpolated at a later time by some scholar, whose work has in this case very far surpassed his master's. On the whole, Quinctilian has criticised Hesiod with judgment and fairness. "Raro assurgit Hesiodus, magnaque pars ejus in nominibus est occupata; tamen utiles circa præcepta sententiæ lenitasque verborum et compositionis probabilis, daturque ei palma in illo medio genere dicendi."

ie Ho- ric mns.

The Homeric hymns, a series of compositions in praise of the gods, and probably of a date a little later than the age of Hesiod, seem to bridge over the passage from the epic and heroic poetry to the lyrical. The steps of the transition may even be in some measure traced, in the gradual ascendency acquired by the musical accompaniment which had from the first been employed in the recitation of the epic, but to which a greater prominence was given in the hymns, thus leading on to the decided influence of the lyre and pipe, and consequent accommodation both of the form and character of the poetry to that lyric mould in which it was thenceforward to be cast. Terpander himself composed the music for these Homeric rhapsodies; and Hesiod is said to have been denied admittance to the Pythian games because he could not accompany his verses on the harp. These hymns, strange, quaint, some almost comic; others, like that to Hermes (the finest of all), full of a wild and dancing gaiety; almost all treating the inhabitants of Olympus with a free and easy familiarity; abounding in rapid transitions, invocations, and reflections or sentiments of the writer; prepared the way for the more regular lyric, as it appeared in the strains of Archilochus (about 700 B. C.), to whom is assigned the distinction of being the father of the Grecian lyric.

e lyric try of ece.

The perfection of the Greek lyric had grown out of the intimate connection of poetry with music, fusing the finest results of both into a whole, which, charming the senses and the soul at once, hurried away the listener with an irresistible sweep of enthusiasm. Every thing in the circumstances of Greece contributed to its rapid development and unfailing effect. A spirit of gaiety and social enjoyment was the national characteristic, heightened by the influence of a delightful climate, and by a religion whose airy and fantastic character interposed no gloomy reflection to check the enjoyment of the present. The public and family festivals, sacrifices, games, and poetical contests, assembling multitudes together, exciting the spirit of rivalry, and gratifying the poet as it were with a foretaste of his poetical immortality, the high honours and distinctions everywhere paid to song, rapidly advanced the art to perfection. It is probable, that if the whole mass of the Greek lyric poetry could now be recovered, not only would Horace, Catullus, and the Latin lyric writers, be unquestionably shorn of many of their finest passages, but, in all probability, we should be presented with the noblest and most varied collection that the world has ever produced. For if the light luxurious Bacchanalian spirit of the time be imaged in the graceful trifling of Anacreon's festive songs, we know how the deeper and more gloomy sentiments of a genuine passion were embodied in the burning lines of Sappho; the ardour of military enthusiasm in him who sang his verses to the Spartan fife, Tyrtæus; the inspiring themes of patriotism in "Alcæus, fancy drest, singing the sword in myrtles dressed;" the touching tenderness of maternal affection in the Danae of Simonides, weeping over her child in her frail and sea-beaten prison; and, above all, the loftiest strains of religious fervour, the praises of demigods and heroes, all the pride, pomp, and circumstance of human existence, in the odes of the greatest master of the Grecian lyre, Pindar. But, unfortunately, of the works of the nine who are enumerated by the ancients as forming the constellation of the lyric writers, and embracing the period from the death of Hesiod down to the great era of the Persian war, viz. Pindar, Bacchylides, Sappho, Anacreon, Stesichorus, Simonides, Ibycus, Alcæus, and Alcman, some have completely perished, and of others only the most trifling fragments remain. Anacreon and Pindar are the only two of which we possess any considerable specimens.

Sappho.

Judging from the few fragments we possess of Sappho, the loss of her works is particularly to be deplored; for she appears to have possessed not merely that wild fire and hurry of passion which predominate in her celebrated ode (with which every one is familiar in the version of Phillips), but a tenderness of heart, a power of presenting imagery in a line or a word, not surpassed by any of the ancient writers, and justly entitling her to the lofty title of the Tenth Muse, bestowed upon her by antiquity. How exquisite, for instance, is the fragment preserved by Demetrius Phalereus,

> 'Εσπερε παντα φερεις
> φερεις οἰνον, φερεις αἰγα
> φερεις ματερι παιδα.

Thus expanded, yet scarcely improved, by Lord Byron:—

> O Hesperus, thou bringest all good things
> Home to the weary, to the hungry cheer,
> To the young bird the parent's brooding wings,
> The welcome stall to the o'erlaboured steer;
> Whate'er of peace about our hearthstone clings,
> Whate'er our household gods protect of dear,
> Are gathered round us by thy look of rest;
> Thou bringst the child too to the mother's breast.

Pindar.

Pindar unquestionably occupied the highest place among the Greek lyrists; and though it is certain that we are in possession of only a small part of his works, for he appears to have written on every variety of theme, enough remains to satisfy us that the judgment of antiquity, which raised him to the lyric throne, was well founded. Forty-five triumphal lays, in honour of the victors in the public games, have descended to us, and the character and peculiar merits of these have been described with such eloquence, and at the same time critical justice, by Sir Daniel Sandford, in his able sketch of the rise and progress of literature, that we quote the passage in preference to any remarks of our own.

"The most careless reader of these odes must be struck by the excessive admiration of wealth, magnificence, and every species of greatness, to which we have alluded as a characteristic of Pindar's mind. Splendour was the passion of his soul; splendour of achievement, splendour of renown, splendour of station and outward circumstances. His very pride seems to have suggested to him that nothing but splendour was worthy of his muse. His genius, to use a figure of his own, was the eagle of Jove, that would not be severed from the sceptre and the god. These aristocratic predilections, this enthusiastic attachment to munificent monarchs and chiefs of ancient fame, were in perfect unison with the whole tenor of his destiny; born as he was in the midst of the Pythian festival, living surrounded by shows of solemn pomp, and dying, as he had lived, in the full blaze of public ceremony, in the centre of a theatre, and while rapt in those emotions of rejoicing sympathy which such scenes were sure to awaken in his bosom. To those, however, who may deem apology requisite for the indulgence of so stately a temper, it may be urged in behalf of Pindar, that, as in the case of many remarkable poets, the abstract feeling of veneration was predominant in his mental constitution, and that it was called forth not merely by rank and opulence among mankind, but even more powerfully by the contemplation of the divine attributes. Hence that glow of piety which shines so brightly in his odes, sometimes breaking out in expressions of the deepest awe, or in sublime pictures of deity, and sometimes assuming an aspect of moral beauty, adding force and lustre to the lessons of wisdom. The latter modification of religious feeling has given birth to some of the noblest passages in the poetry of Pindar. He was well aware that emotion does not exclude sentiment; that the ethics of the heart are not less sound than those of the brain; and that nature is often hurried, in moments of excitement, into the innermost shrines of truth. But he knew likewise, that the philosophy of such moments is prompt and peremptory; oracular, not syllogistic; and this knowledge has secured him from frequently offending against the genuine character of lyric song by lengthened trains of moral reflection."

When the lyric poetry of Greece had reached its perfection in Pindar, its drama rose into shape and grandeur in the tragedies of Æschylus. But for the history of the progress and decline of the Greek drama, tragic and comic, the reader is referred to the article DRAMA in this work.

Decline of Greek poetry. Alexandrian school.

Little remains to be said of the declining portion of Greek poetry. General corruption, introduced by luxury, and the evil principles of the sophists; loss of liberty, when all the powers of Greece had yielded to the sway of Alexander; the introduction of a tumid oriental taste into eloquence and composition in general; such are the features which mark the period from the rise of Alexander the Great to the extinction of the poetical literature of Greece. After the death of Alexander, indeed, a strong effort was made by the Ptolemies to render Alexandria the rival of Athens, and to assemble about their court poets, orators, and men of science. In the latter point only their efforts were successful. Science continued to flourish, and long after Greece had ceased to produce any great works in the fine arts, we find geometrical invention carried to a height by Euclid, whilst the wonder-working science of Archimedes struck the Romans at the siege of Syracuse with terror and astonishment. But eloquence remained, as before, hollow and pompous, whilst poetry was in a great measure wasted in the vain attempt to give life and interest to the abstractions of science. This was the period of the learned or didactic poetry. Mythology, astronomy, botany, were the favourite subjects to which the art of the poet was devoted. One attempt, however, to revive the epic taste is visible in the elegant Argonautics of Apollonius Rhodius. He cannot indeed be regarded as an epic poet, for he wants fire and originality; but he is a graceful compiler of traditions, the effect of which he heightens by occasional touches of tenderness.

Pastoral. Theocritus.

The most interesting, however, and by far the most original, of the works of the decline of Greek poetry, are the Idylls of Theocritus (270 B. C.). One is at first surprised to find the appearance of the bucolic or pastoral poetry, so late in comparison with the heroic, the lyrical, and the dramatic. As it seems to paint a primitive period of human nature, we are led to think that it would be one of the first forms in which poetry would appear. The truth is, however, that it has generally made its appearance, and has always been most popular, in ages of great social refinement, when excess of luxury in the life of cities drives the mind back upon the supposed simplicity of rural life and its occupations. Such was the case with the Greek Idylls of Theocritus, with the Bucolics of Virgil; with the pastoral dramas of Tasso, Guarini, and Bonarelli; and with the pastorals of Pope and Phillips. They are all the growth of a period of great literary refinement. Frederick Schlegel observes justly, however, that there is an essential error in isolating pastoral poetry, as is generally done, and viewing the country life abstracted from its due situation in that picture of the world and of human life which it is the province of poetry to unfold. "Let us reflect for a moment on those passages in the heroic poems of antiquity, or in the chivalric romances of the moderns, which afford us glimpses of the simplicity and repose of rural manners. Their simplicity appears still more innocent, and their repose still more peaceful, from the situation in which they are placed in the midst of the guilty tumult of wars, and the fierce passions of heroes. Here everything appears in its true and natural connexion, and the poetry is as varied as the world and the men which it professes to represent." It is certain that this treatment of the rural life as a department of life, by narrowing within the most confined limits the materials of the poet, is the cause of that monotony which is generally found to pervade pastoral poetry. Nothing, in fact, becomes more wearisome than the repetition of Arcadian descriptions of the golden age,

> Lactis uberes
> Cantare rivos atque truncis
> Lapsa cavis iterare mella.

But this fault is more prominent amongst the modern, particularly the Italian pastoral writings, than in Theocritus, who has in general painted his shepherds and peasants with a natural and manly simplicity, approaching even, as it seems to modern ideas, to coarseness. His Idylls, as indeed the name implies, are little poetical pictures or representations in miniature, sometimes of mythological subjects, at other times of matters of common life, but almost always amatory in their purpose and termination. With Theocritus may be classed, though far inferior to him in vigour, the "showy Bion and the delicate Moschus," the last names of any note which precede that period of exhaustion, when, the days of high imagination and great works being over, those of mere cleverness and neatness of execution, of slender trifles, epigrams, and anthologies, commenced.

LATIN POETRY. Its rise.

But as the genius of one nation, yielding to the force of circumstances, declines, nature seems to provide a principle of compensation in the development of that of another. The course of literature and poetry appears to resemble an arctic summer, in which the sun scarcely dips in one quarter of the horizon before he re-appears in another. While the creative energies of Greece either sink into barrenness or expand into a rank and unwholesome luxuriance, as her morals are corrupted, and her liberties impaired and at last extinguished, we perceive in the Italian peninsula the rise of a national character and a literature, destined, alike in arts and arms, in polity or in literature, to give laws to the world.

This not till centuries after the existence of Rome.

Yet Italy, free and independent as she was, and animated by a consciousness of national pride and growing power, exhibits during the first five centuries of her history (735 B. C. to 253 B. C.) a mere blank, so far as poetry is concerned. That she *may* have possessed legendary ballads founded on those various mythic or semi-historical traditions which were afterwards interwoven by Livy into his history of Rome, is not improbable; but of the nature of these we know nothing, of their existence at all we have no certain traces; and nothing can be more fanciful than the extent to which Niebuhr, Schlegel, and other German writers have carried their conjectures on this subject.

ivius Anronicus.

In fact, we know nothing of Roman poetry prior to the introduction of the Greek language and literature, through the conquest of Tarentum (272 B. C.) and Magna Græcia; soon after which the rude attempts of a Greek slave, Livius Andronicus, to translate the Odyssey of Homer into Latin (240 B. C.), first gave the victors some idea of the poetical treasures of that nation, to which, though victors in the field of warfare, the Romans felt their inferiority in the more peaceful domain of literature. His preferring the wilder and more homely of Homer's poems to his more imposing, elaborate, and dignified performance, only showed that he rightly apprehended the tendencies of an infant taste. Children as they were in poetry, the power of the marvellous had attractions for the Romans, which that of simple yet heroic truth would probably not have possessed. The efforts of Andronicus to diffuse a taste for Greek literature did not stop here; for he was the translator also of several specimens both of the tragic and the comic drama of Greece.

nnius.

He was succeeded by a Roman poet of original though coarse and unequal genius, Ennius (239 B. C.). Yet, with strong originality of mind, he was a worshipper of Greek literature; and his influence on his successors is probably owing in a higher degree to what he transplanted from the soil of Greece, than what he reared from the independent stores of his mind. He attempted by turns, epic, tragic, satiric, epigrammatic, didactic, and even acrostic poetry. He versified the Roman Historical Chronicles, a poem of which few specimens survive, but these calculated to excite much regret that a work, executed with so much force and feeling in parts, should have been irrecoverably consigned to oblivion. His vigorous and forcible style, with all its rudeness, conceits, and ridiculous jingles, appears in its better parts to have possessed great charms for the best judges of diction at an after period; for we find that Virgil, Lucretius, and Ovid, and particularly the first, have availed themselves most liberally, not only of the ideas, but of the precise expressions, and frequently whole lines, of Ennius;[1] while Horace, who seems to have had a warm feeling of the poetical fire that lay under the rude crust of the verses of Ennius, after citing two of his lines, says that the "disjecta membra poetæ would appear visible," however their arrangement might be transposed; a result which, he fairly admits, would not be the case with regard either to the satirical works of Lucilius or his own.

lautus d Tence.

Neither in Ennius, however, nor in his dramatic successors, Plautus (died 184 B. C.) or Terence (born 195, died 159 B. C.), do we meet with much that is truly national. In all we are in fact perusing Greek compositions in Roman forms; for the plays of Plautus and Terence present to us, not the aspect of Roman life, but the state of Greek society, pretty much as it had appeared in the days of Menander. In the former we perceive more vigour, more variety, broader humour, but at the same time more coarseness; in the latter a limited invention, and characters reducing themselves to a few limited classes, generally an over-indulgent father, a profligate son, a rapacious mistress, and a knavish slave; to which Plautus is fond of adding some Bobadil or parasite, by way of relief. Yet in Terence's case we perceive the traces of genius, notwithstanding the close imitation by which he is fettered. His characters have a truthful air, his dialogue is always free from affectation, and sometimes touching and tender in the highest degree. In fact, a few of his best passages in this style are models of apparently artless and yet consummately artful and beautiful expression.

Lucretius.

Two other individuals of distinguished genius precede what is called the Augustan period of Roman poetry, Lucretius and Catullus; the one the most distinguished of the Roman didactic poets, the other unequalled in the short and tender lyric. Lucretius contended with an absolutely unmanageable subject; one which, from its unimaginative character, from the dreary details, psychological, meteorological, geological, which it necessitated, the inherent feeling of discomfort which it leaves behind, and the irreligious character of the opinions which it involves, necessarily interposed the most formidable difficulties in the way of the poet, which it is no disgrace even to the most distinguished genius, and such Lucretius possessed, not to have entirely overcome. It is, in fact, the highest proof of the ability and genuine inspiration of Lucretius, that he has infused a poetical vitality even into the dry bones of that philosophical mummy which he was attempting to animate; that he has treated with a feeling of poetical enthusiasm the coldest and most heartless of all creeds, the Epicurean; so that the very strains which he has employed in combating the belief of the immortality of the soul, bear upon their face the stamp of immortality. "In inspiration and in sublimity," says Frederick Schlegel, "he is the first of Roman poets; as a painter and worshipper of nature, he is the first of all the poets of antiquity whose writings have come down to us."

Catullus.

In Catullus the Epicurean theory, which wears a majestic aspect in Lucretius, appears in a less dignified but more probable form. *Carpe diem* is the motto which might be inscribed over all his compositions; yet with this enjoyment of the present mingles not absolutely a melancholy, but a pensive feeling, which gives a peculiar interest to them all. For compositions of a higher mood and more extended plan, Catullus apparently had as little ability as inclination; his taste was Grecian, and formed in the school of Alexandria; slight performances, epigrams, elegies, little lyric effusions expressive of individual feelings, like the charming lines to Sirmio, or the lament for the sparrow, and polished with the most exquisite felicity of diction, were the subjects to which his talents were devoted. There is, in fact, every reason to believe that his more ambitious performances, such as the Epithalamium of Peleus and Thetis, and the Atys, were simply editions in a Latin form of Greek originals.

The poets hitherto mentioned belong to the period of the republic; in their successors, the poets of the Augustan period, we perceive a considerable change both of spirit and expression. Under the calm but firm sway of Augustus, which had reduced all the contending parties under one powerful dominion, and conferred upon the country the blessings of peace, the art of poetry was peculiarly cultivated and patronized. And it is at this period that the Roman poetry first displays in its fullest extent that feature which Frederick Schlegel considers its truly national and original trait, namely, that exaltation of Rome and of the Roman character; that feeling of the unrivalled energies, the rapid growth and ever-increasing dominion of their country, which formed, to the imagination of the poet at least, an ample compensation for the loss of that liberty which, since the commencement of the troubles of the Gracchi, or the contests of Sylla and Marius, had been little better than a political phantom, or a party watchword with no real meaning.

Virgil.

The great representatives of this Augustan period of poetry are Virgil and Horace. No two poets could be more dissimilar in the direction of their tastes, and yet it would be difficult to say to whom the palm of greater genius ought justly to be assigned. Even in his Pastorals, though an early work, the leading qualities of Virgil's mind, his exquisite taste and fine sensibility, are apparent, though they can hardly be considered in any other light than as graceful adaptations, and, it may be safely added, *improvements*, of the subjects and manner of Theocritus. In these he was painting from a painting; he was copying a Greek landscape in the colouring of the Latin tongue. But in his Georgics he drew from his own observation of Italian nature; and, bringing the native excellencies and qualities of his mind to bear upon imagery and events and associations which nature and experience had dictated, presenting us with delicious landscapes varied by all the natural occupations of the Italian agricultural life, gilded by sunshine, clouded by storm, or darkened and disturbed by tempests; combining these in the most dexterous manner with striking allusions to well-known events and catastrophes of Roman history, such as the prodigies which portend the death of Cæsar, or with old mythological traditions; and making the driest details of husbandry, such as the grafting of trees or the breeding of bees, prolific of imagery or of fable consecrated by early associations; the result is one of the most original and at the same time delightful poems which exists.

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[1] Dunlop, History of Roman Literature, vol. i. p. 21.

The Æneid was a great, but, it must be admitted, unsuccessful attempt to do that for Rome and the Roman people which Homer had done for Greece, namely, to give the Romans a great national poem. No one felt this failure more than Virgil. His reluctance to give publicity to the Æneid is well known. He could only be prevailed upon to read to Augustus the first, second, fourth, and sixth books. Several causes may be obviously assigned for its want of success. 1*st*, Not only did Virgil, from the intense admiration he felt for Homer, copy in many respects his characters and design; but he endeavoured to combine the distinct and almost incompatible characters of the Iliad and the Odyssey, the grand and warlike character of the former with the wandering and adventurous character of the latter poem. 2*d*, Although the notion of grafting the adventures of Æneas upon the origin of the Roman nation, was in itself a happy one; and the mythological traditions connected with it might have been brought to bear with much effect upon the subject; Virgil committed the great error from which Tasso has also suffered, of making an epic poem a mere instrument of political flattery, by identifying the character of his hero with that of Augustus. By depriving himself of the open and untrammelled field which the traditional character of Æneas presented, and making that character a mere portrait, *en beau*, of the cold-blooded, calculating, and critical emperor, he lost at once all hold over the sympathies of the reader in the fortunes of his hero, a cardinal point in all poems that pretend to the character of epic. 3*d*, Nay, he even enlisted those sympathies against him; for, as Voltaire, who is seldom wrong in what may be called the logic of poetry, observes, he represents him as a mere adventurer, who in the first place is guilty of the most shameless want of feeling in regard to Dido, whose sole object is to acquire a settlement in Italy; who, in breaking off the match of Turnus with Lavinia, is instigated, not by passion, but by policy; and who would in all probability have most willingly surrendered the Latian princess to his brave and generous though cruel rival, if *he* would have resigned the kingdom of Old Latinus to a Trojan stranger, and taken Lavinia, like Cordelia, without a dower.

Only one substantial addition has been made by Virgil to the characters of Homer, and for that character he may have received some hints from the Ariadne of Catullus; but it must be admitted to be one of the most deeply interesting in poetic fiction, we mean that of Dido. The great night-picture of the sack of Troy, and the episode of Dido, are indeed the finest things in the Æneid. In the character of the Carthaginian princess, we perceive the infinite advance which the delineation of the passion of love has made since the time of Homer. Virgil has begun to comprehend that feeling, with the world of emotions to which it gives birth. And if he has not painted it with all that purity and depth which was imparted to it by Christianity, he has exhibited its leading traits with a warmth and sensibility which make all the other classical delineations of passion both cold and lifeless beside that of Dido.

Horace.

Horace exhibits the singular specimen of a poet borrowing half his thoughts from the lyric writers of Greece, and making his odes a mosaic formed from the gems of other countries as well as his own, and yet imparting to the combination a high degree of unity, and a decided originality of character. Calm wisdom, shrewd penetrating observation of life, a sober enthusiasm, and most refined taste, are the qualities which most distinguish him, imparting to all his compositions extreme point, terseness, and occasionally, in themes of a higher cast, particularly those connected with the elder worthies of Rome, or the lofty position she then occupied in the eye of the world, a stately and solemn grandeur. This admirable balance of mind which distinguishes Horace, and informs all his writings with such pregnant good sense, renders him a peculiar favourite in a country like our own, whose national character is marked by not a few of those features that distinguished the mind of the poet. Hence his odes are more read and quoted, particularly by men of business and practical sagacity, than the works of any of the classic poets.

But the merits of Horace, though most conspicuous as a lyric poet, are great also as a satirist. Lucilius had indeed made the first approach to the regular form of Roman satire; but his rude and harsh effusions can no more be compared to the polished and graceful productions of Horace, than the rugged verses of Donne can be compared with the satires and epistles of Pope. In Horace all follies and lighter vices of the day (for he seemed to think satire scarcely a fit weapon when directed against the darker vices) are touched on in a strain of the most urbane ridicule, which insinuates reproof. As compared with those either of Lucilius who preceded, or of Persius and Juvenal who succeeded him, the tone of the Horatian satire is light and playful. It has been correctly observed, that these satires filled up for Roman literature exactly the department which in our times is occupied by the stage. For as the plays of Plautus and Terence truly represented Greek and not Roman manners, it was in the light form of satire that all those humorous follies and oddities of Roman society, which properly fall within the range of the comic, were displayed and exposed.

The elegiac poets.

The elegiac poets of this period, Tibullus and Propertius, wrote with purity and good taste; the former with more of tenderness, the latter with more of force and mental vigour. But in the extravagant luxuriance and frequent conceits of Ovid, we perceive the commencement of that decline of poetry, which, relieved only by the manly vigour of Juvenal's satires, goes on in rapidly-increasing progression to the extinction of the Roman empire. For the amatory and elegiac poems of Ovid little can be said; they want heart and passion as much as delicacy or propriety of sentiment. But the praise of a teeming fancy cannot be denied to him; he is a mine from which thoughts and expressions may be dug without end; and his Metamorphoses, as a graceful exposition of the finest mythological tales of antiquity, will always retain their interest for modern times.

Juvenal

We pass over the so-called tragedies of Seneca, the works of a mere school rhetorician; and the satires of Persius, obscure and rugged, though not without a masculine energy. But the name of Juvenal must be mentioned as the last great poetical name that illustrates this period of decline.

In the finer portions of his satires, for it must be admitted they contain a good deal that is level and prosaic enough, he displays the highest talents for this species of poetry; the strength of his language, the fire of his invective, correspond with the gigantic character of the vices which he exposes. But a certain air of exaggeration mingles with and alloys the effect of his censures; we are led to think of the doubtful character of his own life, and to question the title of the moralist to raise the scourge which he applies with such severity to others. A tinge, in short, of that rhetorical and formal character which his mind appears to have contracted in the schools of declamation attaches to his poetry, and leaves an impression of hollowness and insincerity upon the mind.

Lucan.

Lucan's Pharsalia, it must be recollected, was a comparatively boyish effort; but it seems plain, from the character of his mind, that he wanted the highest of the poetical faculties, imagination. He uttered bold and striking thoughts occasionally in the happiest words. No poems afford finer specimens of single lines for quotation than Lucan. But the whole is destitute of poetical warmth; it blazes only with a phosphoric fire. Quinctillian has, in fact, hit with admirable tact the character of Lucan's mind in the remark, "Si dicam quod sentio, oratoribus magis quam poetis annumerandus."

We shall not here touch upon the remaining writers who feebly kept alive the vestal fire of poetry up to the period of the overthrow of the Roman empire of the west; Statius, Claudian, or Ausonius. Even the introduction of Christianity, much as it did towards improving morality, not only among its votaries, but amongst the Pagan nations themselves, could not re-animate to new life the worn-out and enervated frame of literature. That could only be effected by sweeping away entirely the old landmarks, making a new heaven and a new earth, creating new associations in all the ideas of men, giving them new hopes, aspirations, and pursuits, and thus restoring that elastic principle of moral and mental vigour, of faith and enthusiastic feeling, out of which all high poetry must spring. From the rude but warlike and uncorrupted nations of the North was to come that influence which was to give a new aspect to society; at first, like the descent of a deluge, sweeping the remains of cultivation before it, but ultimately depositing and carrying deep into the bosom of the soil the elements of a reviving and healthy fertility.

POETRY OF MODERN EUROPE.

From the fall of the Roman empire of the West, about the close of the fifth century after Christianity, to the appearance of the first great poet of modern Europe, Dante, an interval of seven dreary centuries elapses, a period characterized in popular language by the epithet of the dark ages. During this period the chaos resulting from the overthrow of the old Pagan constitution in religion, government, laws, and social institutions, was gradually settling into shape; the new religion was incorporating itself with and imparting a new form to social life; new laws superseding the subtile and complex jurisprudence of Rome, new languages growing out of its ruins. During the greater part of the period to which we have alluded, literature, in any high sense of the word, did not exist; but the materials of new literatures were accumulating, and the spirit which was to give them breath and vitality, when language should be sufficiently settled for the purpose, was developing itself, though manifesting itself in other fields and departments than that of poetry. When poetry re-appeared in the thirteenth century, the influence of the intermediate changes which the human mind had undergone became visible in certain marked traits, separating by the broadest distinctive lines the character of the modern European from the ancient classical poetry. A few of these, as applicable to all the modern literatures of Europe, though with differences in degree, may be indicated before proceeding to any notice of these separate literatures.

1. The first and most important is the influence of the Christian religion on the productions of the imagination.

The Pagan religions were mere religions of the fancy; they were nothing but the poetry of humanity. They dealt only with the palpable and the material; and by the combination of the finest features of the actual, they produced an ideal which each moulded to his own fancy. The conceptions of the infinite and the immaterial they avoided. The solemn and the mournful found no place in their thoughts, or, if such ideas did intrude, they were made use of as arguments for present enjoyment. Let us eat and drink, seems the moral of paganism; let us eat and drink, for tomorrow we die.

From this materialism of the ancient mythology, and its purely imaginative character, the results were, 1*st*, great clearness in all its conceptions and its expressions, that clearness which is imparted by the absence of all that is not palpable to sense; 2*d*, a light and cheerful tone, the natural product of that mental indifference, and absence of serious reflection, which the disbelief, or as least doubt of immortality, would produce; 3*d*, the feeling of *beauty* as the object aimed at and accomplished, and the vital principle of all the classical creations.

Very different were the character and the influence of Christianity. This was a revelation, not a creation of the fancy. It spoke to the heart, to the hopes and fears of men, not merely to their imaginations. The outlines of the Christian theology were communicated in a fixed and settled form, with which fancy could not deal at will, or mould them in accordance with its notions of beauty. It excluded at once that plastic power which had formed the excellence of Greek art and literature, and banished mere *beauty* as the aim of the poet, or the principle of modern inspiration.

To the clearness, the sunny lightness of touch, the cheerful levity of tone, which distinguish the classic poetry, it was equally unfavourable. It made the mind familiar with the ideas of infinity and eternity; it accustomed it to abstract conceptions beyond the pale of sense, or the scope of distinct expression; it forced upon its consideration the immaterial and the invisible, as constantly as the Pagan theology had confined the attention of its votaries to the visible and the actual. The Pagan clearness of portraiture, and smiling lightness of tone, were incompatible with the description of regions and states of being, sights and sounds, which eye had not seen, nor ear heard, and which it had not entered into the mind of man to conceive. The Christian poet, before whom, instead of a natural and visible Olympus and Acheron, there stretched out in dim but awful vision the conception of heaven and hell, encompassed by an eternity on this side and on that,—a conception impressed by the sense of moral responsibility, and of eternal punishment or happiness, and animated by a principle of faith based upon things not seen,—could not but carry into the literature which was the expression of his thoughts, and hopes, and fears, some shadow of that solemnity and mystery with which human life was now surrounded. He left this narrow spot of earth, already in the possession of his predecessors, to open up the new and undiscovered country of the abstract and the invisible; and the principle of poetical inspiration which they sought in beauty, he found in *grandeur* and *sublimity*. Hence earnestness and profundity are the means of effect in the literature of Christianity; and elevation rather than beauty may be said to be the aim of the higher poetry of the moderns.

2. The superstitions which grew out of the corruptions of Christianity, and which assumed a systematic form after the crusades had opened to Europe a communication with the East; the belief in spectres, fairies, witchcrafts, and the di-

rect interposition of evil spirits in the affairs of men; gave a different character to the modern literature of Europe. It is true, that in the Canidia of Horace, the Erichtho of Lucan, the Thessalian scenes of enchantment in the Golden Ass of Apuleius, and occasionally in other passages of the classical writers, we have allusions to popular superstitions somewhat analogous to our own; but it is equally plain that these are not matters of serious belief, but of poetical embellishment. They could not, in fact, cohere with any consistency with the framework of the antique materialism, though they might be combined with a religion which assumed the existence of powers unknown to human sense, and of a principle of evil, which, with limited powers, was permitted to oppose the principle of good. These conceptions of immaterial beings distinct from men, but influencing their actions, assumed a reality and appearance of probability, which soon rendered the belief in their existence one of strong practical influence upon society, and of course upon literature. Hence the gloomy and superstitious character impressed upon many of the earlier productions of all nations; and which, during the fifteenth, sixteenth, and seventeenth centuries, manifested itself in such fearful action in the atrocities of the trials and executions for witchcraft.

3. Whilst the Pagan mythology affected only the imagination, Christianity appealed to the conscience, and was calculated to operate practically upon conduct. We see, accordingly, in the history of the middle ages, that religion was not, as it becomes in after ages, a mere profession, often assumed from habit, but a principle of faith, of conviction, and of serious action. We see, through this invisible but powerful agency, a spiritual throne established at Rome, to which, weak and insignificant as it appeared in physical and economical resources, the most powerful monarchs in Europe were content to bow with implicit obedience. During the middle ages, the possession of the keys of St Peter was found a more effectual instrument of supremacy than the temporal sword. We perceive the clergy looked upon as a superior race; their persons and possessions considered as sacred; the rudest and boldest nobles of the time trembling at the thought of their anathemas, courting absolution at their hands, soliciting dispensations, founding monasteries and cathedrals, undertaking penances, pilgrimages, and crusades; and we see them often, in the midst of the fierce career of warfare, as if struck by some sudden inward but irresistible impression, throwing down the sword, exchanging the helmet for the cowl, and wearing out, as is told of our own Guy of Warwick, the evening of a stormy life in the peaceful cell of the hermit. There was in all this much of error, much of impure feeling and doubtful character; but there was also much of truth, much of earnestness; and hence faith and devotion are as visibly stamped upon the literature of the middle ages, as they unquestionably were influential upon its life.

4. Apart from the influence of religion, although not unconnected with it, there were other social changes which had strongly affected the course of feeling and opinion, and could not fail to render themselves visible in literature as soon as it began to assume a regular form. The most important of these was the institution of chivalry, growing out of, and affording an imperfect remedy for, the defects and evils of feudalism; an attempt, in fact, to create a species of police or constabulary, founded upon those principles of generosity and honour which were frequently found associated in the human mind with cruelty or licentiousness, during those stormy days of feudal dominion.

It was not, however, on its warlike and serious side that chivalry exhibited any very novel features; for, as far as regarded merely its spirit of adventure, numerous parallels might be found in ancient story to the exploits of its votaries. The feats of Theseus with the Minotaur, the story of Perseus's deliverance of Andromeda, the Argonautic expedition of Jason in search of the golden fleece, the more celebrated expedition against Troy, all closely resemble the exploits which chivalry prescribed to the members of its order. The true point of view in which chivalry gave a new direction to the opinions of the age, and a new impulse to literature, was in the altered position which it gave to women. It is certain, that before chivalry was known, nay, before Christianity was introduced, a peculiar reverence for women had been shown by the Gothic nations. Tacitus, in his treatise on the manners of the Germans, adverts to this as one of their characteristic features. "Inesse iis etiam *sanctum aliquid* et providum putant." The introduction of Christianity ratified and consecrated this feeling of respect. It made woman the equal and companion, not the slave, of man. But chivalry went a step farther. It reversed the relations in which the sexes had stood during the classical times, and exalted, in theory at least, the softer sex above the stronger and the more warlike. As the best means of arming the helpless against the powerful, it surrounded them with an angelic atmosphere of sacredness, and converted love into adoration, respect into religion. Here, too, there was something affected, but much more that was genuine. This feeling, exaggerated as it seems to us, did unquestionably influence in a high degree the opinions of the age, their tastes, their modes of expression. Its effect upon modern literature has been most remarkable. It has rendered the principle of romantic love almost the mainspring of modern poetry, and of imaginative composition in general. It forms almost the sole subject of the poems of the Troubadours, the minstrels of the south of France, Spain, and Italy, with whose compositions the history of modern poetry properly commences. Dante, the father of the Italian language and poetry, finds the source of the inspiration which dictates his sonnets and canzoni, and at last the *Divina Commedia* itself, in this species of romantic adoration for a deceased mistress. Petrarch's poetry, and his deification of Laura, are one and the same thing. The lyric poets of the fifteenth and sixteenth centuries of Italy seem to have scarcely conceived that any other course than that of imitating Dante and Petrarch in this chivalrous Platonism was open to them. The principle of romantic love is carried by Pulci, Boiardo, and Ariosto to an excess which communicates to it an air of the ludicrous; a reproach, however, from which it is again redeemed by the serious and enthusiastic Jerusalem of Tasso. When in modern times the attempt was made to revive tragedy, it proved totally unsuccessful, until this principle was admitted into the drama to give it warmth and life. Of that species of composition which in its proper sense is peculiar to the moderns, viz. the novel and romance, it forms, as we all know, the moving power. In short, it influences, more or less, every department in which the imagination has exerted itself with success since the revival of literature.

5. Another point in the social institutions of the time, which affects in a considerable degree the spirit of the literature of the European nations in the outset, is the relation of feudal vassalage, the degraded condition of the mass of the people, and the subdivision of the state into so many separate baronies, within each of which its feudal lord exercised supreme authority. This subdivision annihilates that inspiration of *patriotism*, or attachment to country or state, which is very visible in the Roman literature, and more faintly in the Greek, and introduces in its stead the principle of *loyalty* or implicit obedience to the individual superior to whom fortune had given the right of disposing of the destinies of his vassal. Submission to authority under all circumstances, without remonstrance, is represented as the highest of virtues; and a violation of this principle cannot be palliated by any exhibition of courage or self-devotion. A fine illustration of this principle in the moral code

of the feudal times occurs in Schiller's fine ballad of the Fight with the Dragon, founded on a story given as authentic by Vertot, in his History of the Knights of Malta. Rhodes was laid waste by a monstrous serpent, which has already destroyed not a few of the knights of St John, who had been rash enough to engage in combat with it. The grand-master, accordingly, had strictly prohibited any of the order from engaging in the apparently hopeless attempt. One young knight, unable to witness with patience the spectacle of the misery and distress daily caused by the ravages of the monster, ventured to despise the prohibition, and, by dint of art and valour combined, delivers the island from its persecutor. He was conducted in triumph to the hall, where the knights were met in council. The grand-master received him in gloomy silence, reminded him that *obedience* under the Christian creed was the first of virtues, and banished him from the island. The knight, conscious of his error, bowed in silence, divested himself of his knightly mantle, kissed the hand of the master, and was about to go. The stern superior was softened; he called him back, and, presenting him again with his sword and mantle, informed him that his prompt submission and penitence has restored him to the rank which his disobedience had forfeited.

6. One other feature is strikingly characteristic of the earlier literature of Europe, although good taste at a later period has pretty well weeded out its traces, viz. the singular and incongruous mixture of science with poetry. The literary men of the time were learned men, familiar with theology and with the writings of the ancients, and delighted with the abstractions and refinements of a mystical theology and a scholastic logic; and that which interested them in reality, they unconsciously incorporated with their poetry. This tendency tinges the whole Italian poetry, from Dante to Ariosto. Petrarch, even while singing of love, cannot allow the subject to pass without some learned and complimentary allusions to Aristotle. The Spanish lyric poetry of Boscan, Garcilaso, and their successors, is a sort of versified Platonism. The verses of Ronsard, and the other worthies composing that poetical constellation which arrogated to itself the name of the Pleiades, are so full of learned allusions as to be absolutely unintelligible; and the influence of this somewhat pedantic exhibition of ancient literature is undeniable even in our own Milton.

Poetry during the middle ages.

Having premised these remarks on some of the characteristic features of distinction which separate the religious, reflective, warlike, and mystic poetry of modern Europe, from the airy, graceful, and transparent spirit of the classical, we may observe, that although, as we mentioned, nearly seven centuries elapsed before the appearance of any poet of permanent European reputation, poetry was not entirely idle during the intervening period; but, on the contrary, towards its close at least, in a state of high activity and fertility of production. Scarcely, indeed, had the different languages of Europe begun to arrange themselves into form, before poetry in a rude form made its appearance. Perhaps in Germany the cradle of the modern poetry of Europe may most probably be found. By the time of Charlemagne, it is certain that country contained a vast mass of legendary poetry, which was carefully collected, committed to writing by the directions of the emperor, with a view to preservation, but of which scarcely a traditional fragment now remains. Earlier than the time of Charlemagne (A. D. 740 to 814), in all probability, were the lays of the Nibelungen and the Heldenbuch composed, though they have descended to us only in the altered form given to them when recast by Henry of Afterdingen. The former carries back its scenes to the days of Attila the Hun; and in truthful simplicity and vividness of painting, its homely and nervous verses are even yet worthy of admiration. A fund of bold and rich invention is, in like manner, displayed in the Sagas of Scandinavia, the mythology of which, at a later date, came to exert a strong influence over the poetry of Europe.

Provençal.

The Provençal language, the first-born of European tongues, in which Thebaut afterwards sung, and Cœur de Lion expressed his complaints in prison, we find moulded into form about the close of the ninth century. The Provençals had undoubtedly borrowed many things besides rhyme from the Arabian literature of the Peninsula, for an oriental spirit is visible in many of their compositions, and much of their imagery. But, on the other hand, they added much from their independent stores; they widely extended the domain of poetry, gave it spirit as well as refinement; they even rendered it, as Villemain observes, a substitute for the liberty of the press; while their forms of versification, canzoni, sonnets, sestine, madrigals, &c. soon became the patterns adopted by all the southern languages of Europe. Their compositions, introduced into Germany through the Hohenstauffen emperors, instantly communicated a marked impulse to German poetry: the numerous band of the Minnesingers of the twelfth and thirteenth centuries are, in fact, the Provençals of Germany.

Trouveres.

In the north of France, again, arises, during the same period, the literature of the Trouveres; a literature of satires and legends, and tales of knavery, licentious gallantry and adventure, destined afterwards strongly to influence the direction of the genius of Boccacio, and his successors the Italian novelists, and to furnish the amplest materials for later writers of fiction. Nor during this creative period were fictions of a higher cast wanting.

Three cycles of legendary romance.

Three leading cycles of romance may indeed be pointed out, which owe their origin to this period. The first consists of the legends of Gothic, Frankish, and Burgundian heroes, during the times of the great northern emigrations, of which the Nibelungen and the Heldenbuch are the depositories; legends breathing a purely northern spirit, and generally having some foundation in history: the second, those which embody the traditions as to Charlemagne's wars against the Saracens, the achievements of his court of Paladins, and the "dolorosa rotta" at Roscesvalles, where he is represented as perishing with all his peerage. In these Charlemagne is strangely represented, not as a most warlike and energetic monarch, but rather in the garb of a lazy and luxurious eastern sultan; a perversion of historical truth which, Frederick Schlegel thinks, must be accounted for by the poems which refer to the emperor having been chiefly written by Normans, who drew their notions of Charlemagne from some of those faineant monarchs of their own days, whom they saw in possession of his throne. It is certain, at all events, that the legends connected with Charlemagne soon became largely interwoven with incidents of a comic cast, and with a mass of absurd and fantastic machinery. The third class of romantic traditions then first embodied in poetry are those relating to the fabulous Arthur, "begirt with British and Armoric knights;" by far the most interesting of which is the celebrated legend of a pathetic and elegiac character, which bears the name of Tristan or Tristram. "Among all the great and epic poems of love and chivalry in the middle ages," says Frederick Schlegel, "the first place is given by all nations to Tristram; but that we may not be fatigued with uniformity of fiction, the airy and lively legend of Launcelot is placed by the side of its more grave and elegiac representations." He traces also in these legends of Arthur and the Round Table a double purpose; an allegorical character, viz. an attempt to shadow forth the ideal of a spiritual and Christian knighthood, imparting to them in general a higher character than to the corresponding traditions of Charlemagne.

The Monkish hymns.

One other class of the compositions of the middle ages may be alluded to, their monkish hymns, written in Latin, that is to say, the bastard Latin of the period, and generally in rhyme. They cannot indeed be praised for their novelty of thought, or high imagination; but their earnestness of purpose, whether in describing ideas of terror or pity, and which was the expression of one belief and one heart pervading many nations, give them a considerable hold over the mind. No one can be insensible to the awful grandeur of the *Dies iræ, dies illa,* which Roscommon, who translated it into English, is said to have died repeating; or the simple pathos of the *Stabat mater dolorosa,* which, even divested of the charms of Pergolesi's music, speaks to the heart. Of nearly equal beauty are the *Jam mœsta quiesce querela* of Prudentius; and the *Ave Maris Stella,* being an invocation to the Virgin, which may still be traced in the songs of the boatmen of the Mediterranean. The forcible impression made by these simple sacred hymns on the mind of Dante is obvious, from the manner in which lines or portions of lines from them, are here and there woven into the *terza rima* of his great poem.

It cannot therefore be said that the middle ages were an unpoetical period. On the contrary, there was then a very general diffusion of poetic feeling. But the poetry to which it gave rise was not marked by any of those works of excellence rising conspicuously above the rest, which attract attention to the names of the authors. Its productions are chiefly anonymous; its poets have died and made no sign. A great genius was still wanting to form an epoch in the annals of poetry; but that genius was found in Dante, about a century after the Tuscan dialect had assumed a predominance over the other dialects of Italy.

ITALIAN POETRY.
Dante.

The Divine Comedy of Dante (born 1265, died 1321) is the first work of distinguished and original genius which graces the literature of modern Europe; and it is in many respects a most striking and remarkable production. It is not, as the name would import, a drama; as little does it resemble an epic poem; it is an allegorical pilgrimage through heaven, hell, and paradise, which the poet has peopled with human shapes, human passions and crimes. He has made his poem an instrument through which he vents his political loves and hatreds, his vast and undigested learning, his scholastic acuteness, his mystical philosophy, his reverence for the ancients, his sympathy with the spirit of freedom, the enterprise, the enthusiasm of the moderns. It resembles, in fact, the Homeric poems in its encyclopædiac character. The poet stands, as it were, on an isthmus, from which he can cast back his glances across the tumultuous and still heaving chaos of the middle ages, into the serener regions of the past, and forward into a futurity of which he foresees and foretells the coming glories. Many, no doubt, had been the allegorical compositions which went before him; the Roman de la Rose, indeed, still survives, in the translation of which Chaucer wasted so much of his earlier powers; but all have been thrown into shade, and it may be said effaced, by the grasp, magnificence, and sombre power, combined with deep human feeling, of the great allegorical pageant of Dante. For in this last quality, quite as much as in the attributes of sublimity and grandeur, which are universally conceded to him, lies the secret of that perennial charm of freshness which still gives interest to the *Divina Commedia.* Amidst the darkest scenes of infernal punishment some soothing objects or images are constantly introduced to lighten our pilgrimage, and flowers are made to spring up beneath our feet, as if to freshen the path "over the burning marle." His wearisome metaphysics have long ceased to please; his mystic raptures, his pictures of the celestial occupations of the saints, appear almost ludicrous; his demons and his Satan grotesque rather than impressive: but the deep pathos of the story of Francesca of Rimini; the thrilling scenes in the town of Hunger; the few simple lines which tell the story of Madonna della Pia, imbibing a slow but certain death among the swamps of the Maremma, to which she is consigned by a jealous husband; the sweet apostrophe to evening, and the fireside recollections which the sound of the vesper-bell brings along with it: these and such episodes are the passages which linger in the memories of all, and give to the poem of Dante its main hold over the heart.

The imagination, on the other hand, is singularly roused by the scenes of torture and bliss through which we are led, the burning tombs, and cities alive with flame, and valleys of the shadow of death, where serpents torture their victims, and the ever-deepening descent through the circles of hell, contrasted with the cheering light which begins to break upon us in the ascending circles of purgatory, and the refulgence of the visions which greet the wanderer on his entrance into paradise, when he exchanges the guidance of Virgil for that of Beatrice.

Distinct as the imagery in the foreground is, the prospect fades away on all sides into the illimitable, and the imagination has full room to expand itself in the sphere of the mysterious and indefinite. Dante's poem may, indeed, be well compared to that "wild and hoary wood" in which he describes himself as losing his way in the outset, with here and there a path cut through the trees, where the sunshine pours in and shows spots of verdure or still waters, but backed on all sides by dusky labyrinths, inhabited by beasts of prey, into the gloom of which the eye can hardly pierce, and the immemorial stillness of which the sound of human footsteps has never broken.

The style of Dante's poem is scarcely less remarkable than its spirit. Obscure and unyielding, as might be expected, in some parts, it has, nevertheless, a picturesqueness without parallel in modern literature. It makes every object palpable or sensible; flashing images upon the mind with the rapidity and the splendour of lightning. "They are," says Ugo Foscolo, "the bold and prominent figures of an alto-relievo, which, it seems, we might almost touch, and of which the imagination readily supplies those parts that are hidden from the view." It fixed the Italian language, so that at this moment it remains less changed since the time of Dante than any other European tongue.

Petrarch.

As Dante is the head of the Italian allegorical poetry, so Petrarch may be regarded as the founder of the lyrical; borrowing indeed his manner, and not a little of his matter also, from the Provençals, but by a refined taste acquired from the deepest study of the classic poetry, and a sensibility, the liveliness of which was quickened by a real passion, investing their strains with a character of tenderness and perfect finish, which really appear to confer on them a different character. The monotony disappears of which we are conscious in reading the compositions of the Troubadours and Minnesingers, "qui toujours d'un même ton semblent salmodier;" and a wonderful variety of emotions are seen to arise out of a theme which, in their hands, had appeared limited and barren. No one has ever drawn a finer poetical ideal of female loveliness, purity, and worth, than Petrarch has done in Laura. "Every lover," says Herder, "will find *his* Laura in that of Petrarch; he will find his own heart, with all its weakness, and that beneficent influence which the female character in its purity can erect over the disposition of the youth and the man." The verbal subtilties and plays on words which disfigure many of the lyrics of Petrarch no doubt detract from their effect, and excite surprise that one whose taste was in general so pure should have given admittance to such conceits; but, like the puns and equivoques of Shakspeare's time, they were part of the fashion of the day. Petrarch found them imbedded, as it were, in the Provençal poetry from which he drew, and he yielded, like Shakspeare, to the evil influence of the time. Upon the whole, however, the services rendered by him as an Italian poet (for we need not here allude to his great and most beneficial influence on the taste of Europe, by his exertions on behalf of classical literature) have been very great; he sensibly added to the polish, grace, and pliancy, of the Italian tongue; and of the Platonic poetry of love, a love existing rather as a lambent glow than as a flame, and living on as a sentiment after it has ceased to be a passion, Petrarch still remains the purest and the most charming representative. (See the article PETRARCH.)

he Pe-
archists.

It is a remarkable fact, that though the genius of Dante was unquestionably far more masculine, original, and imposing than that of Petrarch, the former left no successors, while Petrarch turned for nearly two centuries the whole current of poetry into the direction of the amatory lyric. Dante was found to be unapproachable; within the circle he had formed, none durst walk but he; but the Platonism of Petrarch, and the apparent simplicity and brevity of the medium through which his tranquil and gentle inspiration was conveyed, appear to have tempted every one into imitation of his lyrics. Hence, until the fifteenth century in Italy was well advanced, its poetry consisted of little else than imitations of Petrarch. But, in truth, though this was not perceived, all the finer essence of Petrarch's poetical character was nearly as incommunicable as that of Dante; and accordingly we find, among the latter Petrarchists, that much of the delicacy and truth of Petrarch, that *feeling* which gives a tempered warmth to his expressions, and calms without chilling the heart, disappears. The raptures of love, and that struggle of passion and reason which so constantly recurs in Petrarch's poetry, are pitched in an exaggerated and falsetto key; the conceits grow more numerous as the feeling grows less intense and real; till at last, of all which their great original had produced, little is found transplanted into their imitations, save the indestructible harmony of the versification.

The fifteenth century, which followed the death of Petrarch, is fruitful in learned men, in grammarians and philosophers, but barren in poetry. The excessive cultivation of classical literature, and the admiration excited by its great models, created a feeling of distaste for Italian composition. Traces, no doubt, of a teeming fancy appear in the unfinished stanze of Politian; and the rustic and carnivalesque songs, both of the great Lorenzo and of Machiavelli, have a merit independently of the interest attached to their authorship. Machiavelli's comedy of the Mandagola has been pronounced by a competent judge to be amongst the best specimens of the comic which the Italians possess. But till the rise of that branch of poetry which may be regarded as the peculiarly national poetry of Italy, namely, the serio-comic romance of chivalry, nothing of a marked or original character appears. We turn, therefore, at once to the dawn of that school in the rough poem of Pulci.

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ivalry.

There seems little doubt that feudalism, with that attendant spirit of chivalry which was born of its union with religion, never obtained any great influence in Italy. Petrarch even speaks of the warlike fictions of romance with dislike and contempt; and indeed, from the earliest periods, we can perceive the traces of a commercial much more than a military spirit; inclining the nation, in the adoption of foreign models, to turn with far greater interest to the gay, lively, and licentious tales of the Trouveres, or the dreamy reveries of the Provençal poets, than to those tales of chivalry, the "romans de longue haleine," which formed the study and the delight of the rest of Europe.

Before the period, too, when the Italians first thought of resorting to the fictions of chivalry as the materials of poetry, the feeling of chivalry itself was generally on the decline throughout Europe, and its high-flown sentiments and extravagances in action were beginning to be looked upon as a superannuated and exploded fashion. Hence the consciousness of a certain air of ridicule attaching itself to themes of this kind must from the first have been present to the minds of the Italian poets; and accordingly the chief puzzle connected with the work of Pulci, the Morgante Maggiore, is, whether the work be of a serious nature, or an elaborate jest; or whether, as seems more probable, it be not a jumble of both.

All the Italian poets who have adopted these fabulous themes of chivalry seem, in fact, to have perceived that, in their own country at least, the taste for romance, if it ever existed, had gone by, and that a serious poem, in the style of the prose romances of chivalry, would have met merely with ridicule or neglect. Their aim, therefore, seems to have been to avail themselves merely of the fictions and machinery of romance, as affording a new source of poetical embellishment; to address no higher feeling than the principle of curiosity aroused by complicated adventure; and to anticipate, by a tone of levity, and a gaiety approaching to the comic, that ridicule with which they felt that the spirit of chivalry had begun to be associated. They wrote "as if they mocked themselves, that could be moved to *sigh* at any thing." This aim is visible in them all; they differ only in the degree of art, taste, and genius with which the result at which they aimed has been accompanied.

Pulci.

In the rude poem of Luigi Pulci (born 1431, died 1487), there is no harmony whatever between the extremes of the tragic and comic. The poet appears to be in one page sincerely devout; in the next he seems a profligate and scoffer. The broadest farce in the adventures of the good-natured but stupid giant Morgante, alternates with the elevated and the pathetic in the really chivalrous enthusiasm of the battle of Roncesvalles and the death of Orlando; the dreariest platitudes are succeeded by occasional outbreakings of devotional enthusiasm or fine sentiment. The effect of the whole is disjointed and painful, and such as to excite our surprise that the accomplished companion and favourite of the great Lorenzo should have produced a work so enigmatical and unsatisfactory.

Boiardo.

With more invention and greater variety than Pulci (for in the construction of plots, and in sketching the outline of characters, Boiardo left little for Ariosto to perform), and with far less of that disposition to caricature in which Pulci unconsciously indulges, the *Orlando Innamorato* of Matteo Maria Boiardo (1430 to 1494) still wants that airy grace and ease of movement, that unconscious flow, like the marvellous tale of an Arabian improvisatore, without which this species of poem,—a "chartered libertine," in as far as regards the ordinary canons of criticism,—can have no permanent success. In Boiardo's hands it moves laboriously and stiffly; his verse wants harmony; his style wants pruning, polishing, and lightening. This, together with the infusion into the poem of a most peculiar species of grave humour, was the service afterwards performed for Boiardo by Berni, with such perfect success, indeed, that the *rifaccimento* has superseded and almost obliterated the recollection of the original.

Ariosto.

It remained, however, for Ariosto (1474–1533) to hit the happy medium between the *poco meno* and *poco piu;* to blend the tragic and comic in the proper proportions suited to the serio-comic epic; to give life and natural movement to the mere machines of his predecessors; to throw over his recitals an air of simplicity and *bonhommie,* which gives probability to the wildest marvels; and to invest the whole airy tissue of romance, with a style, the peculiar charm of which, though most clearly felt, appears almost indescribable; so clear, so popular and translucent, as to charm the most uneducated; so correct and classical as to satisfy the most critical taste. To compare Ariosto to Tasso as a poet of feeling, is to compare objects absolutely disparate, and unsuited to comparison. Probably the native cheerfulness and easy temper of his mind was not consistent with strong emotion; but it is equally clear, that the expression of strong emotion was inconsistent with his plan. To have grafted the deep and serious interests and passions of men upon so gossamer a groundwork as that which he has adopted, would have been like building an edifice of marble upon the unsubstantial basis of a summer cloud. In the department he assigned to himself he has employed the most appropriate instruments with corresponding success. After Homer, he has been, on the whole, the favourite poet of Europe. Above sixty editions of the Orlando were published in the course of the sixteenth century alone. "The Orlando Furioso," says Mr Hallam, in summing up a most just and discriminating criticism of Ariosto, in his Introduction to the Literature of Europe, "as a single great poem, has been very rarely surpassed in the living records of poetry. Ariosto must yield to three, and only three, of his predecessors. He has not the force, simplicity, and truth to nature, of Homer, the exquisite style and sustained majesty of Virgil, nor the originality and boldness of Dante. The most obvious parallel is Ovid, whose Metamorphoses, however, are far excelled by the Orlando Furioso, not in fertility of invention, or variety of images and sentiments, but in purity of taste, in grace of language, and harmony of versification."

The incongruous elements of devotion and ribaldry, caricature and tragic emotion, which had been left unblended by Pulci, which Boiardo partly rejected and partly harmonized, had received from the pen of Ariosto the last graces of which such a poem was susceptible. In him there is even a gentle pathos combined with a sort of enthusiasm of valour, which gives sincerity and elevation to the fantastic. But the serious and brooding fancy of his successor Tasso (born 1544, died 1595) could not be contented to sing, like Ariosto, "le donne, i cavalier, l'arme, gli amori," in the same light, and at times half-mocking strain. He determined to present the serious side of the romantic epic, as Ariosto had done the comic. Whether the dull "Gazette in verse," by Trissino, the Italia Liberata, in any way suggested to him the idea of a historical subject, we know not. Certain it is, however, that his earnestness of purpose, his deep and at last morbid sensibilities, impelled him to the selection of a theme where reality should give steadiness and human interest to the creations of imagination; and where the spirit of the Christian religion should be the moving principle, instead of a phantasm which played round the head rather than touched the heart. This theme he sought and successfully found in the delivery of the Holy Sepulchre by the crusaders; an event more interesting to Christianity than had been the Trojan expedition to the assembled princes of Asia; and satisfying that essential condition of a good epic, that its action, whatever its importance, shall be one springing from enthusiastic feeling rather than political motives. His poem was written while the European monarchs still flattered themselves with the hope of regaining the lost conquests of Godfrey in the Holy Land, and the glorious exploits at Malta, at Rhodes, at the Goletta, and Lepanto, showed the strength of the feeling that still prevailed "against the general enemy, Ottoman;" and dealing as it did with a topic of religious interest, placed among scenes hallowed by the most affecting recollections, and presenting the finest natural features for the pencil of the poet; admitting, from the remoteness of the period to which it related, and the faith which then prevailed, the introduction of a fabulous agency, contrasting with the impressive machinery which the Christian religion afforded, it is difficult to conceive a theme uniting more features of interest, or affording a richer or more picturesque groundwork for an epic poem.

Tasso has conceived his plan in the spirit of antiquity, and in the grand and enlarged style of the classic epic; but he has executed it in the spirit of the middle ages; and perhaps the point in which Tasso has been more completely successful, is the skill with which the spirit of a religious chivalry is breathed into the classic framework; and all the incidents which he liberally borrows from Homer or Virgil, are made to harmonize with that prevailing tone of devotion, valour, and tenderness, which is spread like an atmosphere of purity over the Jerusalem Delivered.

The e
sodes.

Whilst the general plan of the Jerusalem, perhaps, bears too close a resemblance to that of Homer, in the retirement of Rinaldo, like Achilles, from the army, which is made the nodus of the poem, the singular beauty of its episodes has been always felt and admitted. In fact, it is by the episodes that we chiefly remember the poem. Tasso has thrown the whole tenderness of his soul into such passages as those where he describes Sofronia and Olindo at the stake, the "pastoral melancholy" of Erminia's residence with the shepherds, or Clorinda perishing by the hand of him who would willingly have died to save her. The turn of his mind, in fact, was fully more towards the lyrical than the epic, and, in passages like these, the lyrical tendency breaks forth with peculiar force and flow.

Chara

In his characters Tasso has not made any very substantial addition to the picture gallery of the ancients, though even in this respect he is superior to Ariosto, who in most cases contents himself with a few general types without distinctive traits. Tasso's male characters, with one exception, that of Tancred, are judicious adaptations of Homer's outlines of character to other times, manners, and religious creeds. Tancred, however, is an original conception; perhaps the more striking that its outline was drawn in some measure from within; for in Tancred, the brave, visionary, melancholy Tancred, the victim of a hopeless passion, we probably see a dim reflection of the poet himself.

The same broad line of distinction which divides Ariosto and Tasso as to the conception of their subjects, may be traced in the whole details of their execution. Ariosto is throughout a painter. It is with external things that he chiefly deals; with colour, arrangement, form, and grouping, rather than with their internal spirit. But Tasso cannot paint this objectively. Every image, every feeling, as it passes through his mind, receives the stamp of his own peculiar habits of thought, and issues forth impressed with the image and superscription of his own tender and loving soul.

Pastor
and pas
ral dra

Though Tasso is best known by his great epic, his Aminta deserves notice as the finest of those pastoral dramas which were so common in Italy in the sixteenth century and the commencement of the seventeenth. It was not indeed the earliest, for the Sagrifizio of Agostino Beccari (1510–1590) had preceded it. And even Beccari's work had grown out of those pastorals, frequently in dialogue, of which the fifteenth century was so fruitful, and of which the Arcadia of Sannazzaro (1458–1530) affords the finest example. Tasso's, however, of all the Italian pastoral dramas, is the most inspired by the spirit of poetry. The Pastor Fido of Guarini (1537–1612) certainly has the advantage of a far more stirring plot; it rouses more curiosity and attention, but it wants the charm, the truly Arcadian repose, which Tasso has spread over his Aminta. Here also, as in his Tancred, the feelings of the poet gave vivacity and truth to the poem; for it is not difficult to see, that under the disguise of Amyntas, and in the form of allusions to the joys and sufferings of the pastoral life, or invectives against that influence of rank and honour by which the natural feelings of the heart are suppressed, the lover of Leonora is pleading his own cause, or his own apology.

For an account of the Italian drama, which took its rise in the Sophonisba of Trissino (born 1478, died 1550), the reader is again referred to the article Drama in this work.

Bernes
poetry.

One species of poetry, which is almost peculiar to Italy, distinguishes or rather disgraces this period, viz. that mass of poems entitled Capitoli, &c. which obtained the name of Bernesque from the poet who first set the example of these specimens of reckless and indecent drollery, Francesco Berni (died about 1543). His quiet, grave humour, the host of ludicrous associations which he conjures up, and frequent felicities of expression, at first render even his ribaldry amusing; but when similar themes were taken up and hunted down by Molza, Casa, Firenzuola, and their followers, it became oppressive and revolting in the highest degree.

We now approach the period of decline in Italian poetry. The sixteenth century had been its golden period: in the seventeenth we drop at once into the age of brass, or the age of tinsel. Chiabrera (born 1552, died 1637) indeed exhibits lyric fire, and, by discarding the hackneyed and outworn form of the Italian versification of the Provençal school, and approximating to the metres of the ancients, gave a character of originality to his odes. Yet, granting the boldness of his imagery, and a certain fervour and enthusiasm, which raise his lyric poetry above the slumbrous and monotonous beauty of most of his predecessors who were of the school of Petrarch, it is yet impossible to subscribe to the excessive eulogiums bestowed upon him by Tiraboschi, who almost seems to think he had combined in Italian the graces of Anacreon with the majesty of Pindar. More impressive, more affecting, though occasionally, and particularly in his sonnets, more deformed by the conceits and exaggerations which give an evil distinction to the poets of this period, whom the Italians have branded with the title of Seicentisti, are the lyrics of the senator Filicaja (born 1642, died 1707), whose religious canzoni, particularly the noble triumphal hymn on the deliverance of Vienna from the Turks by John Sobieski, are amongst the finest specimens of this class of poetry of which Italy has to boast. In his sonnets he is less pure and less natural; even his famous sonnet on Italy is, in its second quatrain, disfigured by one of the poorest and coldest of conceits. One other name must be mentioned, as preserving a pure and classic taste amidst the general corruption which, under the influence of Marini, was now pervading and perverting the whole spirit of Italian poetry. We refer to Fulvio Testi (1593–1646), the Italian Horace, as he has been called, a title certainly quite unmerited, so far as regards the power or brilliancy of his imagination, but not inappropriate, if limited to the purity and terseness of his style. The greater corrupter of this declining period of Italian literature is the once famous Marini (born 1569, died 1625), the author of the Adone, a poem which is an absolute chaos of brilliant antitheses and exaggerated language, plays of wit and ingenious imagery, but heaped together without the slightest direction of any governing judgment, and producing a tiresome and chilling, instead of an exciting effect. In his own days his writings were differently estimated. For a time, indeed, his popularity in his own country was boundless, and his influence on the literature of other countries, particularly that of Spain, as powerful as it was mischievous. But good sense and good taste shortly resumed their sway, and Rousseau, if one may judge from the frequent quotations from Marini in his Heloise, would almost appear to be the last person of any literary distinction who was familiar with the once celebrated and now completely forgotten Adone.

In comic poetry, however, the seventeenth century was more successful. To this period belongs the Secchia Rapita of Tassoni (1565–1635), the first specimen of that style which was afterwards carried to perfection in the Lutrin and the Rape of the Lock. The imitations of Tassoni need not be mentioned. Instead of improving on his model, they degraded and vulgarized it.

Excepting in the drama, which was distinguished by the great and strongly contrasted genius of Metastasio and Alfieri, the eighteenth century in Italy can boast of little in poetry. Some graceful fables by Pignotti, imitations of Pope by Parini, and of Gray and Young by Pindemonte, redeem it from the charge of utter barrenness, but cannot entitle it to the praise of originality. Nor, with the exception of Manzoni, has the nineteenth century produced any poem which can justly be said to have attained a European reputation.

SPANISH POETRY.

Of all the languages formed from the ruins of the Latin, the Spanish approaches the nearest to the Italian. The spirit of the two literatures differs extremely; but so closely do the words resemble each other, that translations have been executed by Spaniards from the Italian, as in the case of Jauregui's translation of Tasso's Aminta, where even whole lines are found to correspond with the original. The language, as it now exists, is the dialect of Castille, polished and purified, the Catalonian or Limousin having long ceased to be the language of poetry.

Its oriental character.

One feature peculiarly marks the whole of the Spanish poetry with a character unknown to that of the rest of Europe, viz. the strong traces of orientalism which it exhibits, a tendency to the pompous and the exaggerated, and a strange compound of strong passion, combining with a great wantonness and luxuriance of fancy. More or less this feature is to be traced through all the changes which its poetry has undergone; subdued, no doubt, and kept down by the good taste of such men as Garcilaso or Cervantes, but re-appearing in the *estilo culto* of Calderon, and reaching its height in the ludicrous extravagancies of the Spanish Marini, Gongora. Considering, indeed, the intimate connection which subsisted between Spain and Arabia from the eighth down to the close of the fourteenth century, a connection which, though one of hostility in the field, appeared to have admitted of many of the ties of friendship and mutual respect, and the natural admiration which the brilliant poetry of Arabia was likely to exercise over the minds of a ruder people, the Asiatic character of the Spanish poetical genius appears exactly what, under such relations, might have been expected.

Chronicle of the Cid.

The earliest monument of the Spanish poetry is the old Chronicle of the Cid, a cycle of romantic legends, founded upon the exploits and misfortunes of that Don Rodrigo Laynez who, after exalting the glory of the Spanish arms under Ferdinand king of Castille, and his son Don Sancho, was treated with such ingratitude by Alfonso VI., the son of the latter, that he fled to the Moorish court, where, from 1081 to 1085, he gained many brilliant victories over the Christian arms. Again recalled to the Spanish court by Alfonso, who began to feel his value, he was a second time disgraced, and banished about 1090. The Chronicle, which, both from internal and external evidence, appears to be as old as the twelfth century, relates to this second banishment; and though its language is rude, and its rhymes most imperfect, there is a captivating freshness in the scenes which it presents, in its vivacity of movement, and in the occasional traits of poetry which seem to escape almost involuntarily from the writer, that raise it considerably above the ordinary level of such chronicles.

Ballad poetry.

From the date of the poem of the Cid to the reign of John II. (1407–1454), the only monuments of Spanish poetry, at least the only specimens possessing the slightest interest, consist in that vast mass of popular or ballad poetry in which Spain is richer than any other country in Europe. Fortunately the process of collecting and preserving these relics of an adventurous and enthusiastic period, "ere polity, sedate and sage, had quenched the fires of feudal rage," was commenced at a very early period, the first collection having appeared in 1510, under the title of the *Cancionero General*. Not only in numbers, however, but in merit, the Spanish ballad poetry appears superior to that of any other nation of Europe. Everything, in fact, united to give to this species of poetry its freest development. A national character of strong sensibility, excitable yet constant; national pride, in the feeling that they had so long formed the advanced guard of Europe against the Moors, and were daily driving backward the tide of invasion; a life of adventure and gallantry; a strong passion for music and the dance; a delicious climate; a language rich in rhymes, and admitting a species of versification (the assonance), in which "Sponte sua carmen numeros veniebat ad aptos," were here found united. The result has been a collection of ballads of all kinds, warlike, amatory, Moorish (these last chiefly composed after the conquest of Granada by Ferdinand and Isabella in 1492), and satirical, marked by a degree of taste and poetical beauty, of which very few of our English or Scottish ballads have to boast. The Moorish ballads have a peculiar charm, from the richness of the colouring with which they are invested, and their style, which has hit the happy medium between the boldness of some of the old historical ballads, and the over-refinement and affectation of those which were composed after the introduction of the Italian taste into Spanish poetry. The picturesque character of the Moorish life, the natural beauties and artificial magnificence of Granada, the quarrels of the rival families of the Zegris and the Abencerrages, the tournaments, feasts of canes, and other amusements of the luxurious court of Boabdil, afford in these ballads inexhaustible materials for descriptive poetry, a tendency which is hardly to be traced in the earlier ballads. "It is wonderful," says a very eminent Spanish critic, Quintana, "with what vigour and brevity they paint scenes, personages, and feelings. In one it is the Alcayde of Molina, who enters, rousing the Moors against the Christians, who are ravaging their fields; in another, the unfortunate Aliatar, borne back with the gloom of a funeral procession, through the gate from which he had issued with such gaiety the day before; now it is a simple country maiden, who, having lost the ear-rings her lover had given her, weeps at the prospect of the reproaches which await her; and now a shepherd, who, solitary and forsaken, grows indignant at the sight of two turtles cooing in a neighbouring poplar, and drives them away with a stone." Besides the ballads descriptive of incidents, these collections contain many charming little songs and lyrical snatches, vague and undefined, indeed, but often pleasing us even by this very vagueness, which merely suggests a hint to the mind, and leaves the rest to be filled up by the imagination. With few exceptions, the authors of these lyrics are unknown. A few are attributed to the great Don Juan Manuel (who died in 1362), but on doubtful evidence; the writers of the others have died and made no sign.

Though the Spaniards date the rise of their classic poetry from the reign of John II., it is certain this period contains little which has any interest for foreign readers. The pedantic and tedious *labyrinth* of Juan de Mena (1412–1456), a cold and lifeless imitation of Dante's great poem, possesses nothing of a more classical nature than the older poetry, save its form. One poem only of this period, viz. the noble stanzas or coplas written by Don Jorge Manrique on the death of his father, and a few graceful *redondillas* by the accomplished Marquis of Santillana, afford some relief from the pretension and pedantry which generally characterize this period of Spanish poetry.

Introduction of the Italian taste. Boscan.

A great revolution, however, was about to be effected in Spanish taste, by the introduction at once of the measures and of the spirit of the Italian poetry. The close relation into which Spain was brought with Italy during the reign of Charles V. had led to a general knowledge of the treasures of Italian poetry; while many changes in the political constitution and habits of the Spaniards themselves concurred to weaken their attachment to their old and natural romantic poetry, and disposed them to adopt the more regular and polished strains of their Italian neighbours. This change was introduced by Don Juan Boscan (from about 1500 to 1544), who, though he had at first composed and published a volume of poems in the old Spanish manner, had been led, by his acquaintance with the Venetian ambassador Navagero, to the study of the Italian classics, and in consequence formed the design, in conjunction with his friend Garcilaso de la Vega (1500–1536), of introducing to his countrymen the refinements of the Italian versification, and the superior polish of the style of the Petrarchists. But with all Boscan's careful study of the Italian poets, which is evident from the perpetual imitations which his poetry contains, of Petrarch, Bembo, and Sannazzaro, he never could acquire their elegance of taste, nor divest himself of the national tendency to orientalism. Something of the old leaven of impetuosity and hyperbole attaches to his poetry, producing a feeling of incoherence between the matter itself and the medium through which the ideas are conveyed.

Garcilaso.

But what Boscan attempted and imperfectly performed, Garcilaso accomplished with complete success. He was equally distinguished in the field of warfare and of literature. "One hand the sword employed, and one the pen;" and he fell at last, crowned at once with the laurels of poetry and war. In Garcilaso the Italian poets found a rival, if not a superior; for while he adopted their best points, he avoided in a great measure that subtilty of taste which had grown out of the study of the later Platonists, and introduced a metaphysical and reasoning style into those subjects where it was the most out of place. Garcilaso has written little, but that little (at least his Eclogues, for his Sonnets are not of equal merit) is of the highest class; for he has contrived so finely to temper the subtilty of the Italian poets by the more natural warmth of the Spanish, and to clothe his sentiments in words at once so simple and so classically pure, that the result is something superior to any thing that is to be found in his models. In all of them, no doubt, the classic reader will recognize at every turn resemblances to the Latin poets; but these imitations are introduced with so much taste, and fitted with such art into a Spanish framework, that the knowledge that they are imitations rather increases than diminishes our sense of the talent of the poet.

Mendoza.

A third personage was associated with Boscan and Garcilaso in this poetical triumvirate, the famous "tyrant of Sienna," the accomplished warrior, statesman, historian, novelist, and poet, Diego de Mendoza (1500–1575). Mendoza's Epistles, however, betray more rudeness of manner than even the verses of Boscan; and indeed the chief feature of interest which they possess, is the singular spectacle they present of a stern and hardhearted warrior of the school of the Duke of Alva breathing out to his friends Boscan and Zuniga the most fervent aspirations after the domestic happiness of a rural life, or longings for the enjoyment of a philosophical solitude. This feature indeed more or less marks the whole poetry of the period. Whilst the Spanish warriors were distinguished all over Europe for their ferocity, presenting, as Sismondi says, "to the enemy a front of iron, and to the unfortunate an iron heart," we find all their poetry marked with a dreamy, tender, and melancholy spirit. In Mendoza, Garcilaso, and Montemayor, all of whom were soldiers, and conversant with scenes little calculated to soften the affections, we observe this union of practical ferocity with theoretical innocence; nay, even the terrible Duke of Alva appears to have been inspired by the same tastes, and appears in the poetry of the time, not as the ferocious governor of the Low Countries and the organ of the Inquisition, but as the discerning critic, the lover and the patron of literature.

Montemayor.

This tendency to themes of an Arcadian cast gave rise to the Pastorals of Montemayor (1520–1561) and his successors. The Diana of Montemayor, a pastoral romance, interspersed with ballads and canzoni in the style of Sannazzaro's Arcadia, was once amongst the most popular productions of Europe. Its influence may be traced, not only in the host of Spanish pastorals which succeeded it, but in the literature of other countries, in the Astrea of D'Urfé, and in the Arcadia of our own Sir Philip Sydney. Cervantes bestows upon it a sort of qualified praise in his review of Don Quixote's Library, but is disposed to give the preference to the continuation by Gil Polo over the original. Montemayor labours, in fact, under the fault of all his countrymen of the time; he cannot compress; he pours out a stream of musical language, "which runs, and, as it runs, for ever would run on;" but he gives us few ideas that are at once natural and new, and none that stir the heart or strongly awaken the imagination.

The works of Herrera, another poet of this period (1500–1578), on whom the Spaniards have, with questionable propriety, bestowed the title of "the Divine," are in a totally different strain. His themes are religious and warlike, such as the triumph of the Christian arms at Lepanto, or the fatal defeat of Sebastian in his expedition to Africa. Of all the Spanish poets, Herrera, whose mind was deeply imbued with the beauties of the sacred writings, possesses the loftiest style of expression; but the majesty of his diction is often obscured by strange and new creations or combinations of words, while his elevation not unfrequently explodes in palpable bombast. There is a strong resemblance between Herrera and the Italian Chiabrera, both in their beauties and their faults.

The greatest of the Spanish lyrical writers is Luis Ponce de Leon (1527–1591). "More earnest and enthusiastic than Boscan; tender as Garcilaso, but with a soul whose tenderness was engrossed by heavenly, not earthly love; pure and high-hearted, with the nobility of genius stamped upon his brow, but with religious resignation calming his heart, he is different from his predecessors, but more complete; a man Spain only could produce, for in Spain only had religion such sovereign sway as wholly to reduce the rebel inclinations of man, and, by substituting supernal for terrestrial love, not diminish the fulness and tenderness of passion, but only give it another object."[1] The most remarkable feature of Luis de Leon's poetry, is the union of a mystical and religious enthusiasm with the most perfect clearness and transparency of expression. Never was a high and soaring imagination more perfectly under the control of a cool judgment and a critical taste. Whilst a religious Platonism forms the *fond* of his odes, the style exhibits all the terseness, precision, and finish, of that of Horace, of whom, notwithstanding the great differences in their poetical character, he continually reminds us, by the sententious air of his odes, and that serene moral wisdom which drops from him in common with the Epicurean poet, whatever subject he touches on. But the odes of the Spanish poet have a moral grandeur far exceeding those of Horace. The spirit of present enjoyment, or indifference to futurity, which not unnaturally pervades the latter, was revolting to the warm sympathies and devout belief of Luis de Leon. Accordingly, the ideas and images which, to the Epicurean poet, only afford inducements to devote the hours to pleasure, such as the shortness of life, the fading of flowers, or the instability of fortune, the Spanish moralist holds out as inducements to the cultivation of those higher faculties which raise the soul above this world of mutability and misfortune, and prepare it for that purer abode, which he regarded as its appointed home.

The close of the reign of Charles V. is adorned by the great name of Cervantes (1547–1616), more distinguished, however, as a prose writer than as a poet; and by the rise of the dramatic literature of Spain. For a general account of the peculiarly national and remarkable character of the Spanish theatre, which, while it is connected with our own by so many common features, has yet some striking points of distinction, which render its study peculiarly interesting to the admirers of our older British theatre, we refer to the article on the drama. Cervantes, we must admit, appears to mark its *childhood;* for the plots of his dramas are loose, disjointed, and scarcely deserving of the name, though the gloomy grandeur of the Numantia gives it a painful fascination, like the scenes in the town of Hunger in the Inferno. Lope is identified with its boyhood; Calderon, with its maturity and perfection; Moreto, Roxas, De Solis, Mira da Mescua, Da Hoz, and others, who wrote during the reign of Philip IV., with its decline. Invention, high poetry in parts, the power of exciting and maintaining curiosity and suspense, must be accorded to the Spanish theatre. Against these must be set religious bigotry and mysticism, often painfully predominant in the plays of Calderon, particularly in those autos which the German critics have especially selected as the themes of their admiration; the affected and redundant style into which most of their poets were led by the facility of their versification, combined with the habit of working for the stage; and the practice which, upon the Spanish stage, is almost universal, of painting manners and general types of character, rather than discriminating its shades, or giving individuality to the personages represented.

We may here notice, in connection with Spanish literature, the solitary great name of which the kindred literature of Portugal has to boast, Luis de Camoens (1524–1578), who conferred upon his countrymen that which Spain has in vain essayed to produce; for the Araucana of Ercilla certainly does not deserve the title of an epic poem. Viewed in this light, too, it must be admitted that even the Lusiadæ of Camoens is most objectionable; the action flags miserably; the mythology is ludicrous; the morality of some portions of the poem, as, for instance, the scenes on the island which Venus prepares for the refreshment of the returning Portuguese, is more than questionable; but, with all these, the work is inspired and supported by the true spirit of poetry; and its continued popularity and reputation prove how little the real charm or success of an epic depends on the mere plan or machinery of a poem. That which will always render Camoens delightful, is the tenderness of heart which overflows in such episodes as that of Ignez de Castro; and the pride and zealous endeavour with which he labours to embody in immortal verse the spirit of those days in the annals of Portugal, when learning and commerce, warlike enterprise and success, went hand in hand; when De Gama braved the terrors of the Cape, and Alvarez and Albuquerque first launched their gallies into the Atlantic.

Gongora and Quevedo.

From the seventeenth century to the present time, the literature of Spain has been one of decline. Three names only, amongst the many whose works are found quoted in Anthologies and *Parnasos*, deserve notice; those of Gongora (1561–1627), Quevedo (1580–1645), and Villegas (1595–1669). The real talents and rich imagination possessed by Gongora make us lament that, like Marini (from whom indeed he borrowed his manner), he applied them only to corrupt and pervert the public taste. Some of his little Anacreontic verses, songs, and letrillas, written at an earlier period of his life, are models of natural grace and felicity of expression; contrasting most painfully with the ridiculous jargon of language, and *galimatias* of sentiment, which he employed in his later days. The same evil tendency is visible in Quevedo. We have great invention, much acuteness and comic humour, but a lamentable deficiency of feeling and taste. His works have been most justly compared by Bouterwek to a massive ornament of jewellery, in which the setting of some parts is exquisitely skilful, of others extremely rude, and in which the number of false stones and of valuable gems is nearly equal.

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[1] Literary and Scientific Men of Italy, vol. iii. p. 70.

Villegas A purer taste occasionally appears in Villegas, the Anacreon of Spain, though he, too, seems to labour under the mania of the day, and now and then to run into extravagances worthy of the very wildest of the Cultoristos. After Villegas there appeared no Spanish poet of any originality; for the verses and the pastoral comedy of Melendez Valdez, founded on the episode of the marriage of Camacho in Don Quixote, do not rise above mediocrity; the fables of Yriarte have merely the merit of brevity and neatness of expression; and the comedies of the younger Moratin, the last dramatic works which have attracted any attention, are merely ingenious imitations of Molière. At the present moment Spanish poetry would seem to be absolutely *effete;* nor does there appear much reason to anticipate its speedy revival.

FRENCH POETRY. The present language of France has sprung from that northern dialect which was spoken in Normandy, and known by the name of the Walloon. The earliest compositions in that dialect were romances, founded on some fabulous history, such as Brut of England, which appeared about 1155. **Romances.** To these succeeded the romances of chivalry, from about 1130 to 1190, of which, unless the Portuguese romance of Lobeira, Palmerin of England, be supposed to have appeared before this time, it would seem the Norman-French are fairly entitled to claim the invention. Taking them as a whole, there is no disputing that much fancy and ingenuity are expended upon these now-forgotten performances, though the style is invariably flat and lumbering. They are sustained merely by the high spirit which they breathe, and the happy incidents which the chronicler occasionally introduces.

Allegorical romance. The taste for the allegorical romance was of a date somewhat posterior. Of these singular compositions, the most remarkable is the once celebrated *Roman de la Rose*, begun by William de Lorris, and concluded by Jean de Meun, a poem which was received with boundless admiration, and which continued for a century strongly to influence the literature of Europe. It was at once a romantic and an allegorical poem; a new edition of the art of love, adapted to the moral and metaphysical creed of the middle ages; of dreary length, and yet enlivened here and there by allegorical portraits of imaginary personages, drawn with considerable vivacity and spirit, and by those strokes of satire, or lessons of practical philosophy, which, together with the art of narration, very early began to characterize the literature of France. The conclusion, by Jean de Meun, is inferior to the commencement; it is deformed by a ribaldry and coarseness which justifies the term "niedrige polissonerie," or low blackguardism, applied to it by Bouterwek.

The Fabliaux. But by far the most striking and characteristic part of the early French literature consists in that vast collection of short tales entitled Fabliaux, which were almost exclusively the production of the French provinces lying to the north of the Loire, and which are well deserving of attention, whether their own merits and originality be regarded, or their general influence on fiction. The period of their appearance extends from the last half of the twelfth, through the whole of the thirteenth and part of the fourteenth century, but the greater number are supposed to have been written during the reign of St Louis (1226 to 1270). The compositions of these minstrels differ extremely in character from those of their Provençal brethren of the south of France. The poets of Provence were generally knights and nobles; their themes love or war, or mystical allegoric dreams; and, with much monotony, their poetry certainly presents an elevated and imposing exterior. The Trouvères were generally men of an inferior grade, sprung from the lower ranks of life, in fact literally wandering minstrels. Yet the position they occupied in society was particularly favourable to the promotion of those habits of satirical observation and comic description which constitute the chief attraction of the Fabliaux. Men, in general, of acute and vigorous minds, though destitute of learning and delicacy, and too often of principle; welcome guests in all society from their powers of amusing, yet respected in none, experiencing every extreme of life, and making themselves at home in all; sometimes helping to dispel the ennui of baronial castles, at others courting the society of the humblest vassals, they rambled over the world, harp in hand, as it were, picking up everywhere the materials of their art, and thus painting with a truth and freshness otherwise unattainable, the full-length portrait of French manners during the thirteenth and fourteenth centuries. These light and joyous compositions turn chiefly on subjects of a familiar nature, and consist of stories of knavery and intrigue, and occasionally of those Asiatic legends with which the crusades had by this time rendered Europe familiar. Except, therefore, in invention of ingenious incidents and comic imbroglios, and in a certain tinge of humour and vivacity, which breathes of the sunny skies and vine-covered hills of France, they have little pretensions to poetry. And yet this opinion must be taken with exceptions, for they have occasionally shown that they could excel in themes of a higher kind; and the beautiful and well-known fabliau of Aucassin and Nicollette, by its tender and natural spirit, combined with the deep interest of its situations, throws into the shade the greater part of the more ambitious and elaborate chivalrous romances. We perceive in it all the romantic spirit and deep feeling of the old Spanish ballads, heightened by the graceful naiveté peculiar to the early French poetry.

The period from the commencement of the fifteenth to the sixteenth century is regarded by the French as the transition period of their poetry from infancy to maturity; and the three leading names of the period are Marot, Ronsard, and Malherbe.

Marot. Clement Marot (born 1495, died 1544) is the creator of that school of naive poetry which was afterwards carried to its perfection by La Fontaine and Voltaire. With a playful unambitious grace, he gives a happy turn to every subject, and delights to put the world in good humour with itself. It is justly observed by a French critic, Nisard, that the naiveté of Marot differs from that of any previous poet. In the older strains of the Trouvères and their successors, what we call naiveté often arises merely from the imperfection of the language, and not from any peculiarity in their turn of mind. But Marot wears this air of unconsciousness even in giving expression to ideas the most subtile and recherché; his naiveté seems independent of the language, independent almost of the ideas; it is an emanation of the peculiar genius and idiosyncrasy of the man.

Ronsard It is amusing to contrast the fame of Ronsard during his life (1524–1585) with his reputation at the present moment. His own age elevated him to honours almost divine: in the present how many are acquainted even with a single page of his poems? He was considered the presiding luminary of that constellation of genius which arrogated to itself the title of the French Pleiad; whose great object it was to transplant into French the form and the manner of the lyrics of antiquity; but who succeeded only, as Boileau says, in making a jumble of everything (*brouiller tout*), a patchwork, in short, of Greek and Latin ideas with Italian subtilty of thought and French naiveté of expression.

Malher "Enfin Malherbe vint," says Boileau (1558–1628), like Ronsard a classicist, but endeavouring, and not without success, to seize rather the spirit of the ancients than their forms. Of the higher inspiration of the ode he had little; his march is stately enough, but it is measured and slow; he has little or no enthusiasm, but, in all that regarded the judicious treatment of a subject, or the minutiæ of language or versification, he was well fitted to be the legislator of that new and more sober school of composition which superseded in France the extravagances of Ronsard and his satellites. The three pieces of Malherbe which appear to indicate the highest talent, approaching indeed to genius, are the Ode to Henry IV. on the taking of Sedan, the Ode to the Queen-Mother, and the beautiful verses addressed to the Councillor Duperier on the sudden death of his daughter. Few lines could be selected more beautiful than the following stanza from the latter:

Mais elle estoit du monde où les plus belles choses
  Ont le pire destin;
Et Rose, elle a vecu ce que vivent les roses,
  L'espace d'un matin.

But she was of a world where fairest things
  Have foulest doom:
Rose as she was, she had a rose's life,
  A morning's bloom.

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uisXIV.

We now arrive at the period which is, or rather was, considered by the French as the golden age of their poetical literature, the long reign of Louis XIV. Everything at this time concurred to impress on poetry that stamp of stateliness, polish, and courtier-like adoration of monarchy, which at that time pervaded French society, and which exerted so powerful an influence on the general tastes of Europe. The French monarchy had now been consolidated by the firm hand of Richelieu, who, whilst he unrelentingly pursued his design of lowering the aristocracy and exalting the throne, was not insensible to the claims or the importance of literature, and had been the first to give it the support which a corporate character appeared likely to afford, by the formation of the celebrated academy. The troubles of the Fronde were over. The heats and animosities of rival religions had been appeased by the edict of Nantes. The personal character of Louis was well suited to effect his main object, which was to render his court a model for the imitation of the world. Of limited abilities, without talent either for warfare or diplomacy, he possessed tact enough to perceive at once his deficiencies and his advantages; and, endowed with many of the most attractive outward graces and accomplishments of a king, he played the part of a dignified monarch with much discretion and ability. Thus wielding, without opposition, the energies of a powerful kingdom, and collecting around him at his court all that France contained of intellectual ability, a tone of courtly polish and extreme refinement was imparted to society, which soon impressed its traces upon literature, 'partly for good, and partly for evil. The influence exercised by French manners and French literature upon other countries became paramount and unprecedented, superseding the most inveterate usages, overturning the strongest national prejudices, and establishing a despotism more universal than had been known in literature since the downfall of Greece and Rome.

The most imposing shape in which poetry appears during this supposed Augustan period of French literature, is in that of the drama; which, commencing with the rude plays of Jodelle (who died in 1560), reached its perfection during the close of the reign of Louis XIII. and the reign of Louis XIV., in the tragedies of Corneille and Racine, and the exquisite comedies of Molière. For a full account of the French stage we refer to the article Drama.

It cannot be said that, in any other department of poetry except that of the drama, the age of Louis XIV. was pre-eminently distinguished; for the artificial and hollow refinement of the time seemed unfavourable to that vigorous and natural feeling which should speak in poetry, with a corresponding strength and originality of expression. Yet two names impress themselves, by their strongly discriminated traits, upon the memory,—La Fontaine (1621–1695) as the reviver of the old naive style of Marot, though with a degree of polish and grace of which Marot had no conception; and Boileau, as the representative of that school of terse morality, sound sense, and wit, mingled with and heightened by fancy, of which Pope is the best example in English poetry.

La Fontaine.

With all the levity and licentiousness which deform the Contes, there is no denying to La Fontaine many of the best qualities of the poet; knowledge of the world, which yet does not impair his bonhommie and kindness of heart; a humour playful, gentle, continuous, never pushed to excess, combined with tenderness, with a disposition to reverie and pensiveness; a strong sensibility to the beauties of the country, of which his descriptions, though short, are always striking, and marked by that just selection of points and clear local portraiture which we find in Crabbe, and which show that he made his studies for them on the spot; the whole heightened and set off by a style apparently simplicity itself, but which must have been, as we know it was, the result of the most laborious polishing and elimination: all these give an extreme charm to the Contes, and perhaps still more to the Fables, of La Fontaine; for the Contes, though their licentious gaiety has made them more generally known, display to less advantage the peculiar qualities of La Fontaine's genius.

Boileau.

Boileau, again (1636–1711), pleases and must always please, although by qualities the most opposite to those of La Fontaine; namely, by awakening a calm emotion of intellectual satisfaction, rather than by any excitement of the imagination or the feelings. As Racine represents the tender and voluptuous side of French manners and character during the age of Louis XIV.; as La Fontaine embodies in his tales and fables its easy tone of moral indifference and *malice*, masking itself under the disguise of simplicity; so in Boileau we find, arrayed in a dignified and philosophical dress, its better points, its good sense and sagacity, its lively perception of the eccentric and ridiculous, its love of external decency, order, and propriety, both in morality and in literature.

In his Lutrin he even displays a considerable degree of invention, though chiefly of a comic kind; for, though not destitute of a sense and feeling of high poetry, he was essentially deficient in any actual power of dealing with such themes; and, with that tact and judgment which distinguished him, he has rarely, save in his most unfortunate Ode on the taking of Namur, which has been so justly but so unmercifully parodied by Prior, ventured within this province of poetry. Within his proper field of moral censorship, or of the mock heroic, arrayed in all the graces of elegant diction and classic allusion,—or the poetical abridgment, in the most condensed and pointed form of the approved critical canons of the time,—he is assuredly without a rival in French poetry, and, with the exception of Pope, in European literature.

Eighteenth century.
Rousseau.

The literature of the eighteenth century in France is more distinguished by its prose than its poetry. Prior to Voltaire, at least, in whom great and versatile powers of mind, approaching if not attaining to high genius, must be admitted, it added nothing of substantial value to the contributions of the age of Louis XIV. At one time indeed the odes of J. B. Rousseau (1669–1741) were extolled to the skies, as models of lyric poetry; and Voltaire certainly speaks of them in terms of extravagant praise. To any one now perusing them, with the recollection of the great models of antiquity before him, or even testing them by the simpler process of his own feelings, they will assuredly appear totally deficient in genuine inspiration. The enthusiasm is imitative and factitious; the imitation dexterous, no doubt, but yet palpable to every one who possesses any real poetical sensibility; the thought is often propped up by the words, not the words elevated and quickened unconsciously by the vital grandeur of the thought. What true lyric enthusiasm, indeed, could reside in a mind which busied itself alternately in the composition of rapturous religious odes, and epigrams of disgusting obscenity?

Chaulieu and Gresset.

Much more of real poetry, because accompanied by nature and simplicity, is to be found in Chaulieu's pastoral lyrics; in some of the little romances of Moncrif, such as Alexis and Alix, which abounds with lines that by their truth and simplicity of expression have become proverbial; or in Gresset's pleasing stanzas on the golden age, or even in his lively tale of Vert-Vert.

Voltaire.

The reputation of Voltaire (1694–1778) at the present day rests more upon his witty and amusing prose than upon his poetry. That didactic tendency which was the spirit of the age, that attempt to make all the creations of poetry subservient to inculcating certain philosophical opinions, appears in all the poetry of Voltaire; it speaks even in Mahomet and in Zane, as much as in his graceful occasional verses, his Tales in the manner of La Fontaine, or his epistles. "Les François n ont pas la tête Epique," was his own expression; and the Henriade certainly went far to prove the fact. It is the mere *simulacrum* of an epic; hard, laboured, soulless. It is most unfortunate for Voltaire, that the poem in which his versatile abilities have been displayed to the greatest advantage, is one which its indecencies and impieties have in a great measure banished beyond the pale of literature.

About 1770 may be noticed the rise of the descriptive school of poetry, in the poems of St Lambert and Delille; an importation in all probability from England, where a similar taste had been introduced by the success of the Seasons of Thomson. From 1730 to the commencement of the present century, numerous attempts were also made to confer on France something that should merit the title of an epic poem; but without the slightest success.

During the despotism of Napoleon, poetry appeared to be almost silent. With the restoration of the Bourbons appears the rise of that romantic school, the growth of the fermentation of the revolution, and of that removal of the old landmarks both in polity and opinions which it caused; a school which, both in theory and practice, repudiates the principles of the old French classicists, and has certainly effected a complete revolution in the literary tastes of the time. Whether much or anything has been gained by the change, is in the highest degree questionable. Calm observers think the French have injudiciously sacrificed their reputation for correct and classic execution, for wit and good sense, in the search after those higher qualities of lyrical inspiration or epic grandeur which nature appears to have denied to them. We do not speak of the revolting extravagances in which the leaders of the romantic school, at the head of whom stands Victor Hugo, have indulged. The public taste of Europe, and latterly of France, has so strongly revolted against this convulsionary school, that it cannot long maintain any hold over the national mind; but we fear that, even when the worst extravagances of the new school are retrenched, there will remain a permanent injury to the national taste, in the loose, disjointed, and barbarous style, with the total want of all logical plan in composition, which these innovators have introduced.

Beranger.

Yet it is pleasing to close this short notice of French poetry with the name of one who, though partaking of all the modern influences of his time, is yet within his own department, that of song, a genuine classic. In this department of the lyric, France has always been distinguished. In that country not only has it constituted, as elsewhere, the amusement of the lower classes, but it has long attained the dignity of a powerful political agent; its monarchy was justly described by Champfort as a despotism tempered by songs. Of all the modes in which poetry can be made subservient to purposes like these, song is the most effective, universal, and immediate in its operation. It speaks not to a particular class, but to all; its brevity fixes it in the memory; the creature of the moment, it avails itself of every allusion, every passion, every prejudice of the day; while its outward form appears so trivial and harmless, that even despotic governments are deterred, by the fear of ridicule, from attempting to interfere with it. Beranger, whilst he selects the simplest, the most universal feelings, the most familiar sentiments and images, provided they are true, unforced, and natural, yet, by the tact and skill which he employs in their treatment, and the felicity of their expression, invests them with quite an original character. The oftener a thought has occurred to others, so much the better with him; for it is an evidence of its truth, and of its power of affecting the heart. What remains for him, and what he performs, is to impart to this thought, so familiar to all, though perhaps vaguely and indefinitely, form, colour, expression, so that when presented by him to our notice, it is felt at once to be an old acquaintance, and yet awakens all the curiosity and interest with which we regard a new one. His originality, in short, lies entirely in his application of the idea, and the point and compactness with which the image is brought out by his hands. His success in these respects is great; but it is a success attained, as may be imagined, by the most patient revision. He is said to be an extremely slow composer, frequently laying aside the subject on which he is employed for weeks, and patiently waiting, till, by dint of long reflection on the subject, and careful polishing, by the selection of the happiest allusions, by the studious elimination of every phrase or illustration that appears recherché or ornate, he has given to the whole that unity and appearance of ease and simplicity at which he constantly aims.

GERMAN POETRY.

We have noticed the early development of German heroic song in the Nebelungen and the Heldenbuch; and the introduction of the Provençal taste under the Suabian emperors in the poetry of the Minnesingers. In all its leading features the poetry of this period (1138 to 1346) corresponds with that of the French Troubadours, with this unfavourable distinction, that the poetry of the Minnesingers (love-singers) is much more exclusively devoted to amatory themes than that of the Provençals, which blended with these, warlike and patriotic or satirical effusions. Hence their monotony of effect, when we peruse any of these collections at once, is undeniable. Schiller has, accordingly, in a passage of unusual severity, denounced their poverty of ideas, and says, that if the sparrows were to compose an "almanack of love and friendship," it would probably bear a close resemblance to these cloying strains of the Minnesingers. But against this sarcastic remark must be placed the observations of Frederick Schlegel. "The impression of uniformity arises from our seeing these poems bound together into large collections, a fate which was probably neither the design nor the hope of those who composed them. But, in truth, not only love-songs, but all lyrical poems, if they are really true to nature, and aim at nothing more than the expression of individual feelings, must necessarily be confined within a very narrow range both of thought and sentiment. The truth is, that great variety in lyrical poetry is never to be found, except in those ages of imitation when men are fond of treating of all manner of subjects in all manner of forms. Then, indeed, we often find the tone and taste of twenty different ages and nations brought together within the same collection, and observe that the popularity of the poet is increased exactly in proportion as he descends from his proper dignity, when simplicity is sacrificed to conceits and epigrams, and the ode sinks into an occasional copy of verses."

The opening of German poetry, then, had been, on the whole, brilliant and promising; but the confusion, insecurity, and violence, which followed the death of Frederick II. in 1250, seemed fatal to the progress of improvement. After Rudolph of Hapsburg, we perceive in its poetry a visible decline. The Minnesingers were succeeded by the Mastersingers, personages who seemed to think poetry was to be acquired like any other trade, and to be supported and kept alive by guilds and corporations. It is difficult, perhaps, to point out at what precise period the former school of poetry ends, and the latter begins; they melt into each other like the colours of the rainbow. But the character of the two schools, taken in the mass, is very different: for, in place of the tender, thrilling, amatory spirit of the Minnesingers, the great object of the poetical craftsmen who succeeded them was to give a didactic and philosophical air to their compositions, and to substitute for fancy and feeling, common-place truisms and moral aphorisms. One work only of this period deserves notice, not indeed on account of its high poetry, but of its shrewdness, its effective satire, and its invention, the comic epic, as it may be called, of Reynard the Fox, the groundwork of which, no doubt, existed before in other countries; but the novelty of the treatment of the subject by the German or Frisiac writer, and the great superiority of its execution, entitle it to the character of an original work.

From the close of the fifteenth to the middle of the eighteenth century, a dreary blank intervenes in the poetical annals of Germany. Bouterwek has, indeed, devoted more than a volume of his valuable work to this period; but, whatever interest the minute detail of second-rate names may have for Germans, there is certainly little or nothing calculated to awaken the least interest in the foreign reader. The effects of the thirty years' war were felt in Germany, paralyzing science, general culture, and the spirit of poetry, up to the time of the peace of Westphalia. Opitz and Flemming are the only poets who rise above the dead-level of the mediocrity of the time. Opitz was a great importer from other countries, many of his poetical consignments being derived from Holland. Yet, though not a man of original mind, his strong good sense, a sincere honesty of mind, and a patriotic inspiration, render his poetry even now readable; though probably few are disposed to concur with F. Schlegel in preferring his style to that of Klopstock. Flemming is an inferior poet to Opitz, and yet perhaps his poetry is more interesting, precisely because it is more personal; because it lets us into the secret of his feelings, his friendships, and attachments. Hoffmanswaldau and Lohenstein enjoy the evil distinction of having corrupted, by the most false and fantastic taste, that poetry which was already but too destitute of any great pretensions. The period from 1648 to nearly 1750 is characterized by Schlegel as the age of barbarism, a chaotic interregnum in the history of German literature. Poetry existed in no other shape than that of feeble imitations of the French, profuse of mythology, penurious of feeling, destitute of nationality. "Apollo," says Menzel, "sat on the German Parnassus in a full-bottomed peruke, and, with fiddle in hand, led the concert of the well-powdered muses."

K stock.

When at last the German muse began to arouse herself from her torpor, and to "awake a louder and a loftier strain," she received no countenance from royal patronage. The great Frederick despised and disliked the literature of his countrymen, and seemed to think there was no hope for poetry, save in a slavish adherence to the spirit and the rules of the French. If Klopstock (1708–1803) had done nothing more than awaken the feeling of nationality by his poetry, and teach his countrymen that, in the free and independent cultivation of their own genius, and the selection of their own themes, lay their only chance of redeeming Germany from the state of torpor into which its poetry had fallen, he would have conferred an inestimable service on its literature. With the Messiah, Schlegel thinks the modern poetry of Germany may be said to have begun, so great have been the benefits which it has conferred in regard to style and expression, as well as in the spirit of nationality and religious feeling which it imparted to the poetry by which it was succeeded. The plan, indeed, labours under great and insuperable defects. The mind of Klopstock was but ill suited to the epic; it was eminently lyrical and elegiac. Nor can it be denied that there is a degree of rhetorical pomp and long-windedness about his style, which becomes frequently oppressive, and communicates an air of pedantry to his poem. Still Klopstock has exercised an important and beneficent influence upon German literature; he taught his country its own strength, and freed it at once and for ever from the leading-strings of foreign authority.

Wieland.

Wieland (1733–1813) is more French in character than Klopstock, or rather he blends the luxurious and somewhat licentious spirit of the Italian romantic poets, with that tone of gay and heartless philosophy which the example of Voltaire had introduced into French literature; and yet, withal, he is no mere imitator, but possesses a decided individuality in his later and better works, and even a truly German spirit. The tendency towards the imitation of the French appears, however, chiefly in the earlier productions of his romantic muse, such as the Idris and Zenide, the New Amadis, and others, in which he has assailed with such persevering satire the Platonism of love. As he advanced in life, he began to entertain better views: he grew dissatisfied with that epicurism which he had inculcated as the basis of conduct, and that licentious gaiety which he had made the mainspring of his poetry; and in his Oberon he endeavoured to make amends for the levity with which he had treated the better feelings of the heart, by those charming pictures of conjugal love, true constancy, and chivalrous heroism, which, combined with the beauty of the descriptions, and the pure and simple flow of the style, have rendered the Oberon the only successful effort in later times to revive the tones of that Italian harp which has slumbered since the days of Ariosto.

Gessner.

Gessner (1738–1788) belongs to this period. His Eclogues at one time enjoyed great popularity; and he has certainly in some of them, such as the First Navigation, displayed fancy and invention. But he deals in a species of poetry too remote from actual life; and there is a sort of sheepish modesty about his shepherds, and French coquetry about his nymphs and shepherdesses, which communicate something of a ludicrous character to his Arcadia.

Lessing.

The fame of Lessing (1721–1781) must rest more upon his vigorous, transparent, logical, and delightful prose style, than upon his poetry. His dramas, with the exception of Nathan the Wise, are written in prose; and the style of Nathan scarcely rises above the conversational pitch, though its Brahmin-like simplicity of tone, and the air of mild and tolerant wisdom which pervades it, leave a pleasing impression on the memory.

Schiller, Goethe.

The two greatest names in German literature succeed, namely, Schiller (1759–1805) and Goethe (1749–1832). Of their dramas we have spoken elsewhere. Schiller, however, though greatest as a dramatist, is entitled to nearly equal eminence as a lyric poet. His odes, his short poems, mingling so much philosophy with so much feeling; his charming ballads, pitched on every key, from the simplicity of the Toggenburg and the Fridolin, to the rude force of the Diver, the fine chivalrous and devotional tone of the fight with the dragon, and the classic finish of the complaint of Ceres, or the cranes of Ibycus; would alone have been sufficient to place him second only to Goethe, had he never written William Tell, or the Maid of Orleans, or

Wallenstein. In one particular he must rank far higher than Goethe; in the elevated aim which he always had in view; the attainment of noble ends by noble means; the rendering poetry what it always ought to be, not a mere specimen of plastic ingenuity, but something by which the soul feels itself refined and the heart made better. His enthusiasm, impetuous, and yet tender and affectionate, clothed all the universe, moral and material, with forms of grandeur, and gave to all he uttered the stamp of purity and truth. "His greatest faculty," says the most eloquent of his biographers, "was a half poetical, half philosophical imagination, a faculty teeming with magnificence and brilliancy; now adorning or aiding to erect a stately pyramid of scientific speculation, now brooding over the abysses of thought and feeling, till thoughts and feelings else unutterable were embodied in expressive forms, and palaces and landscapes, glowing in ethereal beauty, rose like exhalations from the bosom of the deep."

Of Goethe we have already so very fully expressed our opinion (see the article GOETHE), that we shall not again enter upon the subject.

At the present day the aspect of German poetry is not the most imposing. Tiek, who had evinced high talent for the Mährchen, or Legendary Tale, to which he communicated all the charm of earnest belief, and the most musical versification, has for some time past exchanged poetry for prose and polemical discussion. Uhland and Ruckert are at this moment the most eminent among the German lyric poets; for the effusions of Heine, wretched attempts to infuse a sneering imitation of Byronism into lyric poetry, have already, we believe, survived their popularity. The host of poets, besides these, is numerous, but not of any marked excellence or originality. Judging from a few of his compositions, we should be disposed to say there was more of poetical genius in Leopold Schefer, than in almost any of his contemporaries.

ENGLISH POETRY.

It is not our intention to enter into any minute details as to English poetry, with which we shall conclude the present sketch. Since we have already noticed, under separate heads, most of the individuals by whom it was adorned, we shall merely attempt to indicate generally the directions taken by poetical taste at different periods of our annals.

Even prior to the Norman conquest, we know from William of Malmesbury, that England, like all the Gothic nations, had been possessed by a large mass of ballads, written in Anglo-Saxon, though, as no fragments of these remain, we know nothing of their poetical merit. This earlier minstrelsy must soon have sunk into discredit, or been entirely suppressed, by the Norman conquest.

The English language, as it now exists, grew out of the mixture of the Anglo-Saxon with the Norman, and seems to have acquired a complete form by the middle of the thirteenth century. In 1297, we have the Rhyming Chronicle of Robert of Gloucester, the first undoubted composition in the English tongue.

From the Norman conquest to the time of Edward III., the literature and poetry of England consists of little else than translations from, or imitations of, the Norman romances and chronicles; and, judging from the ridicule with which they have been assailed by Chaucer in his Rhyme of Sir Thopas, they must have been of slender merit, since they are represented as shocking the taste, of course not particularly refined, of the host of the Tabard. The distance, at all events, which separates all our English versifiers of this period from Chaucer (born 1328, died 1406), is such as justly to entitle him to the honour of being the first of English poets, the sun that "flames in the forehead of the modern sky;" throwing out a splendour that showed at once his own lustre, and the dreary wastes that spread far and wide towards the literary horizon.

Chaucer.

Much of Chaucer's time, however, was wasted in the school of those French allegorical poets, whose romances were at one time so influential in Europe. In fact, nearly half his life, as Mr Campbell remarks, was passed amongst the dreams, emblems, flower-worshippings, and courts and parliaments of love, of that visionary and tiresome school. He was fifty-four years of age before he commenced the Canterbury Tales, in which alone the peculiarities of his genius, its originality, and its extent, can be said to be completely manifested. This late discovery of the true bent of his powers is singular; for Chaucer appears peculiarly marked out as the poet, not of mysticism and allegory, but of clear observation of life, and of practical aims. In the Canterbury Tales, which were obviously suggested by the influence of Boccacio's Decameron, he first found full scope for the display of the various qualities of his mind, and of that mass of real knowledge of life with which his experience of society, in all its aspects, high and low, from the palace to the cottage, at home and abroad, had supplied his mind. His clear observation, and corresponding power of clear painting, giving the most vivid picturesqueness to all his delineations; his quiet and unobtrusive humour; his satirical power, at once forcible and delicate (a combination peculiarly rare in that stage of struggling and imperfect civilization); his imagination sufficiently elevated, yet always regulated by good sense; a cheerful contented tone of feeling, which makes him impartial towards all the world; a power either of creating character, or of so artfully and harmoniously putting together the result of his actual studies of men, as to give to these all the free and natural effect of a creation; all these qualities found fit scope for their exercise in the broad, varied canvass he selected, which, by means of its ingenious framework, of a pilgrimage embracing persons of both sexes and of all ranks, and enlivened by tales told to relieve the tedium of the way, admitted equally of the comic and the tragic, the high and low; themes of chivalry and mythology, like the Knight's Tale; tales of wonder, blending oriental marvels with the romance of the West, like the Squire's; or stories of English low life, like the Miller's or the Reve's. The versatility of talent, indeed, displayed in the Canterbury Tales is astonishing; and, as in the case of his Italian rival, Boccacio, it is difficult to say whether it is in the comic or the tragic that Chaucer most excels.

In invention, so far as regards incident, the English poet and the Italian novelist may be placed nearly on a par; the woodland freshness and beauty of Chaucer's forest scenes, may be equalled by the charming country landscapes in which Boccacio places his interlocutors; but in power of characteristic delineation, particularly by those minute strokes of Dutch painting which present the exterior of objects, or those happily selected traits which at once mark the individual, Boccacio cannot sustain the least comparison with the father of English poetry. He has many faults, but they are the faults of his age; the faults of coarseness of taste and manners, of inartificial plans, of prolixity of style; the natural errors to which the infancy of poetry, destitute of models, and struggling with an unformed language, was exposed. Against these must be placed the advantages of a vocabulary in which words are pictures, of subjects of description, unhackneyed, and bright with all their primitive freshness; the wisdom or grave humour of the philosophic observer blending most cunningly with the *bonhommie* and the garrulous graces of the narrator; an easy *abandon*, both as to matter and manner, which has its charm, however little reconcileable with the more artificial treatment which criticism would suggest; nature painted without exaggeration, as without disguise; and withal that feeling of unity imparted to the whole, which makes the most discordant elements unite in kindly harmony, and which is never found except in the productions of the highest minds.

The appearance of Chaucer in English poetry has been well compared by Warton to the early appearance of a bright and genial day in an English spring; exciting the brighter hopes of a speedy and balmy summer,—hopes which are almost immediately blasted by the return of frost and tempest, and the settling down of winter, as bleak and blighting as before. In English poetry that effect was produced by the disastrous period of the wars of the Roses.

From the time of Chaucer almost to that of Spenser, certainly no progress is made; or rather, if the language in some degree advances, the spirit of poetry retrogrades. Gower was his contemporary, Lydgate followed immediately after him; but they belong, so far as regards poetical genius, nay even poetical dexterity, to a previous century. In truth, the first introduction of learning into England appears to have been unfavourable to poetry, giving rise to pedantic imitation in place of independent efforts of genius; a tendency which, indeed, to some extent, is visible even in the finest poetry of the Elizabethan period. By far the most distinguished name, indeed, between Chaucer and Spenser, is that of the Scottish poet Dunbar, who, in humour and power of character-painting, greatly surpasses Gower, and approaches to Chaucer. The poems of Surrey, and Wyatt, and Sackville, who followed during the reign of Henry VIII., can be regarded only as proofs that the love of poetry had not ceased to exist, and that in some shape, however rude, its voice was struggling to make itself heard in that calmer and more settled state of the political atmosphere which had followed the union of the rival houses in the persons of Henry VII. and Elizabeth of York.

Age Elizabe

But when Spenser arose to enrich English literature with another great work of original genius, many causes, which had probably at first acted unfavourably for the progress of poetry, were beginning to exercise a more salutary operation. The Reformation, which had at first produced tumult, bloodshed, and wide-extended distress, by the suppression of those great hospitals, the monasteries, was now beginning to bring forth its better fruits, in the shape of a free and inquiring spirit, carried into all departments of thought and imagination. That acquaintance with the treasures of ancient learning, or the classic poetry of modern Italy, which had at first tended to overpower and confuse the national mind, was now turned to better account; it had insensibly refined the taste, and made the purest models of preceding times familiar to the poet and the scholar. The spirit of chivalry, still lingering in the English character, had been aroused into new and active existence by the triumphs which had attended the national arms during the reign of Elizabeth. A love of adventure had been generated by the frequent expeditions into remote countries and climes, as to which, in that imperfect state of geographical and physical knowledge, marvels were believed, as incredible as any that figure in the pages of Sir John Mandeville. There was, in short, at this period, a remarkable union, in the English character, of the sober qualities of strong intellect with deep convictions and high imagination; a character which manifests itself in every department both of poetry and literature.

Spen

Born in this happy period, and educated under such influences, Spenser (1510–1598) produced his great poem of the Fairy Queen. Familiar with Italian literature, as well as with the best learning of antiquity, it was from the works of Ariosto and Tasso that he had derived his bent towards chivalrous poetry. But the deeper earnestness of his character prevented him from treating his subject with the levity of Ariosto. Chivalry was to him a principle of faith, a part of religion, not the mere fantastic framework in which successive pageants of love and war, or luxurious description, were to be enclosed. In England it had not assumed that outworn and almost comic air which it wore when Ariosto first took up the entangled threads of Boiardo. It had still a vital influence on society, and ran like a thread of silver tissue through the coarser web of life. Nay, even the religious spirit in which Tasso had conceived the Jerusalem, scarcely satisfied the mind of Spenser. He would render every incident which he described a step in some high argument or moral demonstration; every character the embodied representation of some virtue and vice; all the visions of imagination subservient to the cause of religion. He would enlist all the restless and excursive intellect, and adventurous feelings of an ardent and romantic age, under the banner of purity and goodness.

> That with the glory of so goodly sight,
> The hearts of men that fondly here desire
> Faire seeming shews, and feed on vain delight,
> Transported with celestial desire
> Of those fair forms, may lift themselves up higher,
> And learn to love, with zealous humble duty,
> Th' eternal fountain of that heavenly beauty.

And so deeply does this principle pervade his poems, that, whilst wandering among the scenes of enchantment with which he surrounds us in that spiritual region to which he gives the name of Fairy Land, we can never forget that they have a spell beyond their first outward significance, nor be insensible to that still small voice of piety and wisdom, which speaks through all those creations of his genius, and whispers that the place whereon we are standing is holy ground.

It must be admitted, however, that if this under-current of allegory gives a degree of solemnity and moral grandeur to Spenser's poem, its effects in other respects are unfavourable. It does occasionally interfere with the natural movements of the imagination, gives a formal and metaphysical air to the conceptions of the poet, and, by rendering the characters abstractions of moral qualities, impairs their individuality as human beings. So far the injurious effect of Spenser's allegorical plan can hardly be denied; but it is absurd to speak of the allegory in Spenser being so obtrusive and continuous as altogether to destroy the interest of the poem as a representation of romantic life. The fact is quite different. Occasionally, no doubt, in the personifications of Envy or Pride, or the siege of the Castle of Temperance, in which the barriers of hearing, sense, smell, taste, and touch are represented as successively assailed by troops of monsters from without, the allegory is too prominent; but assuredly it sinks entirely out of view, and is perceived only on subsequent reflection, in the deep human interest of all the finer passages of the poem, such as the remorse of the Red Cross Knight, his temptation by Despair; the wanderings of Una, with her angel face "making a sunshine in the shady place;" Guyon's visit to the cave of Mammon, and his trial in the gardens of Acrasia; the combat of Campbel with the three brothers; or the many other passages, which must be impressed upon the memory of every reader.

An extreme sensibility, almost amounting to a luxurious love of beauty, a flush of colour in his descriptions, which has led Mr Campbell to compare him to Rubens, and a fancy of the most remarkable exuberance, are the leading qualities of Spenser's mind. In this prodigality of fancy, indeed, lies at once the strength and the weakness of Spenser: for while it infuses life into all his pictures, making the plumes of Prince Arthur wave like the almond-tree on the top of Selinis; or the face of Britomart, when she raises her vizor, like the moon breaking forth in darksome night from behind the noisome cloud in which she was enveloped; so, on the other hand, it leads him occasionally to revel in images and traits which are painful, or even physically revolting, such as the portrait of Gluttony, the loathsome vomit of Envy, or the minute description of the operation of Diet and Appetite, Concoction and Digestion, with some other inmates of Castle Temperance. His fancy may indeed be compared to the Nile in its overflow, disdaining the confinement of banks, and spreading around a luxuriance of soil, alike productive of the flower and the weed.

In the portraiture of the allegorical beings introduced, Spenser is admitted to be without a rival. In his hand they almost cease to be mere abstractions of good and evil qualities, so life-like is the form in which they are presented, so picturesque the garb and accompaniments with which they are invested, so natural the gestures, actions, and occupations, attributed to them. They appear the natural inhabitants of this realm of enchantment, raised as it is many degrees above the level of reality, bright in the near ground, with the sunniest tints of fancy, and fading away in the distance into the most aerial and heavenly hues.

The language of Spenser seems to be steeped in music; he is the greatest master of the difficult art of employing alliteration with success; his versification unites in the highest degree melody with majesty. It is formed on the principle of the Italian *ottava rima;* but, by the addition of the Alexandrine, it possesses a sonorous grandeur in the close which the Italian stanza wants. "It has not," says Mr Hazlitt, "the bold dramatic transitions of Shakspeare's blank verse, nor the high varied tone of Milton's; but it is the perfection of harmony, dissolving the soul in pleasure, or holding it captive in the chains of suspense. Spenser is the poet of our waking dreams; and he invented not only a language, but a music of his own for them. The modulations are infinite, like those of the waves of the sea; but the effect is still the same, lulling the senses into a deep oblivion of all the jarring noises of the world."

In the hands of Spenser, the allegorical form appears invested with all the brightest colours of the fancy. In the works of most of his contemporaries it appears lifeless and pedantic. A disagreeable mixture of stilted expression and false learning blends with and alloys most of the poetry of the time. It deforms the otherwise noble lines of Sir John Davies, and renders Silvester unreadable. Shakspeare is not free from it; for it was deeply inwoven with the national taste of the time, and showed itself in the language of ordinary conversation no less than in poetry. Yet it is delightful to find the greatest dramatist also the greatest lyrical poet of his age; for, after Spenser, what work of that time will bear the least comparison with Shakspeare's sonnets? Sonnets they are not, in the strict Italian sense; but for condensation of imagery, for natural thoughts, clothing themselves in the aptest expressions either of majesty or melody, without any redundance of expletives, or rank luxuriance of epithets, they leave Petrarch and his imitators at a distance. A singular grace, and even dreamy beauty, surprises us in the masques of Ben Jonson; because it contrasts so strangely with the otherwise hard and saturnine turn of his mind. A few gems, amidst much that is coarse or quaint or indifferent, may be gleaned from the pages of Herrick; power and vigour, mixed with sectarian gloom, and deformed by extreme ruggedness of versification, are visible in Quarles. The rise of satire appears in the works of Hall and Donne, of pastoral in Browne; while sacred poetry finds no unworthy representatives in Giles Fletcher and Crashaw. A lighter and gayer taste, a more level, but natural expression, shows itself in the compositions of the cavalier poets of the court of Charles I., in the graceful little airs and verses of Carew, Lovelace, Davenant, and Suckling. In particular, to them we are indebted for some of the best of the few good songs we possess in English; witness the "He that loves a rosy cheek" of Carew, and the song written by Lovelace during his confinement in Westminster, "When love with unconfined wings hovers within my gates." To Denham and Waller, particularly the latter, have been ascribed by Johnson the glory of improving our English numbers. It would be more just to say, that they had the good sense to perceive the importance of this element of poetry, as Spenser had done, while their contemporaries too much neglected it. Almost all the poets above mentioned have been classed by Johnson under the title of the metaphysical poets; a title of doubtful application as to any of them, but which, if it be applicable to Cowley, whom he considers their chief, can scarcely be very accurate when applied to Suckling and Waller. Cowley is simply a poet in whom the fancy, while it is teeming and fertile, is seldom warmed by passion or directed by judgment; whose miscellaneous learning oppresses and buries his taste; and who therefore wearies us even at the moment he impresses us with the consciousness of his great resources and his mental powers.

Change produced by the civil war.

A great change in the character and spirit of poetry followed the convulsions which closed abruptly the reign of the first Charles. The poetry of that court leant towards the elegant, the romantic, the fanciful, the brilliant, and witty; but the stronger passions which had been awakened, the deeper interests which had been put in hazard, by the civil war, had soon impressed a character of solemnity on all literature, and made poetry itself, following the fashion of the time, assume a polemical, ascetic, sometimes mystical, yet grand and enthusiastic character. In those whose tastes were formed only after the change, this polemical character, and this proscription of certain subjects or associations, to which puritanism led, would probably have damped the wing and narrowed the flight of imagination; and accordingly no great poet appears to have been reared in that rigid and prosaic school. But the tastes of Milton, the great poet of this period, had all been formed in an age and a school more favourable to the exercise of the imaginative powers; his exquisite lyrics, and his Comus, had already been written before he visited Italy in 1638, at the very time when Carew, and Suckling, and Davenant were in the height of their popularity and reputation. Ere his great epic poem appeared, he had witnessed and deeply shared in the agitating struggle which had ended in the temporary subversion of the monarchy, and the stern but imposing despotism of Cromwell; and thus educated in the former period, and as yet witnessing the best bloom and flush of the latter, he united the chivalrous recollections of the Elizabethan age, and the classic associations with which his early education had filled his mind, with the enthusiasm of principle and intensity of will which characterised the men of the Parliament. Milton represents more vividly than any other the wide sweep and overpowering force of those political and religious sentiments which agitated the age; for all his earlier leanings were visibly directed towards the romantic and gorgeous associations of the past, towards the pride and pomp of chivalry, the well-trod stage, the throngs of knights and barons bold, the stateliness of feudal castles, the solemnity of minsters, the pomp of tournaments, the peal of organs, and the dim religious light of painted windows. Such was the poet of Lycidas, of Comus, of the Allegro, and the Penseroso, the two most perfect gems of contemplative lyric poetry of which Britain has to boast; and yet we see these tastes abandoned or repressed as he advances in life and in party spirit, till at last he views them only as unnatural corruptions of primitive liberty and simplicity. Still, with Milton, though a taint of bigotry pervades his views, everything is pure, high minded, and disinterested. "Nought he does in hate, but all in honour." He stands at an immense distance from the sect to whom he had allied himself, but with whom, after all, he had little in common. In no one does poetry more conspicuously appear a part of religion. He regards it as a sacred trust, not to be sacrificed on the altar of vanity, not to be purchased for a price, not to be applied to any unworthy or even trifling end.

> Driving far off each thing of sin and guilt,
> And in clear dream and solemn vision
> Telling of things which no gross ear can hear;
> Till oft converse with heavenly habitants
> Begin to cast a beam on the outer shape,
> The unpolluted temple of the mind,
> And turn it by degrees to the soul's essence,
> Till all be made immortal.

It would be absurd, at the present day, to enter on any formal criticism of his great work of Paradise Lost, the most original, if not the most successful, of modern epics. About no poem perhaps are opinions more agreed; every one feels its sustained loftiness, combined with so much of tenderness, in the scenes of Eden, but always suggesting the idea of effort and labour,—the wonderful art with which learning itself is rendered poetical in his hands; for even the visions of mythology, and the fantastical traditions of chivalry, are made to heighten the effect of a sacred poem dealing with the mystery of the fall of man;—and, lastly, the consummate artifice of the versification, which, as Hazlitt remarks, seems to float up and down, as if on wings.

B[illegible]r.

Milton represents the more imposing side of the Puritans, and he is almost the solitary poet of whom they can boast. The other side of their character, their hypocrisy, and their narrow and coarse tastes, are exposed in the merciless and consummately clever Hudibras of Butler. The poem is now, no doubt, in a great measure obsolete, like every application of poetry to the exposure of the peculiarities or vices of a particular age; yet its masculine vigour, its condensation of thought, and its wit, entitle Butler to a very high rank among the broad humourists of poetry.

Dr[illegible]n,

From the oppressive wit and subtilty of Cowley and his fellows, it is delightful to turn to the manliness, the common sense, the "long-resounding march and energy divine," of Dryden, who marks the point of transition from the metaphysical poetry to the critical. He had himself in youth been strongly influenced by the pervading taste for conceit; and it must be admitted, that in the greater part of his dramatic writings this taint clings to him to the last. As a dramatist, indeed, we can admire in him nothing but the nerve and vigour of his dialogue, and that power of reasoning in verse in which he so much excelled. But in his other works, such as the Absalom and Achitophel, he threw aside this rage for conceits, he was natural, transparent, vigorous; his illustrations, instead of being sought for, as in the case of Cowley, on account of their remoteness and apparent inaptitude, are such as at once adorn and elucidate, and are felt to be close and familiar without being common. High imagination he did not possess, and for his purpose it was scarcely needed. He has, in fact, scarcely written a line which is pathetic, and few that can be considered sublime. Yet in fancy he was not deficient, for it supplies him with inexhaustible imagery; his Ode shows that he could be raised at times into a true lyrical enthusiasm, whilst his judgment rarely fails him, except, indeed, in those bombastic plays, which he had framed by jumbling together an imbroglio of two inconsistent models, the French school, from which he borrowed his rhymes and his affectation of sentiment; and the Spanish, to which he was indebted for the exaggeration of his passionate scenes, and the complexity of his plots. Had he known nothing of these, and been left to form himself on the model of Spenser and Milton and Shakspeare, and in a less artificial state of society, he might at least have avoided the gross want of nature evinced in these rhyming plays, though we can hardly persuade ourselves that, by any process of tuition, he could ever have become a great dramatist. "The general soundness and healthfulness of his mental constitution, his information of vast superficies though of small volume, his wit scarcely inferior to that of the most distinguished followers of Donne, his eloquence grave, deliberative, and commanding, could not save him from disgraceful failure as a rival of Shakspeare, but raised him far above the level of Boileau. His command of language was immense. With him died the secret of the old poetical diction of England, the art of producing rich effects by familiar words. In the following century it was as completely lost as the Gothic method of painting glass, and was but poorly supplied by the laborious and tesselated imitations of Mason and Gray. On the other hand, he was the first writer under whose skilful management the scientific vocabulary fell into natural and pleasing verse. In this department he succeeded as completely as his contemporary Gibbons succeeded in the similar enterprise of carving the most delicate flowers from heart of oak. The toughest and most knotty parts of language became ductile at his touch. His versification, in the same manner, while it gave the first model of that neatness and precision which the following generation esteemed so highly, exhibited at the same time the last examples of nobleness, freedom, variety of pause, and cadence."[1]

Pope.

Pope is the last great writer of that school of poetry, the poetry of the intellect, or rather of the intellect mingled with the fancy, which occupies the period from the Restoration to the close of the eighteenth century. In Dryden's satires and miscellaneous poems, we perceive the reasoning poetry brought to its perfection, as far as regards vigour of conception and force of expression. In these respects nothing remained to be added. But Pope possessed that quick tact and intuitive discernment, both of the range and limit of his own powers, and also of the taste of the age, which showed him the solitary direction in which, so far as regarded this philosophic and critical school of poetry, there yet remained an opening for himself. He felt that the qualities of his mind did not fit him to surpass, and scarcely to contend on equal terms, with Dryden, so far as regarded grasp or force; but he conceived, that in the way of polish, refinement, grace, and choice of expression, something yet remained to be done, and that that something he was able to afford. Selecting, by a natural preference, themes of a moral and didactic rather than passionate character, adopting the idea that everything should be polished to the highest pitch, and that artifice was the fundamental principle of poetry, that artifice, he thought, could hardly be carried too far; and, accordingly, with Pope we find habitual that attention to words which is only occasional with Dryden. If in Dryden we perceive a tendency to substitute logic and reflection for feeling, to exhibit pictures of conventional and artificial rather than of general nature, and to borrow his illustrations much oftener from science and art than from natural objects, this tendency appears still more decided and uniform in Pope, who is pre-eminently the poet of a period of high intellectual culture and limited poetical sensibilities; the poet who wrought to its last perfection the pure but limited vein which this contemplative and preceptive style of poetry afforded. After Dryden nothing new could have been achieved for this style of poetry, save what has been done by Pope; and what he attempted he perfected.

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[1] Edinburgh Review

It is indeed impossible to award to him a rank in poetry of the same kind with that which had been occupied by our Miltons, Spensers, and Shakspeares. In the highest departments of poetry, the epic and dramatic, he has attempted nothing. In the lyrical he has failed. In translation his example has tended to corrupt the national taste, and to substitute a glittering, false, and metaphrastical version for a true translation. His forte is essentially the didactic and satirical; moral instruction or censure enforced with all the charms or all the point of which such subjects are susceptible. Within that range he has never yet found his equal; for to the logical and reasoning power and condensation of Dryden and of Boileau, he adds at times, as in his Rape of the Lock, an excursiveness and brilliancy of fancy, a compact strength with perfect harmony, a quiet, graceful, continuous humour, altogether without parallel. Yet, whilst speaking of the harmony of his versification, it must be added, that he carried this principle to excess; that his system of terminating the sense invariably with the line, and his pauses, placed almost always on the fourth or sixth syllable, led to a monotony the most painful when contrasted with the varied pauses and lines flowing into each other, which were so happily employed by our elder writers; and that, finally, in regard to rhymes, Pope, though he was singularly limited as to range, was even within that range far from correct.

Prior.

" The best," says an eminent critic, " of what we copied from the continental school, is copied in the lighter pieces of Prior. That tone of polite raillery, that airy, rapid, picturesque narrative, mixed up of wit and naiveté, that style, in short, of good conversation, concentrated into flowing and polished verses, was not within the vein of our native poets, and probably never would have been known among us, if we had been left to our own resources. It is lamentable that this, which alone was worth borrowing, is the only thing which has not been retained. The tales and little apologues of Prior are still the only examples of this style in our language."

As we advance through the eighteenth century, we perceive that the critical school of poetry had evidently attained its perfection in Pope, and was destined, at no distant period, to sink into mere prose, disguised under the appearance of verse. At least, after Pope, there is a visible decline, until the appearance of the first germs of a new taste, with which the intellect had less to do, whilst the feelings obtained a more decided supremacy.

Addison,
Swift.

Addison's poetry is so flat, and cold, and destitute of imagination, that, but for the exquisite grace and refined taste of his prose works, it would not now be mentioned; and Swift, though a most clever versifier, and endowed with no ordinary talents for libel in the shape of epigram or satire, can hardly, by any stretch of favour, be regarded as a poet.

Thomson.

The first symptoms of the change which had been gradually going on, appears in the return to a taste for simple instead of artificial nature; for as yet the revival of strong feeling or passion would have met with no sympathetic feeling on the part of the public. In Thomson are to be traced the first symptoms of the reviving taste for the " simple-natural." True it is, his field is limited. When he attempts narrative, when he indulges in properly didactic poetry, his style appears cumbrous, and his ideas commonplace enough. " Liberty," says Dr Johnson, " when it first appeared, I tried to read, and soon desisted." Few at the present day will even make the trial. But when he comes to deal with the matters which lie within his proper sphere, and are congenial to his quiet, contemplative, and indolent turn of mind, he is an original and a striking poet. We must never forget, in speaking of Thomson at the present day, that his poem was the first of its kind, and even yet, like Milton's Eve, it is the fairest of its daughters. Even now we must admire the painter-like skill with which, in his rural descriptions, he selects his point of view, the art with which he seizes the characteristic, and drops the less marking features of the landscape; the infinite variety of little circumstances connected with animate and inanimate nature, unnoticed by his predecessors, but which his quick tact detects and sets before our eyes; the soft, bland, Claude-like glow which he spreads over all he touches; the spirit of love, and benevolence, and philanthropy, which he awakens; qualities which give to his Seasons a fascination which, though felt most strongly in childhood, is yet not materially abated by the judgment of cooler years. His faults are cumbrousness of diction, and occasional vulgarity of taste.

Goldsmi

The same sweet and natural tastes, though of a more refined kind, the same philanthropical spirit, and the same gentle inspiration of poetry, are visible in Goldsmith. He has not indeed Thomson's sympathy with the sublime and terrible in nature; his mind habitually turned towards its milder and more smiling aspects, the fertility and richness of cultivation, the tranquillizing tone of village life, " the short and simple annals of the poor." " He is refined," says Mr Campbell, " without false delicacy, and correct without insipidity. Perhaps there is an intellectual composure in his manner, which may in some passages be said to approach to the reserved and prosaic; but he unbends from this grave strain of reflection to tenderness, and even to playfulness, with a peculiar grace, and connects extensive and philosophic views of the happiness and interests of society with pictures of life that touch the heart by their homeliness and familiarity....His whole manner has a still depth of feeling and reflection, which gives back the image of nature unruffled, and minutely. He has no redundant thoughts or false transports, but seems on every occasion to have weighed the impulse to which he surrendered himself; and whatever ardour or casual felicities he may have thus sacrificed, he gained a high degree of purity and self-possession."

Blair,
Ramsay.

The names of Blair and Ramsay deserve notice, the first as the author of a poem gloomy and homely, but with a decided character, and a picturesqueness of imagery, which redeem it from vulgarity, and which have been justly compared to the powerful expression of a countenance without regular beauty; the latter as the writer of a true pastoral drama, in a style totally different from the hackneyed mythological models on the subject, and delineating the natural and simple manners of the peasantry of Scotland, with a truth, a comic archness and tenderness, which entitle the Gentle Shepherd to an honourable rank in British poetry.

Savage,
Chatterton.

A mournful interest attaches itself to the names of Savage and Chatterton, both the victims of misfortunes caused, in some degree, by their irregularities of conduct or deficiency of principle. In the latter, in particular, the seeds of a mind of considerable power are evidently discernible, choked indeed with many rank weeds of evil tendency, but which, pruned and weeded by years and experience, might have rendered him an ornament to the literature of the eighteenth century.

Collins.

Collins wrote but little, yet that little was of first-rate merit. His Oriental Eclogues may be regarded as only a boyish production; but the rest of his lyrics suffer only by comparison with those of Milton, and that chiefly through a certain obscurity of diction, into which he was led by endeavouring to avoid the commonplaces of expression. In proportion to the neglect which they encountered on their first appearance, has been their popularity since. The Ode on the Passions, in particular, has become a universal favourite, by its admirable personations, the flush of beautiful colouring with which it is invested, and the richness of the versification, which adapts itself with such art to the themes of sadness and gaiety, or deep gloom, which alternate throughout the poem.

There is strength and nerve, but nothing more, in the ferocious satires of the dissipated Churchill; an undeniable, though very often turgid and unsubstantial, grandeur about Akenside's Pleasures of the Imagination; but there is also perfect truth in Johnson's remark, that the words are multiplied till the sense is hardly perceived, and that attention deserts the mind and settles on the ear. Some pleasing pictures in Dyer and Armstrong, and a natural grace in Shenstone (which, however, sometimes borders on childishness), will preserve a certain popularity to Grongar Hill, the Art of Preserving Health, and the School-Mistress. The merits of Falconer's Shipwreck have, we think, been overrated. Its technicalities frequently appear tedious, and few poets have dealt more in needless expletives and mere commonplaces of description. Of Glover, whose Leonidas was once compared to Milton's Paradise Lost, the world now remembers nothing except his clever ballad of Hozier's Ghost.

Young is a poet of more fire, and of a decided though perverted ingenuity. He exhibits a curious mixture of the style of Queen Anne's day with the more pensive and meditative cast of our own. Few poems could be pointed out in which so much point, rare wit, and brilliancy, have been employed with so little effect. The whole poem is a long epigram, a string of hyperboles. It is precisely such a work, indeed, as we should expect to be produced by a person naturally of a cheerful turn of mind, putting on, for the sake of effect, the garb of melancholy, and misanthropy, and weariness of existence; and composing, as he is said to have done, by the light of a candle stuck into a human skull. It has the worst points of Lord Byron's manner, without the earnestness and verity of that feeling of weariness of the world which speaks throughout Childe Harold.

Gray, in the delicacy, the classical neatness, and polish of his verses, is closely associated with the writers of the age of Anne. There is no doubt a certain want of ease and spontaneity about Gray; his inspiration seems to flow slowly; he rises with compulsion and laborious flight. His poetical fire seems often cold and phosphorescent; but he has a fine sensibility to the beautiful and sublime, a mind richly stored with the beauties of the classical and Italian poets, and he has combined his ideas of invention and recollection in a mosaic of singular delicacy and compactness.

In the Minstrel of Beattie, some of the features of modern poetry become discernible, in its stronger sympathy with nature; nay, even in the general idea of the poem, which describes the solitary growth of a romantic and poetical spirit, and which possesses high merits as a sweet picture of still life, and a vehicle of unobtrusive morality.

But the complete transition from the artificial style of the writers of Queen Anne, to that which characterized the poetry of the opening of the present century, first appears visible in Cowper; who, throwing aside the trammels of artificial refinement, and the imaginary requisites of a conventional poetical diction and classical imagery, ventured to write as he thought, with the force and freedom of an older and a better time. In no poet of the last century did a more vigorous and original cast of mind present itself; and to no poet are we more indebted for awakening that freer and more forcible spirit, that poetry of the heart rather than the head, which has formed the marking feature of our own times. His satirical and didactic poems, though abounding with wit, and animated by the eloquence of conviction, are indeed deformed by many defects, both of indifferent poetry and bigotry of opinion; but in his descriptive poetry, in his charming pictures of in-door life, his summer and winter landscapes (so different from Thomson's, by their minute detail), in those bursts of inspiration which occasionally escape the poet, as in that where he addresses the stars in the fifth book of the Task, he has left us some of the most touching and spirit-stirring passages of which the eighteenth century has to boast.

Burns. The same spirit appears, in Scotland, in the deep tenderness of the lyrics of Burns. Much of his poetry, doubtless, can only be remembered with regret, as the effusion of a reckless and ungoverned spirit, mistaking coarseness for force, and confounding genius with extravagance and irregularity. But he has left behind him a few strains which are of a higher mood, nay, of the very highest order; familiar and yet noble, tender and yet manly; such as a peasant only could have written, but a peasant who was one of nature's nobles. "Scotland," says an American critic, "owes a large debt of gratitude to Burns; for he invested the feelings and sentiments of its peasantry, their joys and sorrows, with dignity and beauty; he redeemed their language from neglect, if not from contempt; he made the heart of every true Scot burn within him as he thought of the hills and valleys of his native land; he first guided the footstep of the pilgrim to the scenes of her traditionary glories, and he sung those glories in strains so simple, yet sublime, that the world stood still to listen."

Although, in the poetry of Burns, there are abundant traces of that stern force and strong passion with which we have been of late rather too familiar, the general tone of the poetry of the eighteenth century may be described as quiet and contemplative. But the great and terrible events which darkened its close, exciting the minds of men throughout Europe, introduced into the literature of all nations a spirit of restlessness and doubt, a love of strong agitation and stimulus, which either manifested themselves in a longing retrospection and veneration for the past, or in wild discontent with the present, and delusive visions of the future. This tendency appears in the publication of our ancient ballads, and the enthusiastic admiration which their rough vigour, their simple pathos, and their spirit-stirring pictures of love or war awakened; in the undiscriminating republication and study of our older dramatists of the school of Shakspeare, and our lyrical poets of the period which immediately followed; in the popularity and influence which the works of Goethe and Schiller, stamped with the character of the time, immediately obtained, when introduced to us through the means of wretched translations; and in that mixture of scepticism, moody discontent, and wild enthusiasm which had been painted in such gloomy and forcible colours in the Werther, the Faust, and the Robbers.

On the poetry of the present century, however, we do not intend to enter at all. Many of its most distinguished writers are yet alive; and we are still too near to others to enable us to appreciate their merits with calmness or impartiality. We shall merely remark, that the leading directions which poetry has taken during that period seem reducible to three: The chivalrous poetry of Scott and his school, the taste for which has in a great measure disappeared; the gloomy and sceptical, but most forcible, and occasionally touching poetry of Byron, which may be said to have expired with the great original; and, lastly, the contemplative and philosophical poetry of Wordsworth, the better parts of which are animated by a natural tenderness, and sustained by a moral grandeur, of which the others cannot boast, and which, though its influence over the public mind has been more gradual, promises to maintain a more enduring popularity than either. Crabbe and Campbell alone seem to have been but little influenced by the genius either of Scott, Byron, or Wordsworth, and to have pursued an independent course. In the other poets of the nineteenth century, the influence of one or other of these master-minds, and sometimes of more than one, is too prominent and palpable to be mistaken. (W. W. W. W.)

POGGIO **Bracciolini**, a man of great parts and learning, who contributed much to the revival of letters in Europe, was born at the little town of Terranova, near Florence, in 1380. His first public employment was that of writer of the apostolic letters, which he held for ten years, after which he was made apostolic secretary, and in that capacity he officiated, under seven popes, for a period of forty years. In 1453, when he had attained the age of seventy-two, he accepted the employment of secretary to the republic of Florence, and he died in 1459. Poggio visited several countries, and searched many monasteries to recover ancient authors, numbers of which he brought to light. His own works consist of moral pieces, orations, letters, and a history of Florence from 1350 to 1455, which is the most considerable of them all. In 1802, the Rev. Dr Shepherd published, in one volume quarto, a Life of Poggio, containing much curious information in literary history.

POGGY **Islands**. See **Nassau Isles**.

POGROMNAIA RECA, a small river of Asiatic Russia, in the district of Nertschinsk. It has on its banks a spring of mineral water, which is successfully employed in the cure of several diseases.

POICTIERS. See **Poitiers**.

POINT, a term used in various arts.

Point, in *Grammar*, is a character used to mark the divisions of discourse. A point proper is what is otherwise called a *period* or *full stop*. See **Punctuation**.

Point, in *Geometry*, according to Euclid, is that which has neither parts nor magnitude.

Point, in *Music*, a mark or note anciently used to distinguish the tones or sounds. Hence we still call it *simple counterpoint*, when a note of the lower part answers exactly to that of the upper; and *figurative counterpoint* when any note is syncopated, so that one of the parts makes several notes or inflections of the voice, whilst the other holds on one.

A point is still used to raise the value of a note, and prolong its time by one half. Thus a point added to a semibreve, instead of two minims, makes it equal to three; and so of the other notes.

Point, in *Astronomy*, a term applied to certain points or places marked in the heavens, and which are distinguished by proper epithets.

The four grand points or divisions of the horizon, namely, the east, west, north, and south, are denominated the *cardinal points*.

The zenith and nadir are the *vertical points;* the points in which the orbits of the planets cut the plane of the ecliptic are called the *nodes;* the points in which the equator and ecliptic intersect are called the *equinoctial points;* that whence the sun ascends towards the north pole being called the *vernal point;* and that by which he descends to the south pole the *autumnal point*. The points of the ecliptic, where the sun's ascent above the equator, and descent below it, terminate, are called the *solstitial points;* the former being the *estival* or *summer point*, and the latter the *brumal* or *winter point*.

Point is also used to signify a cape or headland jutting out into the sea. Thus seamen say two points of land are in one another when they are in a right line against each other, so that the innermost is prevented from being seen by the outermost.

Point, in *Perspective*, is used for various poles or places, with regard to the perspective plane.

Point, in *Poetry*, denotes a lively brisk turn or conceit, usually found or expected at the close of an epigram.

Point-Blank, in *Gunnery*, denotes the shot of a gun levelled horizontally, without either elevating or depressing the muzzle of the piece.

POINT DE GALLE, a seaport and fortified town on the south-western point of Ceylon, reckoned the third in consequence in the island, whilst in point of trade it ranks next to Columbo. The petlah or native town is extensive, and enclosed with a wall, and the houses are superior to those at Trincomalee. It has a good and spacious harbour, especially the outer road; whilst the inner harbour is secure during a great part of the year, but the egress is not so easy, as it requires the wind from a particular quarter to carry the vessels out. During the season when the roadstead from Columbo is unsafe, ships frequently wait at Point de Galle till their cargoes are ready. The fortress stands very high, but is much out of repair; and not above six families reside in it constantly, except when the homeward-bound fleet is assembled there, when a much greater number is collected. There is no regular rainy season at Point de Galle; but being open to both monsoons, it has more rain than the continent of India. The shore, both to the westward and in the vicinity of the port, is lined with rocks; and it is therefore advisable to keep in twenty-five fathoms till near the entrance into the harbour. The exports are cinnamon, cardamums, arrack, oil, salt fish, and cotton. Fisheries are carried on to a considerable extent. Cinnamon is also grown, but not to such an extent as about Columbo. Near the fort is a colony of Chinese, established by government as gardeners for the purpose of raising vegetables, in which they have at length succeeded, and have also thriving plantations of sugar-cane. At Billegam, about twenty miles south-east from Point de Galle, is a celebrated Buddhist temple, in which is a recumbent figure of Buddha. There is also a gigantic four-handed figure of Vishnu, of a dark colour; and the walls are covered with painted figures of Buddha. In a corner is another figure seated on a cobra de capella snake coiled up, the hood of which forms a canopy over his head. Point de Galle was occupied by the Portuguese in 1517, and taken from them by the Dutch in 1640. It came into the possession of the British in 1796. It is sixty miles south from Columbo. Long. 80. 15. E. Lat. 6. N.

POINT GORDWAR, a low point of land which projects into the Bay of Bengal, at the mouth of the Godavery River. The sea breaks heavily over it. Long. 82. 17. E. Lat. 16. 48. N.

POINT PEDRO, a town on the northern extremity of the island of Ceylon. Long. 80. 25. E. Lat. 9. 52. N.

POINTING, in *Grammar*, the art of dividing a discourse by points into periods and members of periods, in order to show the proper pauses to be made in reading, and to facilitate the pronouncing and understanding thereof.

POINTS, in *Heraldry*, are the several parts of an escutcheon, denoting the local positions of any figure.

Points, in *Electricity*, are those acute terminations of bodies which facilitate the passage of the electrical fluid to or from such bodies.

POINTY, a town of Bengal, in the district of Mongier, delightfully situated on the south bank of the Ganges, in the view of the Rajemahl Hills, in a country abounding in game. Long. 87. 26. E. Lat. 25. 20. N.

POISON, any substance which, acting on living bodies in small quantities, occasions serious disturbance of their functions, and may cause death. The science which treats of poisons is termed toxicology.

Poisons have been known from remote antiquity; but the notions entertained of their effects were generally fanciful and vague, so that it is often impossible now to discover what the poisons of the ancients really were. In modern times a great addition has been made to our knowledge of them, both as regards their number and their action; and it is only within the last thirty years that the nature and the varieties of their action have been studied scientifically and with success.

The number of poisonous substances now known is very great, and there can be no doubt that very many still remain to be discovered, equally in the mineral, the animal, and the vegetable world, but more especially among vegetables. Numerous, however, as they are, they present many remarkable agreements in their effects or actions, so as to admit of convenient classification.

tion.

Some poisons produce no other effects besides what depend on the local injury they give rise to. Of these, some produce by their chemical properties absolute destruction of the textures to which they are applied; and the result depends less on the nature of the injury, than on the importance of the injured texture, and its sympathetic connection with other parts of the body. The mineral acids, such as sulphuric and nitric acid, and the mineral alkalis, potash or soda, are the best examples of this kind. Others, again, of those which act locally alone, produce inflammation, but not chemical destruction, where they are applied; and all the ordinary effects of inflammation may ensue; of which gamboge and colocynth are good illustrations. The action of the former description of local poisons does not differ essentially from that of mechanical injuries of the same textures; the action of the latter is almost identical with that of the natural causes of inflammation. A third description of local poisons merely produce a peculiar impression on the nerves of the part to which they are applied, without either destroying or inflaming its texture. But there is no pure instance of the kind yet known; all such poisons likewise act otherwise than locally. Opium and prussic acid are examples.

Other poisons, and these by far the most numerous, act upon remote organs and textures, on parts to which they are not, nay, cannot be, directly applied; and the effects of this kind are often developed without any appreciable signs of a direct local action. There is scarcely an important organ in the body which may not be brought thus under the influence of some poison or another. The brain is very often so affected, as by opium, belladonna, prussic acid, and charcoal fumes. The stomach and intestines are also frequently affected indirectly, as by arsenic. The spine is affected by nux-vomica, the kidneys and bladder by cantharides, the lungs by tartar-emetic, the heart by oxalic acid, the liver by manganese, the salivary organs by mercury, and many of the glands by iodine. Many poisons possess the property of acting on a great number of organs in this remote or indirect way, of which arsenic and mercury are perhaps the most remarkable instances. Arsenic introduced by the skin has been known to act on the stomach, intestines, kidneys, heart, the lining membrane of the eyes, nose, windpipe, and vagina, the nerves of voluntary motion, and the skin at a distance from its place of application. Physiologists are still in doubt through what channel these remote effects are produced,—some believing that the poison is carried in substance with the blood from the organ to which it is applied, into the parts on which it acts; others, that the operations are merely nervous, and consist of the transmission of certain local impressions along the nerves which communicate between one organ and another; and others, that both modes of action may exist, even for the same, and still more for different, poisons. Two facts, however, are clearly established, whatever theoretical deductions may be drawn from them; *first*, that very many poisons do enter the blood, and may be detected there; and, *secondly*, that these never enter except in very minute proportion, so that, unless very delicate tests are known for them, they may readily escape detection. It seems not improbable that some poisons are deposited by a species of election in particular organs; but of course their presence in the blood will give them access more or less almost everywhere, since there are few organs not traversed by blood-vessels, and minutely injected with blood.

The greater number of poisons produce their peculiar effects, through whatever texture they are introduced into the body. The effects of local poisons depend, as was stated already, on the texture to which they are applied; but the far more numerous denomination of poisons which act remotely, exert that action, to whatever part they are applied, provided they fairly enter the body. They enter the sound skin with extreme difficulty, unless in the form of gas or vapour, or with the aid of friction. But they act energetically through the surface of the true skin stripped of its cuticle, through the cellular texture under the skin, through the soft mucous membrane which lines the mouth, nose, ears, stomach, intestines, windpipe, and organs of generation, through the firm serous membranes which line the interior of the belly and chest, and also when introduced directly into the blood-vessels, more especially into the veins. They generally act with greatest energy when injected into the blood directly, or when introduced into the serous cavity of the chest or belly; but if they operate in very minute doses, their effects are scarcely less prompt when simply thrust into a fresh wound, or under the skin; and there is no way in which they exert their action with more swiftness and energy, than when inhaled into the lungs, provided they assume the form of gas or vapour. For the most part their activity is greatest when applied to organs and textures where absorption is most prompt.

The action of poisons is greatly modified by an infinite variety of collateral circumstances, without a thorough knowledge of which toxicology cannot be well understood, either as a branch of physiological science, or in its practical bearings on medical practice, as well as medical jurisprudence. These modifying circumstances cannot be accurately laid down here, but the most important are the following: quantity or dose, chemical or mechanical form, the texture directly acted on, habit, and peculiarity of constitution, either natural or induced by disease. By all of these causes the effects of poisons may not merely be altered in degree, but likewise even modified in kind, or entirely neutralized. 1. Most substances which are poisonous in moderate doses, are innocuous in small quantity; but some are amazingly energetic even in very minute quantities,—such as prussic acid or strychnia, the active principle of nux-vomica, either of which may prove fatal to a man in favourable circumstances in the dose of one grain,—or still more the poisonous secretion of venomous snakes, or the secretions of the human body in some diseased states, which will prove fatal in quantities inappreciably small if introduced into a wound. 2. As to mechanical form, poisons must be, or must become, either gaseous or liquid before they act; mixture and dilution weaken their activity, though there are exceptions to this rule; and some, which are rather insoluble, such as arsenic, are rendered nearly inert when mixed with insoluble powders of great tenuity, such as charcoal, magnesia, and the like. 3. Chemical changes materially affect their actions; corrosives becoming innocuous by neutralization, purely local irritants being thereby much enfeebled, and all of them being rendered more feeble, or even inert, if they are converted into substances insoluble in the secretions of the textures to which they are applied. Poisons that act through the blood on remote organs are little influenced by chemical changes, except in so far as their solubility is affected; a very important general principle, which ought never to be overlooked in the search for antidotes. Arsenic, mercury, prussic acid, opium, and numberless other poisons, are almost equally active in all their chemical combinations, provided they continue soluble. 4. The effect of the texture acted on in modifying the influence of poisons has been already adverted to. As examples of this, it may be mentioned that prussic acid has little or no effect through the sound skin, nor snake-poison when swallowed; and that strychnia, the active principle of nux-vomica, has no effect through the skin, while one or two grains might prove fatal if swallowed, and a third of a grain would probably kill a man in a few minutes if injected in a state of solution into a wound, into the cavity of the chest, or into a vein. 5. Habit weakens the effects of many poisons, as in the familiar instances of opium and ardent spirits, of which ten or twenty times what is sufficient to prove fatal in ordinary circumstances may be taken with impunity by those who have long used them. Mineral poisons are less under the influence of this modifying circumstance than vegetable poisons; and of the latter those are most influenced which act chiefly upon the brain. It is very difficult to account for the varying effect of habit on the energy of vegetable poisons. Strychnia, for example, the active principle of nux-vomica, seems altogether excluded from the modifying effect of habit; while another principle, analogous in elementary composition and in chemical properties, morphia, the active principle of opium, may through habit be taken without injury in a dose fifteen times as great as what might in ordinary cases prove fatal. 6. Peculiarity of constitution commonly operates in rendering the body more than usually sensible to the action of poisons, as in the case of opium, mercury, and cantharides, medicinal doses of which act with poisonous violence on some. In a few instances original peculiarity deadens the activity of certain poisons, and this is observed still more remarkably during the constitutional state of certain diseases, such as hydrophobia, locked jaw, mania, delirium tremens, and excessive loss of blood. In some constitutions substances not injurious to mankind generally produce all the phenomena of poisoning. Thus there is scarcely any article of food or drink, except the great staple commodities, beef, mutton, and the simple kinds of bread, which are not at times observed to act poisonously on some people. But the most remarkable substances of the kind are red fish, shell-fish, mushrooms, bitter almonds in small quantity, and eggs.

Classification.

It has been stated that poisons are exceedingly numerous, but that they possess only a limited number of actions. As these actions consist of derangement of the functions of certain organs and textures of the body, it follows that the outward signs of these derangements must be circumscribed within certain bounds, and that many poisons must agree with one another in producing the same, or nearly the same, outward signs. This general fact constitutes the basis of the most approved classification. Formerly physiologists endeavoured to arrange poisons according to certain theoretical notions of their nature, or according to certain mysterious properties imputed to them; and subsequently most were content with distributing them in three classes, according to the kingdom of nature whence they happen to be derived. Every classification, however, should have some practical bearing; and as the most important objects in the present instance are the decision of the question of poisoning in a general sense, the discovery of the particular poison, and the treatment of its effects, these points ought to be invariably kept in view. With this understanding, the best classification is obviously that which is founded on the external signs of poisoning, that is, the grouping of the symptoms produced by each. Such is the basis of all the most esteemed modern arrangements.

The whole wonderful multiplicity of poisons, when thus viewed, may be considered as either exciting irritation in particular organs, or disordering the functions of the brain and spinal marrow, or as uniting both these properties. The first are called *irritants*, the second *narcotics*, the third narcotico-irritants, or more usually *narcotico-acrids*. The irritants comprise chiefly the free acids and free alkalis, with many of their compound salts, several earths with their salts, many compounds of the metals, acrid vegetables, and acrid animal substances. These all agree in producing, as their principal phenomenon, destruction or inflammation, sometimes of the part to which they are applied, such as the skin, mouth, throat, intestines, and so forth,—and at other times of organs at a distance from their place of application, such as the stomach, intestines, kidneys, bladder, lungs. And the symptoms they produce are those incidental to inflammation generally, grouped, however, in so peculiar a manner, either in order, kind, or complexity, as in many instances to distinguish the cause which occasions them from any natural cause of inflammation. Many substances arranged among irritants produce effects which would also associate them with the class of narcotics; but still inflammation and irritation are their leading consequences. The narcotics comprise principally opium, prussic acid, the volatile oils of bitter almond, cherry-laurel, and other drupaceous plants; henbane, thorn-apple, deadly nightshade, and certain poisonous gases, such as carbonic acid, carbonic oxide, carburetted hydrogen, cyanogen, sulphuretted hydrogen. These agree in acting either upon the brain, or upon the spinal marrow, or upon both these parts of the nervous system at once. The symptoms thus arising are stupor and coma, delirium, convulsions, paralysis, with a great variety of less important yet often very significant phenomena. When coma is the chief result, the brain is considered to be chiefly acted on; when convulsions or paralysis occur without stupor or coma, the spinal marrow must alone suffer; and where both sets of phenomena present themselves, it is probable that the whole nervous system partakes more or less of the injury. The narcotico-acrids comprehend hemlock and other deleterious plants of the family Umbelliferæ, black and white hellebore, meadow-saffron, fox-glove, ipecacuan, nux-vomica, cocculus indicus, camphor, poisonous fungi, and all ethereal and alcoholic fluids, besides many others of less note, or not so familiar. It is difficult sometimes to separate the individuals of this class from the narcotics on the one hand and the irritants on the other. But for the most part they produce in different circumstances either narcotism or inflammation alone, or both conjunctly, and that either simultaneously or in succession.

Examples of their several kinds.

It may be well to illustrate these statements by a brief sketch of the effects of a few familiar or interesting species belonging to each class.

The purest examples of irritant poisons are the *strong mineral acids* and *alkalis*, namely, sulphuric, nitric, and muriatic acids, and potash and soda. These, when applied to the external parts of the body for a sufficient length of time, cause corrosion and consequent destruction; and life may be thus brought into imminent danger, either from the extent of the injury and the consequent sympathetic derangement of the vital functions, or from a variety of less direct or incidental disorders. Of such a course of things the public in this country have lately had too many illustrations, resulting from the execrable crime of throwing sulphuric acid over the person. When swallowed, the strong mineral acids and alkalis sometimes act in a great measure on the throat and gullet, more frequently on the stomach and intestines. In the former case there is instant and horrible sense of burning in the mouth, throat, and neck, eructation of acid matter, often bloody, or mixed with dark masses, excessive tenderness of the injured parts, incapability of swallowing, difficult, husky breathing; and the sufferer may either die suffocated, or from the depressing sympathetic impression produced on the heart; or he may survive for a length of time, perishing, however, miserably in the end, from stricture of the gullet and starvation, or he may recover after the discharge of more or less of the lining membrane of the throat, and a tedious and precarious convalescence. Where the stomach and intestines are acted on by the acids or alkalis, there is in general violent vomiting, often of blood, and, especially after swallowing anything burning pain in the pit of the stomach, extending over the belly, with excessive tenderness and eventually swelling, frequently profuse purging and gripes, and extraordinary prostration of the pulse and of the strength; and the issue may be either recovery, more or less prompt, or far more generally death, at times from the sympathetic depression of the heart and general system, more rarely from gradual exhaustion, occasioned partly by constant irritation, partly by inanition, on account of extensive injury of the internal membrane of the stomach,—on which digestion, probably, in a great measure depends for its integrity. These phenomena are purely the results of local corrosion and irritation. No remote phenomena arise except exhaustion of the heart, from sympathy with the local injury; in particular, there is no disturbance of the function of the brain, spine, or nerves, except what arises simply from exhaustion of the circulation. The most remarkable of all the irritants for subtilty and variety of action conjoined is *arsenic*. It is not, however, an absolutely pure irritant; for, though irritation of a multifarious nature is its most prominent result, it also disturbs the functions of the nervous system. When applied for some time to the surface of the body, denuded of the scarf-skin, it kills the part to some depth; at least a portion is thrown off by the process of sloughing, showing either that the part had been killed, or that inflammation is produced, of a kind which leads to its death. Both in this manner, and with much greater certainty if it is applied to a fresh wound, or introduced into any of the external openings of the body, or injected in solution into the cavity of the chest or belly, it excites irritation and inflammation, not merely where it touches, but likewise in various distant organs. The stomach and intestines suffer the most invariably, giving rise to violent vomiting, especially of all articles swallowed, burning pain in the bowels, tenderness, griping, purging, and excoriation of the anus. The kidneys, bladder, and organs of generation, are also often affected, causing strangury, suppression of urine, pains in the loins, tenderness in the lower belly, &c. The lining membrane of the air-passages likewise frequently partakes in the injury, as is indicated by hoarseness, cough, difficult breathing, expectoration, and deep-seated pain in the chest. Not unfrequently the investing membrane of the nostrils and mouth presents signs of derangement, such as redness, aphthæ, and constant discharge. These symptoms are also generally attended with extraordinary depression of the action of the heart, which is the most frequent cause of death; and this sometimes forms the only prominent effect, the sufferer dying in a few hours, with scarcely any other symptom but mortal faintness. Recovery may take place even though the complicated effects which have been described may have been developed. But after these primary disorders have disappeared, there are important secondary risks to be encountered, such as dropsy, gradual emaciation from constant disturbance of digestion, and, above all, epilepsy, palsy, and other affections characteristic of an action upon the nervous system. Of the symptoms thus indicating a narcotic action, the most pointed and most remarkable are epileptic convulsions and local partial palsy. To these illustrations of the phenomena of internal poisoning produced by the irritants, it may be well to add a short sketch of the very striking effects produced by many of them as external poisons, when they have been introduced into the substance of the skin or its subjacent cellular tissue, through a wound. Of poisons of the kind now alluded to the most familiar are *snake-poison*, and the *fluids of the dead human body* after certain diseases or in some peculiar unknown state; but similar effects are also produced by many acrid vegetables. The affection produced is diffuse inflammation of the cellular tissue, so called because it diffuses itself rapidly along that texture, without any tendency to become circumscribed, as in ordinary inflammation similarly seated. It is attended with some puffy elevation and tenderness of the skin over the inflamed part, but not always with redness—with pain, not always acute, usually of that kind called burning pain—and with excessive depression of the action of the heart; and death may ensue either in a few hours from the derangement of the function of the heart, or more slowly from extensive injury of the cellular tissue, which terminates in gangrene.

Of the phenomena produced by the narcotics, the purest and most familiar example is to be found in the effects of *opium*. This drug produces a great variety of interesting nervous phenomena when taken in small medicinal doses. When taken in a poisonous dose, it first occasions languor, giddiness, weakness, and drowsiness, afterwards deep sleep, attended in general with complete repose, soft, slow breathing, and highly contracted pupils, and then profound coma, or insensibility, which cannot be dispelled by any stimulants, and which usually proves fatal if it be permitted to be fully formed. In particular cases these symptoms are varied with delirium in the early stage, and convulsions in the advanced stage; but such deviations from the ordinary rule are rare. *Belladonna*, or *deadly nightshade*, is another narcotic which produces effects somewhat different. Its berries, which are sometimes eaten by mistake by children and other ignorant people, although they have a mawkish and by no means seductive taste, occasion in the first instance a singular state of very active delirium, in which the individual performs a series of incoherent and extravagant acts with much vivacity, or falls into the condition of somnambulism; and after some hours this is succeeded by a state of deep sopor or coma, as from opium, though more frequently intermingled with convulsions than in the case of that drug. Death is sometimes the result, and would be more frequent were it not that the precursory stage of active delirium often leads to the discovery of the offending cause, and its removal by fit treatment. *Prussic acid*, another pure narcotic, which is now almost as familiar as opium among poisons, rivals them all in subtilty and rapidity of action. Small animals, such as rabbits, have been killed with it in the brief space of four seconds. A single drop has killed a cat in half a minute, and one grain, or about four drops, has repeatedly proved fatal to man within three quarters of an hour. These statements apply to the pure acid, which is seldom seen; but the common acid of the shops, which is used in medicine, is equally energetic in larger doses; and so are the distilled waters and essential oils of the bitter almond, peach-kernels, cherry-laurel leaves, rowan-tree root, and apple-seeds, which all owe their poisonous qualities to the same cause. The effects produced by all these poisons are immediate, dreadful alarm, giddiness, and hurried breathing, speedily followed by convulsions, insensibility, one or two fits of deep convulsive respiration, and death. The *narcotic gases* act very much in the same manner with opium, as is well exemplified by the fumes of burning charcoal, and other forms of carbonic acid. When in a pure or concentrated state, carbonic acid extinguishes life immediately, in part by suffocation, on account of the exclusion of respirable air, and partly by its narcotic operation. But when breathed in a diluted state, as in an ill-ventilated mine, or in a confined chamber heated by charcoal, it induces giddiness, fulness of the features, ringing in the ears, gradually increasing stupor, and at length profound insensibility, commonly attended with lividity of the face, glistening of the eyes, and occasional convulsions, which often prove fatal, and always if not speedily relieved by fresh air and other suitable treatment.

The narcotico-acrids may be exemplified by a great variety of well-known and powerful poisons. *Hemlock*, which is believed to have been a familiar poison for more than two thousand years, but whose effects are very generally misunderstood, ought scarcely to be arranged in this class, where it is commonly placed. Its irritant properties are very ill defined. But it is a powerful and very remarkable narcotic, and its active principle, named *conia*, is scarcely inferior to prussic acid in celerity of operation, or in the smallness of its dose. It seems to act by paralyzing the muscles of voluntary motion and of respiration, without affecting the brain; and the symptoms are weakness of the limbs, gradually pervading the rest of the body, and terminating in loss of the power of motion, while at the same time the respiration, at first laborious, gradually becomes more and more circumscribed and slower, till at length it ceases, the heart all the while acting vigorously, and the sensation continuing unaffected. A better instance of a narcotico-acrid poison is *nux-vomica*, and its principle *strychnia*. These are counterparts in action to hemlock and conia. They powerfully stimulate the spinal marrow, producing violent convulsions, like those which attend locked jaw or tetanus, and without impairing the sensibility. The first symptoms are restlessness, undefinable uneasiness, and alarm, speedily followed by fits of stiffness of the jaw and neck, and then by violent paroxysms of muscular contraction, in which the limbs and arms are extended, the features hideously distorted, and the head, body, and legs bent backward forcibly; and the third or fourth fit commonly proves fatal. Strychnia, the source of these dreadful effects, is on a par with prussic acid and conia in energy; for a third of a grain will kill a wild boar in ten minutes, and one grain properly administered would certainly kill a man in half that time. So far this genus of poisons acts like the narcotics; but, in frequent instances, where the narcotic symptoms pass away, they are succeeded by the signs of inflammation in the stomach and intestines, namely, pain, vomiting, purging, and swelling of the belly, which affection, too, may prove fatal. Such irritant effects, however, are rare, perhaps because in the great majority of cases, death is brought about in the early stage by narcotism. A better example still of a narcotico-acrid is *fox-glove*. A most valuable and safe medicine in small doses, this plant nevertheless acts as a very dangerous poison in large doses; and it sometimes produces in the same case both deep coma with convulsions, and likewise profuse diarrhœa, with tormina and tenderness of the abdomen, while at the same time it occasions suppression of urine, and extreme depression of the action of the heart. By far the most characteristic illustrations, however, of the narcotico-acrid poisons are to be found in the *deleterious fungi*, or poisonous mushrooms as they are sometimes called. These differ from most other poisons in their effects being often put off (though to this rule exceptions exist) for several hours, apparently because time must be allowed for the digestion of substances on the whole difficult of digestion. The effects are singularly various; for it has been often observed, that among a number of persons who have partaken of the same poisonous stew, some had only giddiness, confusion, delirium, stupor, coma, and convulsions; while others suffered only from vomiting and purging, distension of the belly, tenderness, and griping; and a third party were seized at first with the former class of symptoms, and on these passing partially off, were attacked severely with the latter.

Besides the irritant, narcotic, and narcotico-acrid poisons, some writers on the subject admit a fourth class, under the name of *Morbid poisons*, comprising those poisonous secretions which are engendered in the body by disease, and possess the property of reproducing by contact or inoculation the same disease to which they owed their own production. The most important of these are hydrophobia, the venereal disease, small-pox, and cow-pox. Authors on toxicology, however, whether physiological or practical, have generally agreed of late in discarding these from the toxicological system, and in arranging the phenomena of their action where they are more philosophically placed, namely, among natural diseases.

In a work like the present, it is not easy to decide how much ought to be introduced of a subject so comprehensive as toxicology, or the science of poisons. The sketch given above will convey some idea of the objects of which it treats, more especially as a branch of physiology. Farther details on the subject at large seem uncalled for. But there are two departments which may be enlarged on with some advantage, namely, the Evidence of poisoning, and the Treatment of the effects of poisons. Poisoning, both criminal and accidental, has become so common and so notorious in recent times, that there are probably few persons who have not turned their thoughts to these two branches of the subject; and it is desirable for many reasons that correct views should be entertained of them, even by unprofessional persons,—more correct views, at least, than what generally prevail.

Evidence.

Till a very recent date, most erroneous notions were entertained, alike by the vulgar as by scientific men, of the evidence of poisoning. Proofs of the most unsubstantial kind were considered infallible tests of death by poison; and, under the authority of grievous professional error, we now know that courts of law must have sanctioned many a judicial murder. It is not uninteresting to trace these dogmas of antiquity, abandoned as they now are by the scientific, still obstinately adhered to by the unprofessional world as articles of popular belief, and leading, as of old, to constant blunders, which it is now the business and glory of the toxicologist to check, whilst it was formerly his fate to foster and give effect to them.

The evidence of poisoning cannot be thoroughly understood in all its bearings, without a minute knowledge of the multifarious phenomena produced by all ordinary poisons; and, in judicial cases, it is in the end viewed commonly in reference to the supposed administration of a particular substance. It would be out of place to attempt embracing this wide field here. All which can be ventured on is a view of the evidence of poisoning in a general sense, that is, without reference to any special poison,—a topic of great interest in relation to the first suspicions and earliest investigation of supposed cases of poisoning, whether criminal or accidental. The evidence of poisoning in this comprehensive sense is derived from symptoms, from appearances in the dead body, from experiments on animals, from certain moral circumstances, and from chemical analysis.

1. The *symptoms* are naturally the first particulars to attract attention and excite suspicion. They were once thought adequate to decide singly any question of poisoning. Now we know that natural diseases imitate so closely the phenomena of poisoning, that the symptoms will rarely yield more than presumptive, and only in rare and very peculiar circumstances, absolute evidence. There is nothing in the kind of symptoms taken generally which will distinguish poisoning from certain natural diseases. The natural diseases, indeed, which imitate the effects of one great class of poisons, namely, the irritants, are on the whole rare; yet they are scarcely less a source of fallacy, at least in judicial cases, where certainty, or something like it, must be aimed at. But there are a number of collateral circumstances connected with the symptoms, which, if taken together, will often supply a very powerful criterion in supposed cases. Thus, in the instance of by far the greater number of poisons, and of almost all which are used for a homicidal or suicidal purpose, the symptoms begin soon after food, drink, or medicine has been taken, commonly within an hour, often much sooner; and in respect of not a few common poisons, such as the mineral acids, mineral alkalis, hartshorn, prussic acid, oxalic acid, they must commence immediately. In general, too, the symptoms begin suddenly, advance quickly, and prove speedily fatal. For the most part they are steady in their progress, exclusive of the influence of treatment. They are upon the whole uniform in their nature. And they appear in the great majority of cases abruptly during a state of good health. The consideration of these characters will not unfrequently en-

able the man of experience to pronounce that suspicions which have prevailed of poisoning are wholly unfounded; but, taken singly, they will never justify, on the other hand, more than a presumption in favour of poisoning. It must at the same time be observed, that when these general characters are all applicable, and concur with a certain complicated grouping of the symptoms in particular cases, the presumption becomes very strong; and when other articles of general evidence are added, the proof may be all but complete, nay, absolutely so. Such is clearly the state of the case in not a few instances of poisoning with the mineral acids and alkalis, with arsenic, corrosive sublimate, nux-vomica, oxalic acid, prussic acid, alcoholic fluids. 2. The same confident reliance was long placed in the *appearances of the body after death*, as in the symptoms, and with even less reason. The discovery of certain morbid appearances may prove poisoning to have been impossible; and yet even here an opinion should not be formed without reserve, because the discovery of the effects of natural disease in the body, even in an advanced stage, is no absolute proof of death from that disease. Poison, as in many authentic cases, may have been nevertheless administered, and have proved the real occasion of death. But there is never anything in the appearances after death which will bear out a general charge of poisoning, as was once universally thought. It should be particularly known, that the vulgar prejudice, which discovers poison wherever the skin becomes unusually livid after death, or wherever the body undergoes prompt decomposition, is utterly without support from scientific experience. Nay, in regard to the latter character, evidence has been proved in recent times to be deducible from the very opposite condition, or the unusual preservation of the body from decay, which is now well known to occur in many cases of poisoning with arsenic. There are certain morbid appearances in the dead body, especially upon the skin, and in the throat, gullet, and stomach, which will furnish the strongest presumption, nay, according to good authorities, almost absolute proof, of poisoning with certain substances, for example the mineral acids; but the details cannot be entered upon here, because a full enumeration, and much professional skill, are required for appreciating precisely their import. 3. *Experiments on domestic animals*, made with suspected articles, were once supposed to furnish the best of all evidence; and this was probably the best evidence to be had in the days when chemistry and chemical analysis were all but unknown. Now, however, such experiments are not admitted, either by medical or legal authorities, to be of any weight, except under particular circumstances. They are admissible, and indeed clearly indispensable, for deciding questions in toxicological physiology which may arise during trials. They ought also to be allowed some weight when they have been observed accidentally, as, for example, when the remains of suspected articles have been devoured incidentally by domestic animals, especially by a number of them, and above all by the dog or cat, with the effect of producing in them symptoms and appearances after death similar to what were witnessed in the suspected case in the human subject. The objection drawn against such evidence, that the effects of many poisons on the brute creation are different from their effects on man, though fundamentally sound, has been allowed to operate far too sweepingly in modern times. The differences in respect to many common poisons are by no means so great as was thought not very long ago; and upon two animals, the dog and the cat, the effects of most poisons are almost identical with those observed in man, due attention being paid to differences in dose, and to the singular facility with which these animals discharge poisons by powerful early vomiting. But the objection here stated may be allowed sufficient force to put an end to experiments made expressly on animals with suspected articles. There is, however, a more urgent objection to such experiments,—that they involve the consumption for doubtful evidence of the materials from which decisive evidence may be obtained by other means; for if there is poison enough left to affect sensibly the lower animals, there is amply sufficient for detection by chemical analysis. Accordingly, express experiments with remains of suspected food, drink, or medicine, are now abandoned by all good authorities in toxicology. 4. There are certain *moral circumstances* which may also be often taken into account in the evidence of poisoning in a general sense, when viewed as a scientific question, because they cannot be correctly appreciated except by a scientific man, and consequently they belong in some measure to the scientific or toxicological proof. The chief particulars are as follows. It may be proved that poison has been purchased, of a kind which may produce the symptoms observed. A suspicious article may be proved to have been administered, either from its taste, or from its having been recommended for properties either absurd in nature, or such as the pretended article is not thought even by unprofessional people to possess, or from a comparative analysis of the materials for making the suspected article, showing that something injurious must have been added at a particular time, and by a particular person. It may be proved that exacerbations of the symptoms have repeatedly occurred soon after articles were given in a suspicious manner. It may be proved that the person poisoned, or a second party under suspicion, exhibited by words or deeds an intention to administer poison, as by assigning impossible properties to what is administered, or by manifestly changing medicine which has been prescribed. A highly important circumstance is the simultaneous and similar illness of several individuals who have partaken of the same meal, coupled perhaps with the degree of their illnesses concurring with their respective shares, and probably also united with the escape of others of the same company who did not partake of the meal, or of particular dishes or liquors. Many other moral circumstances might be here alluded to, by which the question of poisoning in a general sense may be often materially cleared; but as they do not belong to the scientific view of the question, either directly or indirectly, they may be passed over. 5. The *chemical evidence* is justly considered the best of all the departments of proof; for it not only establishes poisoning in a general sense, but likewise points out the particular poison. There is no department of toxicology which has made such amazing progress in recent times as that of toxicological analysis. A century ago, the search for the remains of poison in suspected dishes, or in the dead body, was scarcely ever attempted, and, owing to the ignorance of the chemical properties of poisons, could not have been successful. Even no more than five-and-twenty years ago, the method of analysis was in all cases crude and unsatisfactory, and for many poisons good processes continued unknown; so that it was no uncommon thing for charges of poisoning to break down, solely on account of the dubious quality of the chemical evidence. But at present, the proof of poisoning is scarcely ever defective in the chemical branch; the evidence of death by poison is usually complete; and how can it fail to be so in competent hands, when the chemist can detect in the most complex mixtures the minute quantity of a twentieth or fiftieth of a grain of the common poisons, and when many years of interment frequently cannot withdraw the crime of the poisoner from the keenness of his search? It has been proved by careful experiments, that the mineral acids, arsenic, corrosive sublimate, blue vitriol, opium and its principle morphia, strychnia the principle of nux-vomica, cantharides, and other less familiar substances, may be discovered in the body of animals poisoned with them, though buried for nine months; and instances have occurred of the detection of arsenic in man after interment for two, four, and even seven years. It does not absolutely follow that death has been occasioned by poison because poison is found within the body after death; for it may have been feloniously introduced afterwards, for the purpose of falsely imputing poison; or, though poison has been swallowed, death may nevertheless have arisen either from natural disease, or some other kind of violence. Instances of such extraordinary occurrences are absolutely not uncommon, sufficiently so at least to require being kept always in view. The determination of them involves too refined an inquiry to be considered here. On the other hand, the non-discovery of poison after death is still farther from being evidence that death was not occasioned by poison. For many poisons are still undiscoverable by any method of analysis; others are soon decomposed within the body after death, such as prussic acid; others are quickly absorbed from the stomach during life, so as to prove fatal without leaving any remains behind, as in many instances of poisoning with opium; others may be expelled by vomiting, and nevertheless have, in the first instance, occasioned injury enough to prove fatal, as sometimes happens in the case of arsenic, and very commonly in poisoning with mineral acids. It has, however, been made a subject of question, whether the evidence of poisoning can ever be considered as complete, so as to involve a conviction in a criminal case, unless poison be found either in the body or in the remains of a suspected article which has been swallowed. It appears absurd, however, to insist on the absolute necessity of such evidence. For were the poisoner to choose his means skilfully, and avoid over-doses, he would, on such principles, almost constantly escape. And the best scientific authorities, in the most recent times, seem inclined to allow that the general evidence, from the various sources detailed above, may be often so strong as to leave scarcely any scientific doubt of the occurrence of poisoning; and the conjunction of the circumstances of ordinary evidence may, in a legal sense, entirely remove what little doubt may have existed of a scientific nature. Accordingly there have been instances of condemnation lately in this and other countries, where poison could not be discovered. It may be right to add, that it is most singular how effectually and how quickly poisons are sometimes removed beyond the reach of analysis by incidental causes, even those poisons which may be detected in other circumstances in extremely minute quantities, and where the methods of analysis are well understood. Prussic acid is seldom to be detected if life be prolonged for half an hour, while in the ordinary cases of death in a few minutes it may be discovered with ease. Arsenic, which in the great majority of cases adheres obstinately to the stomach, and may in consequence be detected there though life has been prolonged under frequent vomiting for two days and upwards, has been known to be removed beyond the reach of analysis in the short space of five hours.

Treatment.

The *treatment* of poisoning, like all other branches of toxicology, has, within a few years, been prodigiously improved. It may be said, indeed, to have been understood only within the last quarter of a century. In ancient times the notions entertained of the treatment were not less crude than those formed of the nature and action of poisons. Among other errors, it was strangely supposed that certain counter-poisons existed, which not only possessed the property of curing the effects of all poisons indifferently, but which likewise, when taken for a length of time, had the faculty of impregnating the constitution, and rendering it proof against the influence of any poison. Princes and others often lived thus for years under the care of their physicians, or protected against their treachery, by being charged with conservative antidotes. After these notions were exploded, other erroneous practices came into vogue; and, in particular, it was believed to be established on the basis of observation, that certain antidotes, such as vinegar, milk, oils, and the like, which are really not amiss in some forms of poisoning, were equally efficacious in all. These illusions have been dispelled, even among professional people, only within a very few years; and among the unprofessional they still have currency. The clearing away of the mists of error has been attended with the discovery of many real and most valuable remedies. The improvement which has taken place has been owing partly to the improvements made in chemistry; but in this way nothing could have been ultimately effected without the aid of physiological experiment, and more especially of experiments on animals, a method of inquiry, nevertheless, which it has been too much the practice of an ignorant or spurious humanity to decry.

The treatment of poisoning is directed to three objects, the removal of the poison, the administration of an antidote, and the cure of the disorders which have been produced.

1. The first object, in every instance, is the prompt removal of what may remain of the poison. If it had been applied outwardly to a sore or wound, it must be carefully wiped or washed away. When introduced deep into or under the skin by a puncture, it is to be withdrawn by suction with the mouth, and, still better, with a cupping-glass, the efficacy of which is insured, as in the case of snake-poison, by a bandage being applied above the wound, so as to obstruct the return of blood from the veins to the heart, but without compressing the arteries. Another plan, which has been found effectual in the like circumstances, is simply to apply the bandage above the wound, and then to open a vein between the wound and bandage, so that the poison is drawn from the wound with the blood, and discharged outwardly from the orifice in the vein. Sometimes it is useful to make deep scarifications before applying the cupping-glass; yet in this way the bottom of the wound may be missed; and, on the whole, if incisions are to be made at all, it seems better to calculate the probable depth of the wound, and to remove a portion of the texture with the knife all around it. The bleeding which follows commonly effects the discharge of the remaining poison; but some afterwards add the use of an incandescent iron for cauterizing the whole adjacent parts. The removal of the poison, when taken internally, may be variously managed. But, first, care must be taken not to attempt its removal when nature may have already looked after this step in the treatment, as in the case of profuse, and frequent, and full vomiting. All that is necessary in such circumstances, is to give occasional draughts of lukewarm water, or milk and water, to render vomiting easy, and to aid in washing out the stomach. When vomiting does not occur, or is not free, an emetic ought to be promptly given. Whatever is nearest should be first tried, mustard, for example; but the most effectual is white vitriol, in the quantity of a scruple or half a drachm, dissolved in a large wine-glass-full of water, to be repeated in fifteen minutes if necessary. Where the symptoms indicate narcotic poisoning,—for instance, with opium,—it is essential to keep the person roused after giving the emetic, otherwise it will hardly act. Emetics, when they do operate, are greatly preferable to the stomach-pump, which has been of late currently substituted for them. The stomach-pump, however, is one of the most important additions which have been made to the healing art in modern times. In very many instances of narcotic poisoning no emetics will operate; and all such cases, till of late, inevitably perished where the quantity of poison was considerable. The stomach-pump insures the prompt removal of almost all poisons; so that when used in time recovery is next to certain, where formerly a large majority of cases proved fatal. 2. By all such means, however, the poison

is often but partially removed. Some of it pervades the system; more of it impregnates the tissues with which it was in contact, and is ready for absorption; much of it often passes down into the intestines; occasionally it adheres with obstinacy to the inner membrane of the stomach, and cannot be dislodged either by emetics or by washing through means of the stomach-pump. The second object, then, is to administer an antidote. Antidotes have usually been conceived to be of two kinds. Some, by changing the chemical form of poisons, render them inert, and are called chemical antidotes. Others are thought to subdue the morbid action of poisons by exciting a counter-action, and are termed constitutional antidotes. In ancient times, and likewise until the recent improvements in toxicology, scarcely any other antidotes were known, except what belonged to the constitutional class. But it is now thought that in correct language scarcely any such antidote exists. European physiologists are not acquainted with any decided constitutional antidote for any of the numberless multitude and variety of poisons now familiar to the scientific. It is very generally believed, however, that savages in all quarters of the world are in possession of remedies of this nature, more especially for the effects of snake-poison. Apparently authentic accounts have been published, of a considerable variety of antidotes known to the natives in different parts of North and South America for the bite of venomous snakes. But none of these supposed antidotes have been found to stand the test of scientific investigation; natives who put trust in them have been seen to perish in the usual way; there is no difficulty in accounting for their apparent occasional success; and those who give faith to the marvels of travellers on the subject ought to consider how very extraordinary it would be, if, in every part of the globe where there are savages, discoveries of this kind should be made in regard to their poisons, while, with all the advantages of science to aid them in the search, no civilized people have yet contrived to stumble on a similar discovery in relation to any of the innumerable poisons with which they have long been familiar. If constitutional antidotes are still much wanted, there is no want of excellent antidotes of the chemical class. Some of these act by neutralizing the chemical qualities on which the properties of the poison depend, others by simply rendering the poison insoluble. Thus sulphuric acid is rendered inert by magnesia, because it becomes thereby a neutral salt, soluble, indeed, but no longer capable of corroding the animal textures, or of exciting violent irritation. In like manner potash is rendered inert, or nearly so, by lemon-juice or vinegar, or, though less easily, by oil, because it is converted into neutral salts, which are feebly irritant and not at all corrosive. On the other hand, oxalic acid is rendered inert by magnesia, partly because its corrosive qualities are neutralized by chemical neutralization, but chiefly because these, in common with its not less formidable effects on the nervous system through absorption, are prevented by a substance resulting which is insoluble. So, too, arsenic becomes inert when brought thoroughly in contact with the hydrated peroxide of iron, because an insoluble compound is formed, the arseniate of iron. In using and searching for antidotes of the chemical kind, several important general rules should be attended to. For, first, where a poison is a pure local irritant, destitute of action through the blood or remote organs, it is usually sufficient that it be neutralized; because the resulting compound is commonly but a feeble irritant, although soluble. One condition, however, must be observed, namely, that the antidote shall be itself innocuous, otherwise harm may be done by the antidote before it comes in contact with the poison, or because it is given in excess. Thus the mineral acids are unfit antidotes for neutralizing the mineral alkalis, and the latter for neutralizing the former. But, secondly, when the poison is of a kind which acts on remote organs through the medium of absorption, it is not enough that it be chemically neutralized. For all such poisons act as such throughout their soluble compounds; their compounds act on the whole in proportion to their solubility; and those only are inert which are insoluble, and insoluble not merely in water, but likewise in the animal fluids of the stomach. Hence oxalic acid and arsenious acid (common arsenic) are not neutralized in their physiological actions by being neutralized with potash; prussic acid similarly treated remains as energetic as ever; and the powerful vegetable alkaloids, morphia, strychnia, conia, and the like, instead of becoming inert by neutralization with acids, are rendered positively more active, because they are made more soluble. In the case of every poison, then, it is advantageous, and in very many it is indispensable, that the chemical change effected shall be such as to impart to the compound insolubility; and care should be taken that this insolubility shall exist in regard to the natural juices of the stomach, which are commonly acidulous. But, thirdly, the antidotal tendency of such chemical remedies, even when of undoubted virtue, is often counteracted where the poison is a fine rather insoluble powder; for it adheres forcibly to the inner coat of the stomach, irritates it to throw out tough mucus, which covers the powder, and defends it against the approach of the neutralizing agent. Frequent instances of such a course of things occur in the case of poisoning with arsenic. 3. The last object of the treatment of poisoning is the cure of the disorders which the poison has produced. These disorders, since they are substantially natural diseases, must be treated as such. But there are certain circumstances which render them in some measure peculiar, and consequently modify the treatment. These are chiefly as follows. Treatment will obviously be of little use for such disorders, until what remains of the poison be removed or rendered inert; and as this object is often unattainable, ultimate success is frequently beyond reach. Evacuation of the poison is in this point of view of primary importance, as well as for its own sake. In the case of poisoning with the irritants, the treatment is often exceedingly embarrassing, because it must be simultaneously directed towards two opposite ends, the suppression of inflammation by evacuating, and consequently debilitating measures, and the removal of depression of the heart and general system by stimulating remedies. These two contrary and incompatible objects are often the cause why the best treatment proves inefficacious. The treatment of narcotic poisoning is somewhat differently circumstanced. The remains of the poison being removed, there is only the induced disorder to combat. These disorders are in the great majority of cases functional only; that is, no structural injury has been occasioned. Hence, the offending cause having been withdrawn, there may be expected to prevail in the constitution a natural tendency to throw off the functional disorder,—a tendency towards recovery. Experience shows that such is actually the fact. If in narcotic poisoning the remains of the poison can be removed, and life can be preserved for a moderate length of time, success is highly probable in a great majority of cases. Thus very few die of poisoning with opium, and perhaps still fewer ought to die in skilful hands, who survive for eighteen hours. In narcotic poisoning, then, the treatment for subduing the disorders induced consists mainly in employing, in some instances, sedatives for subduing irritation of the nervous system, but much more commonly stimulants, for the purpose of keeping the person roused, and in applying various means for supporting artificial respiration where the natural breathing fails. Excellent methods for accomplishing the first object are now in familiar use, such as loud talking, agitation of the body, injecting water into the ears, tickling the nostrils, dashing cold water over the head and shoulders, applying sinapisms to the calves, blistering the head with boiling water, and internally ammonia, ether, and spirits. But the best method of supporting artificial respiration has not yet been discovered; there are practical objections to all the methods yet devised; and it is only when these shall be perfected, that the treatment of narcotic poisoning will be rendered substantially superior to what it is at present. It is not unlikely that galvanism will be found a material part of the most efficacious method,—applied, however, not continuously, as is often practised, but interruptedly, so as not to disturb the alternate contractions and relaxations of the respiratory muscles.

Action on vegetables.

In the preceding observations on the effects and treatment of poisoning, poisons have been regarded solely in their operation on the animal body. But they were defined at the outset as acting on living bodies generally; and upon vegetables their action is not less remarkable than upon animals. This branch of the subject has been hitherto little studied; but what is already known of it seems full of interest both in a physiological and in a practical point of view. It appears that in a general sense there is a close analogy between the actions exerted by poisons on both divisions of the living world. As there are two leading effects produced in animals, so are there two great classes of phenomena developed in vegetables, those of irritation and those of narcotism, or at least of an action closely analogous. The apparent phenomena of both kinds are indeed much simpler in vegetable than in animal beings, partly because the organs and functions of the former are more simple than those of the latter, partly because physiologists have not yet ascertained with precision the special changes that are induced. Still, however, it is easy to trace in vegetables the leading effects produced by irritants and by narcotics respectively, upon animals. The former occasion partial or general disorganization or death of the organs of plants to which they are directly applied, and the plant may eventually either recover or perish, according to the extent of the injury or the importance of the organ injured. The latter seem to act upon the vitality of the plant, without in general producing any marked change of a local nature, or such as may be referred to a direct impression, at least until the first signs of vital depression appear; and it is commonly observed, that so soon as such signs of depression do make their appearance, however slight they may be, they quickly pervade the whole plant, which in consequence perishes irrevocably. The irritants appear to act topically, and from without inwards; the narcotics act more generally, and from within outwards, being probably first absorbed.

Poisons act upon vegetables, through whatever channel they are introduced, and to whatever organ they are applied, provided the texture be such as to admit of their passage to those parts which are more or less directly connected with life. The organs through which they act with greatest energy are the leaves and the roots. Liquid poisons act with most energy through the roots; gaseous poisons are probably most energetic when applied to the leaves. Partial action is sometimes produced by the topical application of a general or narcotic poison; thus arsenic introduced into the axilla of a leaf of the *dipsacus fullonum* kills the whole superior part of the plant on the side corresponding with the leaf. Vegetable poisons are not less energetic than mineral poisons. Nay, however extraordinary it may appear, there seems no question that plants may be promptly killed by their own poisons,—that the poison produced by a particular species may kill that species as readily as it will others, if applied to the root so as to be absorbed into the nutritive juices. This singular phenomenon may depend on the poison being secreted and confined in particular receptacles in the ordinary state of the plant. But another and more intelligible explanation in regard to certain poisons may be drawn from the well-ascertained fact, that some vegetable poisons, and probably more of them than the physiologist may at present be inclined to admit, do not exist ready formed in the plants whence they are obtained, but are produced only when certain principles, existing naturally apart in distinct receptacles, are brought in contact by mechanical force or chemical manipulations. A remarkable instance in point is the essential oil of the bitter-almond kernel, or cherry-laurel leaf, which does not exist ready formed, otherwise it would be betrayed, like other essential oils, by its powerful odour, but is formed only when certain principles, named *amygdalin* and *emulsin*, are brought in contact with each other and with water.

No poisons are better fitted for illustrating the phenomena of poisoning in vegetables, or better deserve the attention of physiologists and practical men, than those which are gaseous in their nature. Most of them seem to act in excessively minute quantities and proportions. A tenth part of a cubic inch of muriatic acid gas, which is equivalent to the twenty-fifth part of a grain by weight, will in no long time destroy a small plant, although the gas be diluted with twenty thousand times its volume of air; and the devastating effects produced on surrounding vegetation by all manufactories where this acid is thrown abundantly into the atmosphere, as in the manufacture of black-ash and soda from sea-salt, abundantly show that far less proportions will prove equally deleterious when applied continuously. Sulphurous acid gas acts with nearly as great intensity. The effect of either of these poisons is simply to shrivel and wither the leaves and buds, like the action of frost in spring; and the plant will eventually recover if removed in time from the influence of the noxious agent, but with the loss of its foliage. Other gases, such as sulphuretted hydrogen and cyanogen, produce no visible change until the leaves begin to bend and droop; after which the drooping quickly extends, till at length the whole plant becomes flaccid, so as to present exactly the same appearance as when deprived of moisture; and it perishes inevitably.

Some substances which are poisonous to animals are not poisonous to vegetables. The experiments which have been made on this subject are neither sufficiently extensive nor sufficiently exact to warrant any general deductions. A very remarkable instance is carbonic acid gas, a small proportion of which in the atmosphere will speedily extinguish animal life, but which is innocuous to vegetables in almost any proportion, nay, on the contrary, is commonly thought to supply them with aliment.

Uses.

Poisons are by no means without their uses in the economy of nature. It is in the first place not improbable that vegetable poisons serve some purpose in the economy of the plants which produce them. On this point we are still much in the dark, in consequence of the little advancement which has been hitherto made in vegetable physiology. But one purpose of the kind seems to be the perpetuation and extension of such plants, by rendering them unfit for the food of herbivorous animals and frugivorous birds, which by instinct commonly avoid them. In the case of certain poisons of the animal kingdom, their purpose is obviously to preserve the animals which are endowed with them, by enabling them to destroy their prey and their enemies. Another important use to which poisons from every kingdom may be applied, is for the treatment of diseases. A very close connection subsists between medicinal and poisonous action. This is sufficiently shown perhaps by the undoubted fact, that, with very few exceptions, our best medicines are active poisons; and, conversely, that there are few active poisons which have not been turned to account as useful medicines. Besides, in the greater number of instances, the two properties, medicinal virtue and poisonous influence, are plainly nothing else than manifestations of the same action, differing merely somewhat in degree, which is well exemplified by most purgatives and emetics, by opium, henbane, prussic acid, and other anodynes, and by counter-irritants, or substances employed for irritating the skin. In other instances, again, where the poisonous and medicinal actions are to appearance different and unconnected, the existence of some relationship between them seems to be pointed out by the activity of the substances as drugs being proportioned to their energy as poisons. Another purpose to which some poisons are applied is for the destruction of the lower animals for the use of man. In most parts of the world, where the primitive habits of mankind have not been materially modified by civilization, poisons of great energy are familiarly employed for the destruction of game, and in some countries also for killing beasts and birds of prey. In civilized countries they have hitherto been used chiefly for the more ignoble purpose of getting rid of vermin. But they are susceptible of far more important applications of the same nature; which, however, have been as yet entirely overlooked. (x. x. x. x.)

Poison-Tree of Java, called in the Malayan language *Bohun Upas*, is a tree which has often been described by naturalists; but its existence has been very generally doubted, and the descriptions given of it, containing much of the marvellous, have been treated as idle fictions. M. Foersch, however, in an account of it, written in Dutch, asserts that it does exist, that he made the most particular inquiries, and that he found it was situated in the island of Java, about twenty-seven leagues from Batavia. The poison procured from the Upas is said to be a gum, issuing from between the bark and the tree, and brought by malefactors who have been condemned to death.

But a variety of circumstances conspire to prove that Foersch's account of the tree is extremely suspicious. Although he had letters of introduction, he went to no considerable house, and afterwards withdrew amongst the English. The distances given to mark the situation of the tree are not accurate. The execution of criminals is different from what he represents. There were no such disturbances in 1775 as those stated by Foersch, the tract to which he alludes having submitted to the Dutch East India Company as early as 1756. And, lastly, the assertions and pretended facts of Foersch are supported by no collateral evidence. Sir George Staunton, during his stay at Batavia, made the most particular inquiries concerning the Upas, but found that the existence of such a tree had never been known there.[1]

POITIERS, an arrondissement of the department of the Vienne, in France. It extends over 792 square miles, and comprehends ten cantons, divided into 101 communes, and containing 88,600 inhabitants. The capital is the city of the same name, the seat of the departmental government and of the courts of law. It is an elevated spot, almost surrounded by lofty rocks, at the foot of which run the river Elain on the east side, and the river Boivre on the west; both of which streams unite to the north of the city. It is surrounded with ancient walls, and is built in an antique style and irregular manner. It is the see of a bishop, and has an old cathedral and several other churches, three hospitals, an academy, a lyceum, a public library, 4160 houses, and about 19,500 inhabitants. It is a place of little commerce, chiefly confined to making a few woollen cloths, some hosiery, leather, and distilling brandy. Near to it are some Celtic and some Roman antiquities. It is celebrated for the battle which bears the name of the city, though fought at Beauvoir, between Edward the Black Prince of England, and King John of France, in the year 1356, when the latter was made prisoner. Long. 0. 15. 43. E. Lat. 46. 34. 50. N.

POLA, or OTEWHEI, one of the Navigators' Islands, in the South Pacific Ocean. Long. 172. 20. W. Lat. 13. 52. S.

POLACRE, a ship with three masts, usually navigated in the Levant and other parts of the Mediterranean.

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[1] In the Edinburgh Philosophical Journal (vol. xii. p. 102) we find the following account of a visit to the Valley of Death, extracted from a journal of a tour through the islands of Java and Madara, by Mr A. Loudon, in the year 1830.

"*Balor, 3d July* 1830.—This evening, while walking round the village with the Patteh (native chief), he told me that there was a valley only three miles from Balor, that no person could approach without forfeiting their lives, and that the skeletons of human beings, and all sorts of beasts and birds, covered the bottom of the valley. I mentioned this to the commandant, Mr Van Spreewenberg, and proposed that we should go to see it. Mr Daendels, the assistant-resident, agreed to go with us. At this time I did not believe all that the Javanese chief told me. I knew there was a lake close to this, and that it was dangerous to approach too near, but I had never heard of the Valley of Death.

"*Balor, 4th July.*—Early this morning we made an excursion to the extraordinary valley called by the natives *Guwo Upas*, or Poisoned Valley; it is three miles from Balor, on the road to the Djienz. Mr Daendels had ordered a footpath to be made from the main road to the valley. We took with us two dogs and some fowls, to try experiments in this poisonous hollow. On arriving at the foot of the mountain, we dismounted and scrambled up the side, about a quarter of a mile, holding on by the branches of trees; and we were a good deal fatigued before we got up the path, being very steep and slippery from the fall of rain during the night. When within a few yards of the valley, we experienced a strong, nauseous, suffocating smell; but on coming close to its edge, this disagreeable smell left us. We were now all lost in astonishment at the awful scene before us. The valley appeared to be about half a mile in circumference, oval, and the depth from thirty to thirty-five feet; the bottom quite flat; no vegetation; some very large (in appearance) river-stones; and the whole covered with the skeletons of human beings, tigers, pigs, deer, peacocks, and all sorts of birds. We could not perceive any vapour or any opening in the ground, which last appeared to us to be of a hard sandy substance. It was now proposed by one of the party to enter the valley; but at the spot where we were this was difficult, at least for me, as one false step would have brought us to eternity, seeing no assistance could be given. We lighted our cigars, and with the assistance of a bamboo, we went down within eighteen feet of the bottom. Here we did not experience any difficulty in breathing, but an offensive, nauseous smell annoyed us. We now fastened a dog to the end of a bamboo, eighteen feet long, and sent him in; we had our watches in our hands, and in fourteen seconds he fell on his back, did not move his limbs or look round, but continued to breathe eighteen minutes. We then sent in another, or rather he got loose from the bamboo, and walked in to where the other dog was lying; he then stood quite still, and in ten seconds he fell on his face, and never afterwards moved his limbs; he continued to breathe for seven minutes. We now tried a fowl, which died in a minute and a half. We threw in another, which died before touching the ground. During these experiments we experienced a heavy shower of rain; but we were so interested by the awful scene before us, that we did not care for getting wet. On the opposite side, near a large stone, was the skeleton of a human being, who must have perished on his back, with the right arm under his head. From being exposed to the weather, the bones were bleached as white as ivory. I was anxious to procure this skeleton, but any attempt to get at it would have been madness. After remaining two hours in this Valley of Death we returned, but found some difficulty in getting out...... The human skeletons are supposed to be those of rebels who had been pursued from the main road, and taken refuge in the different valleys; as a wanderer cannot know his danger till he is in the valley, and, when once there, he has not the power or the presence of mind to return."

Mr Loudon conceives that there is a great difference between this valley and the Grotto del Cane, near Naples. In the Grotto the air is confined to a small aperture, whilst in the valley the circumference is fully half a mile, and not the least smell of sulphur, nor any appearance of an eruption having taken place near it, although the whole chain of mountains is volcanic, and there are two craters which constantly emit smoke, at no great distance from the side of the road at the foot of the Djienz. It thus appears that the story told by Foersch is an entire fabrication, and that the notion of a poison-tree is a pure romance; but, like most fictions, it has a thread of truth interwoven in its texture, some of the circumstances agreeing with those above stated, but at the same time proving that Foersch had never visited the Valley of Death.

POLAND.

History.

POLAND, a country of Europe, was, in its largest extent, bounded on the north-west by the Baltic Sea, with the ports of Dantzig, Elbing, Libau, and Windau; on the north and east by Muscovy, and the rivers Dwina and Dnieper, forming part of the frontier of the two countries; on the south by the possessions of the Turkish empire, Wallachia and Moldavia, and Hungary, separated by the Carpathian Mountains; and on the west by Silesia, and the possessions of the duchy of Brandenburg, the present kingdom of Prussia.

Before the year 1772, that is, prior to the first partition, the boundaries of Poland were not materially altered. At that period, the whole territory included under this denomination comprised more than 13,000 square geographical miles, and upwards of 15,000,000 of inhabitants. Excepting the palatinates of Podolia, some parts of Volhynia, Gallicia, Sandomir, and Cracow, this tract of land presents in the greater part one immense plain, where a mountain or a hill is scarcely to be met with. But in the southern part of Poland, the ground rises to a certain degree of elevation, until it reaches the chain of the Carpathian Mountains, which at one extremity abuts on the Rhine, and at another on the Danube. The highest summit of this range is the Great Krapak, the elevation of which has been ascertained to be 10,220 feet above the level of the sea.

The Poles, considered as a nation, are not of very ancient date. Prior to the ninth century, they were divided into a multitude of independent tribes, each governed by its respective chief; and, except in cases of invasion, where the necessity of self-defence produced combination, they acknowledged no general head or chief. Like most other people, however, they lay claim to an antiquity sufficiently venerable, and trace their origin back to one of the immediate descendants of Noah, who, according to them, colonized this part of ancient Sarmatia. But the absurdity of such a claim being too obvious to be long supported, especially amongst a people who never had even a fabulous history, less extravagant chroniclers were content with assigning to Lech or Lesko, who is said to have reigned about the middle of the sixth century, the honour of their incorporation as a nation. Nor can it be doubted that even this era is much too early. As the laws of historical evidence became better understood, it was accordingly given up as untenable, and the authentic opening of Polish history has been brought down three centuries; that is, to the accession of Ziemowitz, in the year 860. Lastly, it was reserved for the Polish writers of our own time, Lelewel, Niemcewitz, Golembrowski, Zielinski, and others, to abstract another century from the national existence, and to proclaim Miecislas I. as the true founder of the Polish monarchy.[1]

Polish sovereigns at first only styled dukes.

The sovereigns of Poland had at first the title of dukes or generals, as if their office had been only to lead the armies into the field. The first of these is now generally allowed to have been Lech or Lecht; and to this day Poland is called by the Tartars the kingdom of Lech. Busching, however, gives a different account of the origin of the Poles. Sarmatia, he observes, was an extensive country, inhabited by a variety of nations of different names; as he supposes the Poles to be the descendants of the ancient *Lazi*, a people who lived in Colchis, on the Euxine; hence the Poles are sometimes called *Polazi*. Having crossed several rivers, they entered Posnania, and settled on the borders of the Warta, whilst their neighbours the Zechi settled on the Elbe, in the 550th year of Christ.

History.

Of the transactions of Lech during the time he enjoyed the sovereignty we have no certain account. His successor was named Viscimar, and is generally supposed to have been the nephew of Lech. He was a warlike and successful prince, who subdued many provinces of Denmark, and built the city of Wismar, so called from the name of the sovereign. But the Danish historians take no notice of his wars with their country, nor do they even mention a prince of this name.

Change in the form of government.

After the defeat of Viscimar, the nobility were upon the point of electing a sovereign, when the people, suffering under the burdens occasioned by the wars of Viscimar, unanimously demanded another form of government. At first the nobility pretended to yield, though with great reluctance; but they afterwards determined on such a form of government as threw all the power into their own hands. Twelve palatines, or vayvodes, were chosen; and the Polish dominions divided into as many provinces. But these palatines exercised a despotic authority within their several jurisdictions, and aggravated the misery of the people by perpetual wars; wherefore the Poles, worn out with oppression, resolved to return to their ancient form of government. For this purpose many assemblies were held; but, by reason of the opposition of the vayvodes, they all came to nothing. At last, however, the people cast their eyes upon one Cracus, whose wealth and popularity had raised him to the highest honours amongst his countrymen. According to the Poles, he was a native of Poland, and one of the twelve vayvodes; the Bohemians, however, affirm that he was a native of their country; but both agree in maintaining that he was descended from the ancient family of the Gracchi in Rome; a paternity which insured assent by reason of its absurdity. Cracus, however, is said to have signalized himself against the Franks, whom he overthrew in some desperate engagements, and afterwards founded the city of Cracow, whither he transferred the seat of his government. He did not enlarge his dominions, but he did more than this; he made his subjects happy by many excellent laws and regulations. At last, after a long and glorious reign, he was assassinated by a nobleman who aspired to the crown.

Cracus left three children; Cracus, Lech, and a daughter named Wenda. The first succeeded to the dukedom in virtue of his birthright, but was soon afterwards murdered by his brother Lech. The latter, however, did not long profit by this fratricide. His crime having been discovered, he was deposed and banished by his subjects, and his sister Wenda was declared duchess. This princess was beautiful and accomplished; and soon after she had been raised to the sovereignty, Rudiger, a German prince, sent an ambassador demanding her in marriage, and threatening war if his proposals were refused. Wenda marched in person against him at the head of a numerous army; but the event proved fatal both to Rudiger and herself. The troops of Rudiger having abandoned him without striking a blow, he killed himself in despair; and Wenda was so much concerned for his death that she is said to have drowned herself in the Vistula.

The family of Cracus having become extinct by the death of Wenda, and the Poles being again at liberty to choose a new sovereign and a new form of government, through a natural levity restored the vayvodes, notwithstanding all that they had formerly suffered from them. The consequences were precisely the same as before. The vayvodes abused their power; the people were oppressed; and the state was distracted between foreign wars and civil contentions. The Hungarians and Moravians had invaded Poland, and were opposed only by a handful of men almost ready to surrender at discretion. Subjugation and ruin appeared inevitable; when one Prezemislas, a private soldier, contrived a stratagem by which the numerous forces of the enemy were overthrown, and for his valour was rewarded with the dukedom. We are ignorant of the other transactions of his reign; but historians inform us that he died deeply regretted, leaving no issue.

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[1] The word *Pole* is not older than the tenth century, and seems to have been originally applied not so much to the people as to the region they inhabited; *Polska*, in the Sclavonic language, signifying a field or plain.

On the death of Prezemislas several candidates appeared for the throne; but the Poles determined to prefer him who should overcome all his competitors in a horse-race. A stone pillar was erected near the capital, on which were laid all the ensigns of the ducal authority; and a herald proclaimed, that he who first arrived at that pillar from a river at some distance, named Pradnik, should obtain the prize. A Polish lord named Lech or Lesko resolved to secure the victory by artifice; for which purpose he caused iron spikes to be driven all over the course, reserving only a path for his own horse. The fraudulent design took effect; all the rest of the competitors were dismounted, some being severely hurt by their fall; and Lesko was about to be proclaimed victor, when, unluckily for him, a peasant who had found out the artifice opposed the ceremony. An examination of the fact immediately took place; Lesko was torn in pieces, and the ducal authority conferred upon the peasant.

The name of the new monarch was also Lesko. Having thus attained the sovereignty, he conducted himself with great wisdom and moderation. Though he possessed the qualities of a great warrior, and extended his dominions on the side of Moravia and Bohemia, yet his chief delight was to render his subjects happy by cultivating the arts of peace. In the decline of life he was obliged to engage in a war with Charlemagne, and is said by some to have fallen in battle; though others assert that he died a natural death, at an advanced age, when the springs of life were quite worn out.

Lesko II. was succeeded by his son Lesko III. who inherited all his father's virtues. He suppressed an insurrection in the Polish provinces; and having led his army against the Greek and Italian legions who had overrun Pannonia, he gained a complete victory over his enemies. Nor was his valour more conspicuous in the battle than his clemency in the victory. He dismissed all his prisoners without ransom, demanding no other conditions than that they should never again disturb the peace of Poland, or the allies of that kingdom. This duke is said to have been endowed with many virtues, and is charged only with the vice of incontinence. He left twenty natural children, and only one legitimate son, named Popiel, to whom he bequeathed the sovereignty. The latter removed the seat of government from Cracow to Gnesna, and was succeeded by his nephew Popiel II. then a minor.

This young king behaved with great propriety as long as he was under the tuition of others; but as soon as he had got the reins of government into his own hands the face of affairs was altered. Lesko III. had promoted his illegitimate children to the government of different provinces; and they had discharged the duties of their offices in such a manner as showed that they were worthy of the confidence reposed in them. But as soon as he came of age, Popiel, seduced by his wife, an artful and ambitious woman, removed them from their posts, treated them with the utmost contempt, and at last found means to poison them all at an entertainment. A dreadful punishment, however, is said to have awaited his treachery and cruelty; and he perished miserably, with all his house.

The nation now became a prey to civil discord, at the same time that it was harassed by a foreign enemy; and the state seemed to be on the verge of dissolution, when Piast was proclaimed duke in 842. The reign of Piast was the golden age of Poland. He engaged in no foreign wars; he was harassed with no domestic commotions; respect and honour met him without, abundance and contentment within. This excellent monarch, from whom those of ducal or regal dignity were called Piast, died in the year 861, and was succeeded by his son Ziemowitz, who was of a more warlike disposition than his father, and first introduced regular discipline amongst the Polish troops. He maintained a respectable army, and took great pains to acquire a perfect knowledge of the art of war. Hence he was victorious in all his battles, retook from the Germans and Hungarians all that they had gained by conquest, and, at the same time, greatly enlarged his own dominions.

Christianity introduced by Miecislas.

After his death nothing remarkable happened in Poland till the time of Miecislas I., who attained the ducal authority in 964. He was born blind, and continued so for seven years, after which he recovered his sight without using any medicine; a circumstance so extraordinary, that in those times of ignorance it was accounted a miracle. In his reign the Christian religion was introduced into Poland. The most probable account of the manner in which Christianity was introduced is, that Miecislas having by ambassadors paid his addresses to Dombrowka, daughter of the king of Bohemia, the lady rejected his offer unless he should suffer himself to be baptized. To this the duke consented, and, after having been instructed in the principles of Christianity, he was baptized. He founded the archbishoprics of Gnesna and Cracow; and appointed St Adelbert, who had been sent by the pontiff to propagate Christianity in Poland, primate of the whole kingdom. On the birth of his son Boleslas he redoubled his zeal, founding several bishoprics and monasteries, and ordering that, when any part of the Gospel was read, the hearers should half draw their swords, in testimony of their readiness to defend the faith. But he was too devout to attend to the duties of a sovereign, and suffered his dominions to be ravaged by the sovereign of Russia. Yet, with all his devotion, he could not obtain the title of king from the pope, though he had warmly solicited it. That title was afterwards conferred on his son, who succeeded to all his dominions.

Boleslas I. king of Poland.

Boleslas I. surnamed Chobry, or the Valiant, succeeded to the sovereignty in 999. He also professed and cherished Christianity, and was a man of great valour and prudence. The first transaction of his reign, however, savoured much of the fanciful piety of those times. He removed from Prague to Gnesna the relics of a saint, which he had purchased at a considerable price. The Emperor Otho III. made a pilgrimage to the tomb of this saint, where he was hospitably received by Boleslas, whom, in return, Otho invested with the regal dignity; an act which was confirmed by the pope. But this new dignity added nothing to the power of Boleslas. He now indeed affected more state than before; his body-guards were considerably augmented; and, whenever he stirred out of his palace, he was constantly attended by a numerous and splendid retinue. In this way he inspired his people with an idea of his greatness, and also of their own importance, which was perhaps necessary for the accomplishment of a design he had formed, namely, an offensive war with Russia; but when he was on the point of setting out on this expedition, he was prevented by the breaking out of a war with the Bohemians.

Conquest of Bohemia.

The elevation of Boleslas to the regal dignity had excited the envy of the Duke of Bohemia, who having solicited the same honour for himself, had been refused; and his jealousy was further excited by the connection between Boleslas and the emperor, the former having married Rixa, the emperor's niece. Without any provocation, therefore, or giving the least intimation of his design, the Duke of Bohemia entered Poland at the head of a numerous army, committing everywhere the most dreadful devastations. Boleslas immediately marched against him, and the Bohemians retired with precipitation. Scarcity of provisions, however, and the inclemency of the season, prevented Boleslas at that time from pursuing; but as soon as these obstacles were removed, he entered Bohemia at the head of a formidable army, with a fixed resolution to inflict ample vengeance. The Bohemians were altogether unable to resist; neither had they the courage to venture a battle. So great, indeed, was the cowardice of the duke or his army, that they suffered Prague, the capital of the duchy, to be taken after a siege of two years, having never, during that time, ventured to raise the siege by attacking the Polish army. The taking of this city was quickly followed by the reduction of places of inferior note; but though Boleslas was in possession of almost all the fortresses in Bohemia, he could not believe his conquests complete until he became master of the duke's person. This unfortunate prince had shut himself up with his son in his only remaining fortress of Wissogrod, where he imagined he would be able to foil all the attempts of the Polish monarch. In this, however, he was deceived. Boleslas invested the place, and made his approaches with such rapidity, that the garrison, dreading a general assault, resolved to capitulate, and persisted in their resolution notwithstanding all the entreaties and promises of the duke. This unhappy prince therefore fell into the hands of his enemies, and had his eyes put out by Boleslas; after which his son Jaromir was sent into confinement.

Other advantages gained by him.

From Bohemia Boleslas marched towards Moravia, and no sooner had he arrived on the frontier than the whole province submitted without a blow. He then resumed his intention of invading Russia, for which he had now a fair opportunity, by reason of a civil war which raged with violence amongst the children of the Grand Duke Vladimir. The chief competitors were Jarislas and Swiantopelk. The latter, having been defeated by his brother, was obliged to take refuge in Poland, where he used all the arguments in his power in order to induce Boleslas to avenge his cause. Boleslas having already an intention of invading that country, needed but little entreaty; and therefore marched towards Russia at the head of a numerous army, giving out that he had no other design than to revenge the injustice done to Swiantopelk. He was met on the banks of the river Bug by Jarislas at the head of an army much superior in number to his own; and for some days the Polish army was kept in check by the Russians. At last Boleslas, growing impatient, resolved to pass the river at all events; and therefore forming his cavalry in the best manner for breaking the torrent, he exposed his own person to its utmost force. Encouraged by his example, the Poles advanced breast-deep in the water to the opposite shore, whence the enemy made every resistance in their power. In spite of all opposition, however, the Poles reached the bank, and soon gained a complete victory, Jarislas being obliged to fly to Kiow. This city was immediately invested; but Jarislas retired farther into the country to recruit his army, leaving the city to its fate. The garrison made a brave defence, but were at last compelled to surrender at discretion.

Swiantopelk raised to the throne of Russia.

Though the king of Poland had now become master of the greater part of Russia, he knew that the only means of keeping the country in subjection was by placing a natural sovereign over the inhabitants. For this reason he reinstated Swiantopelk, though his pretensions were still disputed by Jarislas. The latter had formed a flying camp, and meditated a scheme of surprising and carrying off his brother; but having failed in this attempt, he retired to Novogorod, where the attachment of the inhabitants enabled him to make some resistance, till at last he was again defeated by Boleslas, which seemed to give the finishing blow to his affairs. In the perfidious and ungrateful Swiantopelk, however, the king of Poland now experienced a more dangerous enemy than he had found in Jarislas.

Death of Boleslas.

The Russian prince, imagining himself a dependent on Boleslas, formed a conspiracy, which had for its object nothing less than the destruction of Boleslas and his whole army. The massacre was already begun when Boleslas received intelligence of this daring and profligate scheme. The urgency of the case admitted of no delay. The king therefore mounted his horse, and having with the utmost haste assembled part of his army, fell upon the traitors with such fury that they were obliged to betake themselves to flight, and Boleslas got safe back into Poland. But in the mean time Jarislas, assembling fresh forces, pursued the Polish army; and having come up with them just as one half crossed the Borysthenes, attacked them with the utmost fury. Boleslas defended himself with the greatest resolution; but, by reason of his forces being divided, victory remained for a long time doubtful. At last, when the army had wholly crossed, the Russians were entirely put to the rout, and a terrible carnage ensued. The victory, however, though complete, was not decisive; wherefore Boleslas thought proper to continue his retreat, without attempting to conquer a country too extensive ever to be kept in subjection.

Boleslas, still unsated with victory, now meditated the conquest of Prussia, and also Pomerania, which had, in the former wars, been dismembered from Poland. His arms were attended with equal success in both attempts; indeed the terror of his name seemed to serve all the purposes of a formidable army. These, however, seem to have been designed as his last warlike enterprises; for he now applied himself to enact wholesome laws for the benefit of his people. But whilst he was thus occupied, Jarislas assembled a numerous army, with which he appeared on the frontiers of Poland. Boleslas, though now advanced in years, marched against his adversaries, and met them on the banks of the Borysthenes, where, attacking the enemy before they had time to draw up in order of battle, he totally defeated them. The Russians being seized with a panic, Jarislas was hurried away, and almost trampled to death by the fugitives. Many thousand prisoners were taken, but Boleslas released them on very easy conditions; contenting himself with an inconsiderable tribute, and endeavouring to engage the affections of the people by his kindness. This well-timed clemency produced such a happy effect, that the Russians voluntarily submitted to his jurisdiction, and became once more his subjects. Soon after this he died, in the year 1025, after having greatly extended his dominions, and, as some say, rendered his subjects happy.

Miecislas II.

Boleslas was succeeded by his son Miecislas II.; but the latter possessed none of the great qualities of his father, being indolent, corrupt, and debauched in his behaviour. In the beginning of his reign, the Russians, Bohemians, and Moravians revolted; but as the spirit and discipline introduced by Boleslas still remained in the Polish army, Miecislas found no great difficulty in reducing them again to obedience; after which, having devoted himself entirely to voluptuousness, he was seized with a frenzy, which put an end to his life in the year 1034.

Rixa, and her son Casimir, expelled.

The bad qualities of this prince proved very detrimental to the interest of his son Casimir, though the latter had received an excellent education, and possessed many virtues. Instead of electing him king, therefore, the Poles chose Rixa, his mother, queen-regent. But she proved tyrannical, and so partial to her countrymen the Germans, that a rebellion ensued; and she was forced to fly to Germany, where she obtained the protection of the emperor, by means of the immense treasures of Boleslas, which she had caused to be transported thither. Her insolent behaviour and consequent expulsion proved still more fatal to the affairs of

Casimir than even that of his father. He was immediately driven out of the kingdom; and aa a civil war took place, there appeared a great many pretenders to the crown. To the miseries thus occasioned were added those of a foreign war. The Bohemians and Russians invaded the kingdom in different places, committing the most dreadful ravages; and the consequence of these accumulated distresses was, that the nobility came at last to the resolution of recalling Casimir, and electing him sovereign.

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The only difficulty was where to find the fugitive prince; for he had been gone five years, and nobody knew the place of his retreat. At length, by sending an embassy to his mother, it was found out that he had at first retired into France, where he applied closely to study at the university of Paris; that afterwards he went to Italy, where, for the sake of subsistence, he took upon him the monastic habit; and that having returned to France, he had obtained some preferment in the abbey of Clugny. Nothing now obstructed the prince's return but the sacred function with which he was invested. A dispensation was, however, obtained, by which he was released from his ecclesiastical engagements, on condition that he and all the kingdom should become subject to the capitation tax, called Peter's pence. Some other conditions of less consequence were added, such as, that the Poles should shave their heads and beards, and wear a white linen robe at festivals, like other professors of the Catholic religion. Great preparations were also made for the reception of the young prince; and he was met on the frontier by the nobility, clergy, and forces of the nation, by whom he was conducted to Gnesna, and crowned by the primate with more than usual solemnity. He proved a virtuous and pacific prince, equal to the difficulties of his situation, worthy of the confidence of the people, and anxious to repair the evils which had so long afflicted his country. Casimir, however, evinced his courage in subduing the banditti by which the country was infested, in re-establishing order, and in restoring the dominion of the laws. By marrying the Princess Mary, sister of the Duke of Russia, all quarrels with his most formidable enemies were for the time extinguished. In a word, the kingdom flourished during his reign, and, from the wisdom and stability of the administration, became more respectable than it could have been rendered by many victories. After a happy reign of sixteen years, he died beloved and regretted by all his subjects.

Bo las II.

By the happy administration of Casimir the kingdom recovered sufficient strength to carry on successful wars against its foreign enemies. Boleslas II., the son of Casimir, an enterprising and valiant prince, succeeded to the throne, and soon rendered himself so famous that three unfortunate princes took refuge at his court, having been expelled from their dominions by their rebellious subjects. These were, Jaromir, brother of Wratislas duke of Bohemia; Bela, brother of the king of Hungary; and Zaslaf duke of Kiow, eldest son of Jarislas duke of Russia, and cousin to the king of Poland. Boleslas determined to redress all their grievances; but whilst he deliberated upon the most proper means of so doing, the Duke of Bohemia, dreading the consequences of Jaromir's escape, assembled an army, and, without any declaration of war, marched through the Hercynian forest, desolated Silesia, and laid waste with fire and sword the frontiers of Poland. Boleslas marched against him with a force greatly inferior; but, by dint of superior capacity, cooped up his adversary in a wood, where he reduced him to the greatest distress. In this extremity the duke sent proposals for accommodation; but these were rejected with disdain by Boleslas; upon which the former, ordering fires to be kindled in his camp, as if he designed to continue there, removed with the utmost silence in the night-time, and marching through narrow defiles, advanced several leagues before Boleslas received intelligence of his retreat. The king pursued the fugitive, but in vain; and, after ravaging the frontiers of Moravia, he returned to his own dominions. The next year Boleslas entered Bohemia with a numerous army; but the duke, unwilling to encounter such a formidable adversary, submitted to such terms as Boleslas thought proper to dictate. In these the king of Poland stipulated for certain conditions in favour of Jaromir, which he took care to see punctually executed; and he next determined to march towards Hungary, to assist the fugitive prince Bela.

This prince had for some time been solicited by a party of disaffected nobility to return, his brother, the reigning king, having, by his tyrannical behaviour, alienated the hearts of his subjects. As soon, therefore, as Boleslas had finished the war in Bohemia, he was solicited by Bela to embrace the present favourable opportunity for putting him in possession of the kingdom of Hungary. This the king readily complied with; and both princes entered Hungary, by different routes, each at the head of a numerous body. The king of that country, however, was not disconcerted by such a formidable invasion; and, being largely assisted by the emperor, advanced against his antagonists with a great army, in which there were a numerous body of Bohemians, who had come to his assistance in direct violation of the treaty subsisting between the duke and the king of Poland. A decisive battle was at length fought, in which the Germans behaved with the greatest valour, but were entirely defeated through the treachery of the Hungarians, who in the heat of the battle deserted and went over to Bela. Almost all the foreign auxiliaries were killed on the spot; the king himself was seized, and treated with such cruelty that he died of a broken heart; and Bela was placed on the throne without further opposition, except from a revolt of the peasants, which was soon quelled by the Polish army.

Boleslas projects the conquest of Russia.

Boleslas, having thus succeeded in two great enterprises, began to look upon himself as invincible; and, instead of designing only to assist Zaslaf, as he had at first intended, now projected the subjugation of the whole country. He had indeed a claim to the sovereignty in virtue of his descent from Mary, queen of Poland, the sister of Jarislaf; and this he endeavoured to strengthen by marrying a Russian princess. Having, therefore, assembled a numerous and well-disciplined army, he entered the duchy of Kiow, and was there opposed by Uscheslaf, who had usurped the sovereignty, with a great body of forces. Boleslas, however, continuing to advance, the Russian prince, intimidated by the number and order of his enemies, deserted his own troops, and fled privately with a slender retinue, upon which his force dispersed. The inhabitants of the city of Kiow now called to their assistance two brothers of Uscheslaf; but these princes acting the part of mediators, procured pardon for the inhabitants from Zaslaf, their natural sovereign; and with the same facility the two princes recovered all the other dominions belonging to Zaslaf. In the mean time the king of Hungary died; a revolt immediately ensued; and the two sons of Bela were on the point of being deprived of their paternal dominions. This Boleslas no sooner heard of than he marched directly into Hungary, where, by the terror of his name alone, he re-established tranquillity, and confirmed the princes in the enjoyment of their kingdom. In the mean while Zaslaf was again driven from his territories; all the conquests that had formerly been made were lost; and his brothers became more powerful than ever. The king's vigour, however, soon disconcerted all their measures. He ravaged the territories composing two palatinates, reduced the strong city of Wolyn, and transported the booty to Poland. The campaign was finished by a battle, which proved so bloody, that though Boleslas proved victorious, his army was so weakened that he could not pursue his conquests. In the winter he made numerous levies, and returning in the spring to Kiow, reduced it by famine. But on this occasion, instead of treating the inhabitants with cruelty, he commended their valour, and strictly prohibited his troops from pillaging or insulting them; distributing provisions amongst them with the utmost liberality.

This clemency procured the highest honour to the king of Poland. But his stay here was productive of a great disaster. Kiow being the most dissolute as well as the richest city in the north, the king and his soldiers gave themselves up to the pleasures of the place. Boleslas himself affected all the state of an eastern monarch, and contracted an inclination for the grossest debaucheries. This Russian Capua proved almost fatal to Poland. The Hungarian and Russian wars having continued for seven years, during that time the king had never been at home, excepting for the short space of three months. In the mean time the Polish women, exasperated at hearing that their husbands had neglected them, and connected themselves with the women of Kiow, raised their slaves to the beds of their masters; in other words, conspired in one general scheme of prostitution, in order to be revenged for the infidelity of their husbands.[1] Advice of this strange revolution was soon received at Kiow, where it excited violent commotions. The soldiers blamed the king for their dishonour, forgetting how much they had to accuse their own conduct in giving their wives such provocation. The effect of these discontents was a general desertion, and Boleslas saw himself suddenly left almost alone in the heart of Russia; the soldiers having unanimously resolved to return home, in order to take vengeance upon their wives and their paramours.

Civil war.

A dreadful kind of civil war now ensued. The women, knowing that they had no mercy to expect from their husbands, persuaded their paramours to take arms in their defence. They themselves fought by the side of their gallants with the utmost fury, and sought out their husbands in the heat of battle, in order to secure themselves from all danger of punishment by their death. They were, however, on the point of being subdued, when Boleslas arrived with the few remaining Poles, assisted by an army of Russians, with whom he resolved to take equal vengeance on the women, their gallants, and his own soldiers who had deserted him. This produced a carnage more dreadful than ever. The soldiers united with their former wives and their gallants against the common enemy, and fought against Boleslas and the Russians with the fury of lions. At last, however, the fortune of the king prevailed; the rebels were totally subdued; and the few who escaped the sword were tortured to death, or perished in prison.

Religious contentions.

To add to the calamities of this unhappy kingdom, the schisms which for some time had prevailed in the Church of Rome found their way also into Poland; and the animosity of parties became aggravated in proportion to the frivolous nature of their differences. But, as generally happens, the matter at length came to be a contention for wealth and power between the king and clergy. Bloodshed followed. The Bishop of Cracow was, like another Thomas a-Becket, massacred in the cathedral whilst he was performing the duties of his office. Violence filled the land, and anarchy reigned supreme. This and other crimes in a short time brought on signal vengeance. Pope Gregory VII. thundered out anathemas against the king, released his subjects from their allegiance, deprived him of the titles of sovereignty, and laid the kingdom under a general interdict. To this sentence Boleslas in vain opposed his authority, and recalled the spirit which had formerly rendered him so formidable. The minds of the people were so impressed with the power of the church, that they deemed it a less heinous crime to rise in rebellion against their sovereign than to oppose the authority of the holy see. Conspiracies were daily formed against the person and government of Boleslas; and the whole kingdom became a scene of confusion, so that the king could no longer continue with safety in his own dominions. He therefore fled with his son Miecislas, and took refuge in Hungary. But here also the holy vengeance of the clergy pursued him, nor did they cease persecuting him till he was brought to a miserable end. Authors differ respecting the manner of his death. Some say that he was murdered by the clergy as he was hunting; others, that he killed himself in a fit of despair; whilst one author informs us that he wandered about in the woods of Hungary, lived like a savage upon wild beasts, and was at last devoured by dogs. The greatest number, however, allege, that being driven from place to place by the persecutions of the clergy, he was at last obliged to become a cook in a monastery at Carinthia, where in this mean occupation the king of Poland ended his days, probably in peace.

The interdict removed.

The destruction of Boleslas was not sufficient to allay the papal resentment. It extended to the whole kingdom of Poland. Miecislas, the son of Boleslas, was not suffered to ascend the throne; the kingdom continued under a severe interdict, which could be removed only by the most abject concessions; and, besides the tax called Peter's pence, new impositions were added of the most oppressive nature; until at length the pontiff, having impoverished the country, consented that the brother of the deceased monarch should be raised to the sovereignty, but only with the title of duke.

Uladislas.

This prince, named Uladislas, being of a meek disposition, with little ambition, thought it his duty to acquiesce implicitly in the will of the pope. Having therefore accepted the terms offered, he sent an embassy to Rome, earnestly entreating the removal of the interdict. The request was granted; but all his endeavours to recover the regal dignity proved fruitless, the pope having, in conjunction with the emperor of Germany, conferred that honour on the Duke of Bohemia. This was extremely mortifying to Uladislas, but it was absorbed in considerations of the utmost consequence to himself and his dominions. Russia availed itself of the recent disturbances to throw off the yoke; and this revolt drew after it that of Prussia, Pomerania, and several other provinces. The smaller provinces, however, were soon reduced; but the duke had no sooner returned to Poland than they again rebelled, concealing their families in impenetrable forests. Uladislas marched against them with a considerable army; but was entirely defeated, and obliged to return in disgrace. Next year, however, he had better fortune. Having led against them a more numerous army than before, he compelled them to submit, and deliver up the ringleaders of the revolt to be punished as the duke thought proper.

But no sooner were the Pomeranians reduced, than civil dissensions took place. Sbigniew, the son of Uladislas by a concubine, was placed by the discontented nobility at the head of an army to subvert his father's government, and dispute the title of Boleslas, the legitimate son of Uladislas, to the succession. The war was terminated by the defeat and captivity of Sbigniew, who was at first confined, but afterwards released on condition that he should join his father in punishing the palatine of Cracow. Before this could be effected, however, the palatine found means to effect a reconciliation with the duke; and the young princes being displeased with this, a war ensued between them and their father. At length, however, the palatine of Cracow was banished, and the princes submitted; after which, Uladislas, having chastised the Prussians and Pomeranians, who had again revolted, died in the year 1103, in the fifty-ninth year of his age.

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[1] This prostitution or bigamy must have been all but universal, since only one lady is mentioned who had the virtue to resist the strange epidemic passion with which the Polish matrons appear to have been seized. Her name, which history has been careful to preserve, was Margaret, the wife of Count Nicolas de Zembosin

B slas II

Uladislas was succeeded by his son Boleslas III. who divided his dominions equally between his brother Sbigniew and himself. But the former being dissatisfied with his share, raised cabals against his brother; and a civil war was for some time prevented by the good offices of the primate. At last, Sbigniew, having privately stirred up the Bohemians, Saxons, and Moravians, against his brother, made such formidable preparations as threatened the conquest of all Poland. Boleslas, unprovided with forces to oppose such a formidable power, had recourse to the Russians and Hungarians, who readily embraced his cause, in expectation of turning it to their own advantage. Ultimately, however, Sbigniew was defeated, and might have easily been obliged to surrender at discretion, had not Boleslas generously left him in quiet possession of the duchy of Mazovia. This kindness the ungrateful Sbigniew repaid by entering into another conspiracy; but the plot being discovered, he was seized, banished, and declared a traitor if ever he again set foot in Poland. Even this severity, however, did not produce the desired effect. Sbigniew having persuaded the Pomeranians to arm in his behalf, was defeated, taken prisoner, and again banished. All the nobility now solicited the king to put the ungrateful traitor to death; but that generous prince could not think of polluting his hands with the death of his brother. He even took him back to Poland, and appointed him a maintenance suitable to his rank; but he soon had reason to repent of his kindness. His unnatural brother soon began to raise fresh disturbances, and at length met with the death which he had so well deserved.

W with th mpe- ro enry V.

Boleslas was scarcely freed from the intrigues of his brother, when he found himself in greater danger than ever, from the ambition of the Emperor Henry V. The emperor had attacked the king of Hungary, with whom Boleslas was in close alliance, and from whom he had received assistance in his greatest distress. The king of Poland determined to assist his friend, and therefore made a powerful diversion in Bohemia, where he repeatedly defeated the imperialists. The emperor then collecting all his forces, ravaged Silesia, and even entered Poland, where he laid siege to the strong town of Lubusz; but he was at last obliged to abandon the enterprise, after having sustained severe loss. Henry, in no degree discouraged, penetrated still farther into Poland, and was laying waste all before him, when the superior skill of Boleslas compelled him to retire. Enraged at this disappointment, Henry laid siege to Glogau, in hopes of drawing the Poles to an engagement before he should be obliged to evacuate the country. The fortifications of the place were weak, but the spirit of the inhabitants supplied their deficiencies. At last, however, they were on the point of surrendering, and had actually agreed to give up the place, provided they did not receive any succours within a definite time. But Boleslas, determined not to allow so brave a garrison to fall a sacrifice to their loyalty, prevailed on the besieged to break the capitulation rather than surrender when they were on the point of being delivered. All this was transacted with so much secrecy, that the emperor advanced, without thoughts of meeting any resistance, to take possession of the city; but being received by a furious discharge of arrows and javelins, he was so incensed that he resolved to storm the place, and not give any quarter. On the approach of the army, the imperialists were astonished to see not only the breaches filled up, but new walls, secured by a wet ditch, reared behind the old, and erected during the suspension of hostilities by the industry of the besieged. The attack, however, went on; but the inhabitants, animated by despair, defended themselves with incredible valour, and at last obliged the imperialists to raise the siege. Next day Boleslas arrived, and pursued the emperor with such vigour that he obliged him to retreat with disgrace into his own country. This soon brought on a peace, which was confirmed by a marriage between Boleslas and the emperor's sister.

Boleslas brought into difficulties.

Hitherto the glory of Boleslas had equalled, or perhaps even eclipsed, that of his namesake and predecessor Boleslas the Great; but about the year 1135 he was brought into difficulties, and even disgrace, by his own credulity. Imposed on by an artful story trumped up by a certain Hungarian, who had insinuated himself into his affections, he conferred on that adventurer the government of Wislica, a strong town on the river Nida. But the traitor gave up the place to the Russians, who pillaged and burned it, at the same time carrying the inhabitants into slavery. Boleslas, incensed, immediately entered into a war with Russia, by which he only heaped one calamity upon another. Having received a deputation from the inhabitants of Halitz to implore his assistance, Boleslas marched to their relief with a choice body of troops; but as he was preparing to enter the town he was attacked by the whole Russian army, and, after a most violent conflict, entirely defeated. The unfortunate prince was so much afflicted by this reverse, that in a short time he died, after having reigned thirty-six years.

Poland divided amongst the children of Boleslas.

Boleslas, by his will, divided his dominions equally amongst his four sons. Uladislas, the eldest, had the provinces of Cracow, Sieradz, Lencsysa, Silesia, and Pomerania. Boleslas, the second son, had for his share the palatinates of Culm and Kujavia, with the duchy of Mazovia. The palatinates of Kalszh and Posen fell to Miecislas, the third son; and to Henry, who was the fourth, were assigned those of Lublin and Sandomir. Casimir, the youngest child, then an infant in the cradle, was entirely forgotten, and no provision made for him. There have been but very few instances where dominions were thus divided, that the princes remained satisfied with their respective shares; neither did the sons of Boleslas long continue at peace with one another. By the will of the duke, all the brothers were obliged to own the supremacy of Uladislas, who was declared duke of Poland; they were restrained from forming alliances, declaring war, or concluding peace, without his approbation; they were obliged to take the field with a certain number of troops whenever the duke required it; and they were forbidden to meddle with the guardianship of the infant Prince Casimir, his education being left entirely to the sovereign.

A civil war.

The harmony of the princes was first disturbed by the ambition of Christina, the wife of Uladislas, who formed a scheme to get possession of all Poland, and deprive the younger children of the benefit of their father's will. Having obtained her husband's concurrence, she assembled the states of Poland, and made a long speech, showing the dangers which might arise from a partition of the ducal dominions amongst so many; and concluded with attempting to show the necessity of revoking the ratification of the late duke's will, in order to insure the obedience of the princes and the tranquillity of the republic. Many of the nobility expressed their resentment against this speech, and fully refuted every article in it. But all were afterwards gained over or intimidated by Uladislas, and none appeared to take the part of the young princes except a noble Dane, who lost his life for this generous interference.

Conduct and fate of Uladislas.

Uladislas having now got the nobility on his side, first drove Boleslas from his territories, and next marching against Henry, dispossessed him also, forcing both to take refuge with Miecislas in Posnania, where all the three brothers were besieged. Several of the nobility interposed, and employed all their influence to effect a reconciliation, but in vain. Uladislas, as inexorable as if he had received an injury, insisted that the besieged princes should surrender at discretion, and submit to the will of the conqueror. Thus driven to despair, the brothers sallied out, attacked the

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duke's army, and having obtained a complete victory, took all his baggage and valuable effects. Next, to improve their victory, they laid siege to Cracow. The Russians, who had at first assisted Uladislas, now abandoned him, and evacuated Poland. This obliged him to shut himself up in Cracow, whence, finding the inhabitants little disposed to stand a siege, he retired into Germany to solicit assistance. But in the mean time the city of Cracow surrendered, Uladislas was formally deposed, and his brother Boleslas raised to the supreme authority.

Boleslas. Poland invaded by the Emperor Barbarossa.

The new duke began his administration with an act of generosity towards his brother Uladislas, on whom he conferred the duchy of Silesia, which was thus separated from, and has never since been re-annexed to Poland. But this had no other effect upon Uladislas than putting him in a condition to raise fresh disturbances; and he now found means to persuade the Emperor Conrad to invade Poland. Boleslas, however, so harassed and fatigued his army by marches, ambuscades, and skirmishes, that he was soon obliged to return to his own country; and for some years Poland enjoyed profound tranquillity. During this interval Henry entered on a crusade; and though he lost almost his whole army in that enthusiastic undertaking, yet he is celebrated, by the superstitious writers of the age, as the bulwark of the church, and one of the greatest Christian heroes. Soon after the return of Henry, Poland was invaded by the Emperor Frederic Barbarossa, who had been persuaded to make the attempt by Uladislas and his wife Christina. The number of the imperialists was so great, that Boleslas and his brothers did not think proper to oppose them in the open field; they contented themselves with cutting off the convoys, placing ambuscades, harassing them on their march, and keeping them in perpetual alarm by false attacks and skirmishes. With this view the three brothers divided their forces, laid waste the country before the enemy, and burned all the towns and cities which were in no condition to stand a siege. Thus the emperor, advancing into the heart of a desolated country, where he could not subsist, was at last reduced to such a situation that he found himself obliged to solicit a conference with Boleslas. The latter was too prudent to irritate him by an unseasonable haughtiness, and therefore went to the German camp, attended only by his brothers and a slight guard. This instance of confidence proved so agreeable to the emperor, that a treaty was soon entered into, and confirmed by a marriage between Adelaide, niece of the emperor, and Miecislas, duke of Posen.

Boleslas having thus happily escaped from imminent danger, resolved to attempt the conquest of Prussia, the inhabitants of which were still heathens. Having unexpectedly invaded the country with a very numerous army, he succeeded in his enterprise. Great numbers of infidels were converted, and many churches erected; but no sooner had Boleslas withdrawn, than the inhabitants returned to their old religion. Upon this Boleslas again advanced against them with a formidable power; but being betrayed by some Prussians whom he had taken into his service and raised to posts of honour, his army was led into defiles and almost entirely cut off. Duke Henry was killed, whilst Boleslas and Miecislas escaped with great difficulty.

This misfortune was quickly followed by another. The children of Uladislas now laid claim to all the Polish dominions which had been possessed by their father, and the greater part of which had been bestowed upon Casimir; and they were supported in their pretensions by a great number of discontented Poles, together with a considerable body of German auxiliaries. Boleslas, finding himself unable to withstand his enemies by force, had recourse to negotiation, by which he gained time to recruit his army and repair his losses. An assembly of the states was then held, before which the duke fully refuted the claims of the children of Uladislas; and, to take away all pretence for renewing the civil discords of Poland, they were a second time invested with the duchy of Silesia, which for the time put an end to all disputes. After this, Boleslas applied himself to promote the happiness of his subjects, and continued thus occupied until the period of his death, which happened in the year 1174.

Miecislas.

On the death of Boleslas, the states raised his brother Miecislas to the ducal throne. But the moment that Miecislas ceased to be a subject he became a tyrant, and the slave of almost every vice; so that in a short time he was deposed, and his brother Casimir elected in his stead.

Casimir. Conquest of Russia.

Casimir was a prince remarkable for his justice and benevolence. He set himself about securing peace and establishing tranquillity in all parts of his dominions. He redressed grievances, suppressed exorbitant imposts, and assembled a general Diet, in which it was proposed to rescue the peasants from the tyranny of the nobility. This last was an affair of such consequence, that the duke hesitated to engage in it of his own authority, even though supported by the clergy. Yet it proved less difficult than had been imagined to persuade the nobility to relinquish certain privileges of a kind extremely detrimental. Influenced by the example of their sovereign, they immediately granted all that he required; and, to secure this concession in favour of the peasants, the archbishop of Gnesna thundered out anathemas against all who should endeavour to reclaim the privileges they had just renounced; whilst, to give still greater weight to this decision, the acts of the Diet were transmitted to Rome, and formally confirmed by the pope. But though the nobility in general consented to the partial retrenchment or limitation of their power, it occasioned discontent amongst some, who for this reason immediately became the partisans of the deposed Miecislas. That unfortunate prince was now reduced to such indigence, that his brother Casimir, affected by the accounts he had received, proposed, in an assembly of the Diet, to resign the sovereignty in favour of Miecislas. To this proposition, however, the states replied in the most peremptory manner; desiring him never again to mention the subject to them, lest they should be under the necessity of deposing him; and intimating their determination that his brother should never more have the dominion of Poland. Casimir, however, was so much concerned on account of his brother's misfortunes, that he tried every method to relieve him, and even connived at the arts that were practised by some discontented noblemen to restore him. But this generous and amiable conduct was repaid by the grossest ingratitude. Miecislas used every art to wrest from his brother the whole of his dominions, and actually conquered the provinces of Mazovia and Cujavia; but of these he was soon dispossessed, and only some places in Lower Poland were left him. Nor was this all. On occasion of a report that Casimir had been poisoned in an expedition into Russia, he surprised the city of Cracow. But the citadel refused to surrender, and his hopes were entirely blasted by the return of Casimir himself. The last action of this amiable prince was the conquest of Russia, which he effected rather by the reputation of his wisdom and generosity than by the force of his arms. The people of that country voluntarily submitted to a prince so famed for his benevolence, justice, and humanity. Soon after his return he died at Cracow, lamented as the best prince that had ever filled the throne of Poland.

Civil war between Lesko and Miecislas.

Casimir left one son, named Lesko, an infant; but the states, dreading the consequences of a long minority, hesitated to appoint him sovereign. At last, however, Lesko was nominated, chiefly through the interest he had obtained by reason of his father's virtues. The consequence was precisely what might have been expected. Miecislas formed an alliance against him with the Dukes of Oppeln, Pomerania, and Breslau; and having raised all the men in Lower Poland fit to bear arms, took the road to Cracow with a numerous army. On the banks of the river Mozgarva a sanguinary conflict ensued; but both sides were so much weakened that they were forced to retire for some time, in order to repair their losses. Miecislas was first ready for action, and therefore had the advantage. But he thought proper to employ artifice rather than force; and having attempted in vain to corrupt the guardians of Lesko, he entered into a compact with the Princess Helen, his mother. Representing in the strongest manner the miseries which would ensue from her refusal of the conditions he proposed, he stipulated to adopt her sons Lesko and Conrad as his own; to surrender the province of Cujavia for their present support; and to declare them heirs to all his dominions. The principal nobility opposed this accommodation; but it was accepted by the duchess in spite of all their remonstrances; and Miecislas was once more put in possession of the capital, after having taken a solemn oath to execute punctually every article of the treaty.

Mi slas re red.

It is not to be supposed that a prince of such a perfidious disposition as Miecislas would pay much regard to the obligations of a simple contract. It was a maxim with him, that a sovereign is no longer obliged to observe his oath than whilst it is neither safe nor beneficial to break it. Having therefore got all the power into his hands, he behaved in the same manner as if no treaty with the Duchess Helen had ever subsisted. The princess, perceiving herself duped, formed a strong party, and having excited a general insurrection, the rebellion proved successful. Miecislas was expelled from Cracow, and on the point of being reduced to his former indigence, when he found means to foment a quarrel between the duchess and the palatine of Cracow, and thus once more turned the scale in his favour. The forces of Miecislas now became superior, and he regained possession of Cracow; but did not long enjoy his prosperity. He fell a victim to intemperance, and Lesko was restored to the sovereignty in the year 1206.

Po d ra- vag by the ar- tars

The government of Lesko was the most unfortunate of any of the sovereigns of Poland. In his time the Tartars made an irruption into that country, and everywhere committed the most cruel ravages. At last they came to an engagement with the Poles, assisted by the Russians, and, after an obstinate conflict, obtained a complete victory. This incursion, however, terminated as precipitately as it had commenced. Without any apparent reason, they retired, just as the whole kingdom was preparing to submit; but the devastations they had committed produced a famine, which was soon followed by a plague that depopulated one of the most populous countries of the north. In this unhappy situation of affairs, death ended the misfortunes of Lesko, who was assassinated by his own subjects. A civil war followed his death; and the history of Poland is for some time so confused that it is difficult to say who was his successor. During this unfortunate state of the country, the Tartars made a second irruption, laid all waste before them, and were advancing towards the capital, when they were attacked and defeated with great slaughter by the palatine of Cracow, with only a handful of men. The power of the enemy, however, was not broken by this victory. Next year the Tartars returned, and committed barbarities such as can scarcely be imagined. Whole provinces were ravaged, and every one of the inhabitants massacred. They were returning, laden with spoil, when the palatine fell upon them a second time, but not with the same success as before. After a most obstinate engagement, he was defeated, and all Poland thus laid open to the ravages of the barbarians. The nobility fled into Hungary, and the peasants sought an asylum amongst rocks and impenetrable forests. Cracow, being thus left entirely defenceless, was soon taken, pillaged, and burnt; after which the barbarians, penetrating into Silesia and Moravia, desolated these countries, destroying Breslau and other cities. Nor did Hungary escape the fury of their barbarity. The king, having given battle to the Tartars, was defeated with great slaughter, and had the mortification to see his capital laid in ashes, and above one hundred thousand of his subjects perish by fire and sword. The arms of the Tartars proved invincible. Nothing could withstand the prodigious force they brought into the field, and the fury with which they fought. Fixing their headquarters on the frontiers of Hungary, they spread their devastations on every side, with a celerity and success that threatened the destruction of the whole empire, as well as that of the neighbouring kingdoms.

Knights of the Teutonic order first called into Poland.

Poland was reduced to this dreadful situation when Boleslas, surnamed the Chaste, obtained the sovereignty. But this, so far from putting an end to the troubles, only superadded a civil war to the other calamities with which the country was afflicted. Boleslas was opposed by his uncle Conrad, the brother of Lesko, who was provoked at becoming the subject of his own nephew. Having assembled a powerful army, he gained possession of Cracow, assumed the title of Duke of Poland, and might possibly have kept possession of the sovereignty, had not his avarice and pride offended equally the nobility and the peasants. Hence they unanimously invited Boleslas, who had fled into Hungary, to return home and head the insurrection which now broke out in every quarter. On his arrival, he was joyfully received in the capital. But Conrad still headed a powerful party; and it is reported that on this occasion the knights of the Teutonic order were first called into Poland, to dispute the pretensions of Boleslas. All endeavours of Conrad, however, proved unsuccessful. He was defeated in two pitched battles, and forced to live in a private situation; though he never ceased to harass his nephew, and make fresh attempts to recover the crown. Of the reign of Boleslas, however, we have little information, except that he made a vow of perpetual continency, and imposed the same on his wife; that he founded nearly forty monasteries; and that after a long reign he died in 1279, having previously adopted Lesko, duke of Cujavia, and procured a confirmation of his choice by the free election of the people.

Poland overrun by the Russians, Tartars, and Lithuanians.

The reign of this last prince was one continued scene of foreign and domestic trouble. On his accession he was attacked by the united forces of Russia and Lithuania, assisted by the Tartars; but he had the good fortune to defeat the confederate barbarians in a pitched battle. By this victory the enemy were obliged to quit the kingdom; but Lesko was so much weakened, that civil dissensions immediately afterwards ensued, and increased to such a degree that he was obliged to fly to Hungary, the common resource of distressed Polish princes. The inhabitants of Cracow alone remained firm in their duty; these brave citizens having stood all the fatigue and danger of a tedious siege, until they were at last relieved by Lesko at the head of a Hungarian army, who defeated the rebels, and restored to his kingdom a legitimate government. But scarcely had he re-ascended the throne when the united forces of the Russians, Tartars, and Lithuanians made a second irruption into Poland, and desolated the country with the most savage barbarity. Their forces were now rendered more terrible than ever by their having along with them a vast number of large dogs trained to join in their attacks. With an army much inferior, however, Lesko obtained a complete victory, the Poles being animated by all the fury of despair. Soon after this, Lesko died, with the reputation of a wise, warlike, but, on the whole, an unfortunate prince.

Uladislas Lokietek.

As this prince died without issue, his crown was contested; a civil war again ensued; and the affairs of the state continued in a very declining condition till the year 1296, when Prezemislas, the duke, resumed the title of king. However, they did not revive in any considerable degree till the year 1305, when Uladislas Lokietek, who had seized the throne in 1300, and afterwards been driven out, was restored. The first transaction of his reign was a war with the Teutonic knights, who, during the recent disturbances, had usurped the greater part of Pomerania. They had been settled in the territory of Culm by Conrad, duke of Mazovia, but soon extended their dominion over the neighbouring provinces, and had even obtained possession of the city of Dantzig, where they massacred a number of Pomeranian gentlemen in cold blood; an atrocity which so terrified the neighbouring towns, that they submitted without a struggle. The knights were commanded by the sovereign pontiff to renounce their conquests; but they set at nought all his thunders, and even suffered themselves to be excommunicated rather than part with their acquisitions. As soon as this happened, the king marched into the territories of the Marquis of Brandenburg, who had pretended to sell to the Teutonic knights a right to those countries, although he had none to them himself. Uladislas next entered the territory of Culm, which he laid waste with fire and sword; and although opposed by the joint forces of the marquis, the knights, and the Duke of Mazovia, he obtained a complete victory, after a desperate and bloody engagement. Without following up the blow, however, he returned to Poland, where he recruited his army; and being reinforced by a body of auxiliaries from Hungary and Lithuania, he dispersed the enemy's forces, and a second time ravaged all the dominions of the Teutonic knights. Had he improved this advantage, he might easily have exterminated the whole order, or at least reduced them so low that they could never again have caused disturbances in the state. But he suffered himself to be soothed and cajoled by the promises which they made, without any design of keeping their engagements, and concluded a treaty under the mediation of the kings of Hungary and Bohemia. In a few months, however, he was convinced of the perfidy of the knights, who not only refused to evacuate Pomerania, as had been stipulated in the treaty, but even endeavoured to extend their usurpations, and for this purpose assembled a very considerable army. Uladislas, enraged at their treachery, once more took the field, and gave them battle with such success, that four thousand knights were left dead on the ground, and thirty thousand auxiliaries killed or taken prisoners. Yet though the king had it once more in his power to destroy the whole order, he satisfied himself with obtaining the territories which had occasioned the war, after which he spent the remainder of his life in tranquillity and peace.

Black Russia conquered by Casimir the Great.

Uladislas was succeeded by his son Casimir III. surnamed the Great. Having in a single campaign subdued the province called Black Russia, he turned his arms against Mazovia, which he overran with great rapidity, and annexed as a province to the crown. He then applied himself to domestic affairs, and was the first who introduced a written code of laws into Poland. He was a most impartial judge, a rigid observer of justice, and the most submissive to the laws of any potentate mentioned in the history of Europe. The only vice with which he is charged is that of incontinence; but even this the clergy declared to be a venial sin, amply compensated by his other virtues, particularly the great liberality which he showed to the clerical order. Casimir was a great patron of industry as well as an eminent legislator, and through his encouragement numbers flocked into his kingdom from various parts of Germany. He fortified many of his chief towns, which he also embellished; whilst colleges, hospitals, churches, and other public buildings, attested alike his genius, his magnificence, and his patriotism. His reign is considered as the golden age of Poland.

Unhappy reign of Louis.

Casimir was succeeded in 1370 by his nephew Louis, king of Hungary; but as the Poles looked upon him as a foreign prince, they were not happy under his administration. Indeed a coldness between this monarch and his people took place even before he ascended the throne; for in the *pacta conventa*, to which the Polish monarchs were obliged to swear, a great number of unusual articles were inserted. This probably was the reason why he left Poland almost as soon as he had been crowned, carrying with him the crown, sceptre, globe, and sword of state, to prevent the Poles from electing another prince during his absence. He left the government in the hands of his mother Elizabeth, who would have been agreeable to the people had she possessed sufficient capacity for government. At that time, however, the state of Poland was too disturbed to be governed by a woman. The country was overrun with robbers and other gangs of villains, who committed the most horrid disorders; the kingdom was likewise invaded by the Lithuanians; the province of Black Russia had revolted; and the land was universally filled with dissension. The Poles, displeased to see their towns occupied by Hungarian garrisons, sent a message to the king, informing him that they thought he had been sufficiently honoured in being elected king of Poland himself, without suffering the kingdom to be governed by a woman and his Hungarian subjects. Upon this Louis raised a numerous army, intending to subdue the refractory spirit of his subjects. His first operations were directed against the Russians, whom he defeated, and again reduced to subjection. He then turned his arms against the Lithuanians, expelled them from the kingdom, and re-established public tranquillity. Instead of being satisfied with this, however, and removing the Hungarian garrisons, he introduced many more, and raised Hungarians to all the chief offices of government. His credit even went so far as to get a successor nominated who was disagreeable to the whole nation, namely, Sigismund, marquis of Brandenburg. After the death of Louis, however, this election was set aside; and Hedwig, daughter of Casimir the Great, was proclaimed queen.

Hedwig marries Uladislas, duke of Lithuania.

This princess married Jagellon, duke of Lithuania, who was converted to Christianity, and baptized by the name of Uladislas. By this marriage, the duchy of Lithuania, as well as the vast provinces of Samogitia and Black Russia, were annexed to the crown of Poland. Such a formidable accession of power excited the jealousy of the Teutonic knights. They were sensible that Uladislas was now bound to undertake the reduction of Pomerania, and revenge all the injuries which Poland had sustained for a great number of years; and from his first accession, considering this monarch as their greatest enemy, they endeavoured to prevent his designs, by effecting a revolution in Lithuania in favour of his brother Andrew. The prospect of success was the greater, as most of the nobility were discontented with the marriage; and Uladislas had proposed to effect a revolution in religion. Two armies, therefore, marched suddenly towards the frontiers of the duchy, which they penetrated; laying waste the whole country, and seizing upon some important fortresses, before the king of Poland had any notice of the matter. As soon as he received advice of these ravages, Uladislas raised forces with the utmost celerity, which he committed to the care of his brother Skirgello; who, having defeated the Teutonic knights, obliged them to abandon all their conquests.

Troubles in Lithuania.

Having secured the tranquillity of Poland, Uladislas visited Lithuania, attended by a great number of the clergy, in order to convert his subjects. This he effected without much difficulty; but he left the care of the duchy to his brother Skirgello, a man of a cruel, haughty temper, and who immediately began to abuse his power. Along with him the king sent his kinsman Vitowda, a prince of a generous, brave, and amiable disposition, to be a check upon his conduct; but the barbarity of Skirgello soon obliged this prince to take refuge amongst the Teutonic knights. For some time, however, he did not assist the knights in their designs against his country; but having in vain applied to the king for protection, he at last joined in the schemes formed by the knights for the destruction of Poland. Entering Lithuania at the head of a numerous army, he took the capital by storm, burned part of it, and destroyed fourteen thousand persons in the flames, besides a great number who were massacred in attempting to make their escape. The upper part of the city, however, was vigorously defended, so that the besiegers were at last obliged to abandon all thoughts of making themselves masters of it, and to content themselves with desolating the adjacent country. The next year Vitowda renewed his attempts upon the city, but with the same want of success; though he got possession of some places of less importance. As soon, however, as an opportunity offered, he came to an accommodation with the king, who conferred on him the government of Lithuania. During the first years of his government, he bestowed great attention on domestic affairs; but at last his impetuous valour prompted him to engage in a war with Tamerlane, after the victory gained by the latter over Bajazet the Turkish emperor. Prior to this time Vitowda had been at war with the neighbouring Tartars, and had been constantly victorious. Uladislas, however, dissuaded him from attacking the whole strength of the nation under such a celebrated commander as Tamerlane; but Vitowda was obstinate in his determination to fight. He encountered an army of four hundred thousand Tartars under Ediga, Tamerlane's lieutenant, with only a tenth part of their number, and the battle continued for a whole day; but at last Vitowda was surrounded by the numbers of his enemy, and in the utmost danger of being cut in pieces. However, he cleared his way with prodigious slaughter on both sides, and came off without a total defeat, having killed a number of the enemy equal to the whole of his own army.

War with the uto-nic k ghts.

During the absence of Vitowda, the Teutonic knights had penetrated into Lithuania, committing everywhere dreadful ravages. On his return he attacked and defeated them, making an irruption into Livonia, to punish the inhabitants of that country for the assistance which they had given to the Teutonic order. This was succeeded by a long series of wars between Poland and Prussia, in which it became necessary for Uladislas himself to take the field. The knights having now got possession of Samogitia, Mazovia, Culm, Silesia, and Pomerania, Uladislas resolved to punish them before they became too powerful; and with this view he assembled an army composed of several different nations. He then penetrated into Prussia; took several towns; and was advancing to Marienburg, the capital of Pomerania, when he was met by the army of the Prussian knights, who determined to hazard a battle. When the engagement began, the Poles were deserted by all their auxiliaries, and obliged to stand the brunt of the battle. But the courage and conduct of their king so animated them, that after a most desperate struggle, they obtained a complete victory; near forty thousand of the enemy being killed in the field, and thirty thousand taken prisoners. This terrible overthrow, however, was less fatal to the affairs of the Prussian knights than might have been expected. Uladislas did not improve his victory, and a peace was concluded upon easier terms than his adversaries had any reason to hope for.

Uladi s VI.

Uladislas V. died in 1435, and was succeeded by his son Uladislas VI., at that time only nine years of age. He had scarcely ascended the throne, when the kingdom was invaded by the Tartars, who defeated the general of the Polish forces; and, committing everywhere dreadful ravages, returned to their own country loaded with booty. A few years afterwards the nation was involved in a war with Amurath, the sultan, who threatened to break into Hungary. But before all things were prepared for the young king taking the field, a strong body of auxiliaries was despatched under John Hunniades, waywode of Transylvania, to oppose the Turks, and likewise to support the election of Uladislas to the crown of Hungary. This detachment surprised the Turkish army near the river Morava, and defeated Amurath with the loss of thirty thousand men; after which Hunniades retook all the places which had been conquered by Amurath, the sultan was forced to sue for peace, and Uladislas was raised without opposition to the crown of Hungary. A treaty was concluded, by which the Turks promised to relinquish their designs upon Hungary, to acknowledge the king's right to that crown, and to give up all their conquests in Bosnia and Servia. This treaty was sealed by mutual oaths; but Uladislas broke it at the persuasion of the pope's legate, who insisted, that now was the time for humbling the power of the infidels, and produced a special commission from the pope, absolving the king from the oath he had taken at the late treaty. The result of this perfidy was, that Uladislas was entirely defeated and killed at Varna, and the greater part of his army cut in pieces.

Casimir IV.

Teutonic knights subdued.

Uladislas VI. was succeeded by Casimir IV. in whose reign the Teutonic knights were subdued, and obliged to yield up the territories of Culm, Michlow, and the duchy of Pomerania, together with the towns of Elbing, Marienburg, Talkmith, Schut, and Christburg, to the crown of Poland. On the other hand, the king restored to them all the other conquests he had made in Prussia; granted a seat in the Polish senate to the grand-master; and endowed him with other privileges, on condition that, six months after his accession, he should do homage for Prussia, and take an oath of fidelity to the king and republic. This success raised the spirits of the Polish nation, which had drooped ever since the battle of Varna. The Diet did not, however, think proper to renew the war against the Turks.

Crowns of Bohemia and Hungary united to that of Poland.

About this time the crown of Bohemia having become vacant, and the people being desirous of being governed by one of the princes of Poland, the barons were induced to bestow the crown upon Uladislas, eldest son of Casimir, in opposition to the intrigues of the king of Hungary. Not satisfied with this acquisition, however, Uladislas took advantage of the dissensions in Hungary, in order to unite that crown to his own, which he also effected, and thereby greatly augmented his power, though not the happiness of his people. Numerous foreign expeditions had exhausted the treasury, and oppressed the peasants with taxes; the gentry were greatly diminished by a number of bloody engagements; agriculture was neglected, and the country almost depopulated. But before a proper remedy could be applied for these evils, Casimir died in 1492. In the reign of this prince, the deputies of the provinces first appeared at the Diet, and assumed to themselves the legislative power; all laws before that time having been framed by the king in conjunction with the senate.

Exploits of Sigismund.

During the succeeding reigns of John Albert and Alexander, the affairs of Poland fell into decline, the kingdom being harassed by continual wars with the Turks and Tartars. But they were retrieved by Sigismund I. who ascended the throne in 1507. This monarch, having reformed some internal abuses, set about rendering the kingdom as formidable as it had formerly been. He first quelled an insurrection which broke out in Lithuania; after which, he drove the Walachians and Moldavians out of Black Russia, and defeated the Russians in a pitched battle, with the loss of thirty thousand men. In this engagement he was obliged to cause his cavalry to swim across the Borysthenes in order to begin the attack, whilst a bridge was preparing for the infantry. These orders were executed with astonishing celerity, notwithstanding the rapidity of the stream, the steepness of the banks, and the enemy's opposition. The onset was led by the Lithuanians, who were directed to retreat gradually, with a view of drawing the enemy within reach of the cannon. This the Russians mistook for a real flight; and as they were pursuing with eagerness, Sigismund opened his line to the right and left, pouring in grape-shot from the artillery with dreadful success. The Russian general, and several noblemen of the first distinction, were taken prisoners, whilst the whole loss of the royal army did not amount to three hundred men.

After this victory, the king turned his arms against the Teutonic knights, who had elected the Marquis of Brandenburg as their grand-master; whilst this prince not only refused to acknowledge the sovereignty of the crown of Poland, but even invaded the Polish territories. Sigismund marched against him, and gained possession of several important places in Brandenburg; but as he was pursuing his conquests, the marquis, reinforced by fourteen thousand Germans led by the Duke of Schonenburg, ventured to lay siege to Dantzig, after having ravaged the neighbouring country. The Dantzigers, however, defended themselves so bravely, that the besiegers were soon obliged to relinquish their enterprise; whilst in their retreat they were attacked by a strong detachment of Polish cavalry, who made prodigious havoc amongst them, compelling the wretched remains to take shelter in Pomerania, where they were massacred by the peasants. Soon after this the marquis was obliged to submit to the clemency of the conqueror. To secure him in his interest, however, Sigismund granted him half the province of Prussia as a secular duke, dependent on the crown of Poland.

In the reign of Sigismund, the kingdom of Poland may be considered as having attained its greatest pitch of glory. This monarch possessed, in his own person, the republic of Poland, the great duchies of Lithuania, Smolensko, and Saveria, besides vast territories lying beyond the Euxine and the Baltic; whilst his nephew Louis possessed the kingdoms of Bohemia, Hungary, and Silesia. But this glory received a sudden check in 1548, by the defeat and death of Louis, who perished in a battle fought with Solyman the Great, sultan of the Turks. The daughter of this prince married Ferdinand of Austria, an alliance by which the dominions of Hungary, Bohemia, and Silesia, became inseparably connected with the hereditary dominions of the Austrian family. This misfortune is believed to have hastened the death of Sigismund; though, being then in the eighty-fourth year of his age, he could not, by the ordinary course of nature, have lived long. He did not, however, survive the news many months, but died of a lingering disorder, leaving behind him the character of a complete general, an able politician, a good prince, and one of the strongest men in the north.

Sigismund Augustus.

Sigismund Augustus, who succeeded his father Sigismund I. proved also a very fortunate prince. At that time the most violent and bloody wars were carrying on in Germany, and indeed throughout other parts of Europe, on account of religion; but Sigismund wisely avoided interfering in these disputes. He would not admit into his dominions any of those divines who were taxed with holding heterodox opinions, nor even allow his people the liberty of corresponding with them; yet he never persecuted, nor employed any other means for the preservation of the state than those of a well-conducted and regular policy. Instead of disputing with his subjects about speculative opinions, Sigismund applied himself diligently to the reforming of abuses, enforcing the laws, enriching the treasury, promoting industry, and redeeming the crown-lands where the titles of the possessors appeared illegal. Out of the revenue recovered in this manner he raised a formidable standing army without laying any additional tax upon his subjects; and though he preferred peace to war, he was always able to punish those who offered indignities to his person or his crown.

His knowledge of the art of war was soon tried in a contest with the Russians, who, encouraged by the disputes which had subsisted between the Teutonic knights and the archbishop of Riga, cousin of Sigismund, had made an irruption into Livonia. The province was at that time divided between the knights and the prelate; and the Russians, under pretence of assisting the former, had seized great part of the dominions of the latter. The archbishop had recourse to his kinsman the king of Poland, who, after fruitless efforts to accommodate matters, marched towards the frontiers of Livonia with an army of a hundred thousand men. The knights were in no condition to resist such a formidable power; and therefore, deserting their allies, they put themselves under the protection of the king of Poland. But the czar, John Basilides, though deserted by the knights, did not lose his courage; nay, he even insolently refused to return any answer to the proposals of peace made by Sigismund. His army consisted of three hundred thousand men, with whom he imagined himself able to reduce all Livonia, in spite of the utmost efforts of the king of Poland; but having met with some checks in that quarter, he directly invaded Poland with his whole army. At first he carried everything before him; but the Poles soon made a vigorous opposition; and the Russians, though everywhere defeated, still continued their incursions, which Sigismund at last revenged by invading Russia in his turn.

Extinction of the house of Jagellon.

These mutual desolations and ravages at last made both parties desirous of peace, and a truce for three years was agreed on; but during the continuance of the armistice the king of Poland died, and with him was extinguished the house of Jagellon, which had governed Poland for nearly two hundred years. On the death of Sigismund, Poland became a prey to intestine divisions; and intrigues were set on foot at the courts of Vienna, France, Saxony, Sweden, and Brandenburg, each of them endeavouring to establish a prince of their own nation on the throne of Poland. The result of all this was, that the kingdom became one universal scene of corruption, faction, and confusion. The members of the Diet consulted only their own interest, and were ready on every occasion to sell themselves to the best bidder. The Protestants had by this time got a considerable footing in the kingdom, and thus religious disputes were intermingled with political ones. One good effect, however, flowed from this confusion. A law was passed, by which it was enacted that no difference in religious opinions should occasion any contention amongst the subjects of the kingdom; that all the Poles, without discrimination, should be capable of holding public offices and trusts under the government; and that the future kings should swear expressly to cultivate the internal tranquillity of the realm, and to cherish without distinction their subjects of all persuasions.

Duke of Anjou chosen king.

Whilst the candidates for the throne were severally attempting to support their own interest in the best manner they could, John Crasoski, a Polish gentleman of great merit, but diminutive stature, had just returned from France, whither he had travelled for improvement. His humour, wit, and diverting size, had rendered him universally agreeable at the court of France, and in a particular manner engaged the esteem of Catharine de' Medicis, which the little Pole had the address to make use of for his own advantage. He owed many obligations to the Duke of Anjou, whom, out of gratitude, he represented in such favourable terms, that the Poles began to entertain thoughts of making him their king. These sentiments were confirmed and encouraged by Crasoski, who returned into France by order of several leading men in Poland, and acquainted the king and queen-mother that nothing was wanting except the formality of an embassy to procure the crown for the Duke of Anjou, almost without opposition. Charles IX. king of France, at that time also promoted the scheme; being jealous of the Duke of Anjou's popularity, and willing to have him removed to as great a distance as possible. The parties accordingly came to an agreement, in which it was stipulated that the Duke of Anjou should maintain the laws, liberties, and customs of the kingdom of Poland, and of the grand duchy of Lithuania; that he should transport all his effects and annual revenues in France into Poland; that the French monarch should pay the late king Sigismund's debts; that he should maintain a hundred young Polish gentlemen at his court, and fifty in other places; that he should send a fleet to the Baltic to assist Poland against the Russians; and, lastly, that Henry should marry the Princess Anne, sister of the late king Sigismund, though this article Henry refused to ratify till his return to Poland. Everything being thus settled, the young king quitted France, attended by a splendid retinue, and was accompanied by the queen-mother as far as Lorraine. He was received by his subjects on the frontiers of Poland, and conducted to Cracow, where he was soon afterwards crowned.[1] The affections of the Poles were soon engaged by the youth and accomplishments of Henry; but scarcely had he been seated on the throne, when, by the death of Charles IX., he became heir to the crown of France. Being informed of this by repeated messages from Catharine, he repented his having accepted the crown of Poland, and resolved to leave it for that of France. But being sensible that the Poles would oppose his departure, he kept his intentions secret, and watched an opportunity of stealing out of the palace in disguise during the night-time. The Poles, as might well be expected, were irritated at being thus abandoned, from the mere motive of interest, by a prince whom they had so much loved and honoured. Parties were despatched after him by different roads; and Zamoski, a nobleman who headed one of these parties, overtook him some leagues distant from Cracow. All the prayers and tears of that nobleman, however, could not prevail on Henry to return; he rode post to Vienna, and then passed into France by the way of Italy.

He is dep ed.

In the mean time the Poles were so much exasperated against Henry and his nation, that all the French in Cracow would have been massacred if the magistrates had not placed guards in the streets. Henry, however, had foreseen the consequences of his flight, and therefore endeavoured to apologise for his behaviour. But nothing could satisfy the Poles, who now acquainted their king, that if he did not immediately return, they would be obliged to divest him of the royal dignity, and to choose another sovereign. Henry began to excuse himself on account of the wars in which he was engaged, and promised to send men of unexceptionable integrity to govern Poland till he should return. But no excuses were accepted; and on the 15th of July 1575, he was in full Diet solemnly divested of the regal dignity, and the throne declared vacant.

Ste en Bat y cho n king

After the deposition of Henry, commotions and factions again occurred, but the contending parties were now reduced to two; one who supported the interest of Maximilian, emperor of Germany; and the other, who were for electing the Princess Anne, and marrying her to Stephen Batory, prince of Transylvania. The latter prevailed through the courage of one gentleman, who, in imitation of the power assumed by the Roman tribunes, stood up in the full senate, and opposed the proclamation of Maximilian, declaring that his election was violent and illegal. In this situation of affairs, it was obvious that strength and celerity must determine which election was legitimate; and both parties wrote to the princes whose cause they had espoused, entreating them to hasten with all possible expedition to take possession of the throne. Batory proved the more alert; for whilst Maximilian was disputing about certain conditions which the Poles required for the security of their privileges, he entered Poland, married the princess, and was crowned on the 1st of May 1576. No opposition was made to the authority of Batory, except by the inhabitants of Dantzig, who adhered to the interest of Maximilian, even after he was dead, and had the presumption to demand from the king an oath acknowledging their absolute freedom and independence. Batory referred them to the senate, declaring that he had no right to give up the privileges of the republic; but he admonished the citizens to avoid all occasion of a civil war, which must necessarily terminate in their disadvantage. The obstinate citizens, however, construing the king's lenity into fear, shut the gates against the ambassador, seized upon the fortress of Grebin, and published a manifesto against the king and the republic. The king, incensed at these proceedings, marched against Grebin, retook the castle, and ravaged certain territories belonging to the people of Dantzig; who, on the other hand, retaliated by burning to the ground a monastery named Oliva, to prevent the Poles from taking possession of so important a position. Batory now renewed overtures of accommodation, but to no purpose. The people of Dantzig were deaf to these proposals; and it was not until after suffering severely that they were at length induced to submit.

Cruelty of the Russians.

The war with Dantzig had no sooner been ended than the king directed his whole strength against the czar of Muscovy, who had laid siege to Revel, and made himself master of several important cities in Livonia. The czar behaved everywhere with the greatest cruelty, slaughtering without distinction all who were able to bear arms, and abandoning the women and children to the brutality of the Tartars who served in his army. The Russians were allowed to proceed in this manner till the whole province of Livonia, excepting Riga and Revel, had suffered the barbarities of this insulting conqueror. But at length, in 1578, a body of forces was despatched into the province; the towns of Wender and Dwinaburg were surprised; and an army sent by the czar to surprise the former was defeated. At this time the Muscovites were not the only enemies who opposed the king of Poland and oppressed Livonia. That unhappy province was also invaded by the Swedes, who professed themselves to be enemies equally to both parties, and who in cruelty were scarcely inferior to the Russians themselves. The king, however, was not daunted by the number of his adversaries. Having made great preparations, and called to his assistance Christopher, prince of Transylvania, with all the standing forces of that country, he took the field in person against the Muscovites, and laid siege to Polocz, a town of great importance, situated on the river Dwina. The Russians no sooner heard of the approach of the Polish army than they resolved to put all the citizens to death, thinking by this means to strike terror into the enemy. When Batory came near the town, the most shocking spectacle presented itself. The river appeared dyed with blood, and a vast number of human bodies, fastened to planks, and terribly mangled, were carried down the stream. But this barbarity, instead of intimidating the Poles, irritated them to such a degree that nothing could resist them. Finding that their cannon made little impression upon the walls of the city, which were constructed of wood, they advanced to the assault with burning torches in their hands, and would soon have reduced the fortifications to ashes, had not a violent storm of rain prevented them. The design, however, was put in execution as soon as the rain slackened; and the Russian barbarians were obliged to surrender at discretion. It reflects the highest honour on Batory, that, notwithstanding the dreadful instances of cruelty which he had before his eyes, he did not suffer his soldiers to retaliate. Indeed the atrocities committed by the Russians on this occasion seem almost to have authorized any revenge that could possibly have been taken.

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[1] Henry of Valois, afterwards Henry III. of France, when he was elected king of Poland, was the first who swore to the celebrated *pacta conventa*, a document containing certain obligations on the part of the king in regard to the liberties of the nation.

Russia ravaged by Batory.

After the reduction of Polocz, Batory continued the war, and with great success. Two detachments from the army penetrated the enemy's country by different roads, wasted all before them to the gates of Smolensko, and returned with the spoils of two thousand villages which they had pillaged and destroyed. In the mean time the Swedes and Poles thought proper to come to an accommodation; and though John, king of Sweden, was at that time prevented from bearing his share of the war, yet Batory reduced such a number of cities, and committed such devastations, in the Russian territories, that the czar was obliged to sue for peace, which he obtained on condition of relinquishing Livonia, after having thrown away the lives of more than four hundred thousand of his subjects in attempting to conquer it.

Batory being thus freed from a most destructive and cruel war, applied himself to the internal government of his kingdom. He regulated the Polish cavalry in such a manner that they became formidable to the Turks and other neighbouring nations; and this is the military establishment to which the Poles have given the name of *quartienne*, because a fourth part of the revenue was employed in supporting them. Batory sent this body of cavalry towards the frontiers of Tartary, to check the incursions of the barbarians inhabiting that country; and by its means the Ukraine, a vast tract of desert country, was filled with flourishing towns and villages, and became a strong barrier against the Turks, Tartars, and Russians. The last memorable action of Batory was his attaching to Poland the Cossacks, whom he civilized and instructed in the arts of war and peace. All kinds of manufactures at that time known in Poland were likewise established amongst the Cossacks; the women were employed in spinning and weaving woollen cloths, whilst the men were taught agriculture, and other arts proper for masculine cultivation.

Whilst Batory was employed in this manner, the Swedes broke the convention into which they had entered with Poland, and were on the point of obtaining possession of Riga. To this, indeed, Batory himself had given occasion, by attempting to impose the Catholic religion upon the inhabitants, after having promised them entire liberty of conscience; a proceeding which so irritated them, that they revolted, and were on the point of admitting a Swedish garrison into the city, when the king became informed of what was going forward. He resolved to take a most exemplary vengeance on the inhabitants of Riga; but before he could execute his intention, he died, in 1586, the fifty-fourth year of his age, and tenth of his reign.

Consequences of Batory's death. Sigismund III.

The death of Batory involved Poland in fresh troubles. Four candidates appeared for the crown; the princes Ernest and Maximilian of the house of Austria, Sigismund prince of Sweden, and Theodore czar of Muscovy. Each of these had a separate party; but Sigismund and Maximilian managed matters so cleverly, that in 1587 both of them were elected. The result was a civil war, in which Maximilian was defeated and taken prisoner; and thus without opposition Sigismund III., surnamed Vasa, became master of the throne of Poland. He waged a successful war with the Tartars, and was otherwise prosperous; but though he succeeded to the crown of Sweden, he found it impossible for him to retain both kingdoms, and he was formally deposed from the Swedish throne. In 1610 he conquered Russia, and placed his son on the throne of that country; but the Polish conquests of that country have always been short-lived. Accordingly, the young prince was soon afterwards deposed; and the Russians not only regained their liberty, but began to make encroachments on Poland itself. A very unfortunate war also took place with Sweden, which was now governed by the great Gustavus Adolphus; but the particulars of that contest, with the other exploits of that renowned warrior, are elsewhere related. At last Sigismund, worn out with cares and misfortunes, died in 1629.

Uladislas VII.

After Sigismund's death the affairs of Poland seemed to revive a little under Uladislas VII., who obliged the Russians to sue for peace, and Sweden to restore some of her conquests; but an attempt being made to abridge the liberty of the Cossacks, they revolted, and gave the Poles several terrible defeats; nor did the war terminate in the lifetime of Uladislas, who died in 1648. His successor, John Casimir, concluded a peace with these dangerous enemies; but the war was soon after renewed; and whilst the kingdom was distracted between the hostility of the Cossacks and the discontents of its own inhabitants, the Russians took the opportunity of invading and pillaging Lithuania.

Poland subdued by Charles Gustavus.

In a little time afterwards, the whole kingdom was subdued by Charles Gustavus, successor to Christina, queen of Sweden. Happily for Poland, however, a rupture took place between the courts of Sweden and Copenhagen, and the Poles were thereby enabled to drive out the Swedes in 1657. This was succeeded by civil wars and contests with Russia, which so much vexed the king that he resigned the crown in 1668. For two years after the resignation of Casimir, the kingdom was filled with confusion; but on the 17th of September 1760, one Michael Koributh Wisnowieçki, collaterally descended from the house of Jagellon, though in a very mean situation at that time, was chosen king. His reign continued only for three years, during which time John Sobieski, a celebrated Polish general, gave the Turks a dreadful overthrow, though their army consisted of more than three hundred thousand men; and if this blow had been followed up, the Cossacks would not only have been entirely subdued, but very advantageous terms might have been obtained from the sultan. Of that vast multitude of Turks, no more than fifteen thousand made their escape, the rest being all either killed or taken. However, the Polish soldiers, being only bound by the laws of their country to stay a certain time in the field, refused to pursue this signal victory, and suffered the king to make peace on any terms he could procure.

John Sobieski retrieves the affairs of the Poles.

Wisnowieçki died before the news of this transaction reached Cracow; and after his death a new scene of confusion ensued, till at last the fortune of John Sobieski prevailed, and he was elected king of Poland in 1674. A most magnanimous and heroic prince, it was he who, by his valour and good conduct, retrieved the affairs of Poland, and entirely checked the progress of the Turks westward. These barbarians were everywhere defeated; but notwithstanding his great qualities, Poland was now so thoroughly corrupted, and pervaded by such a spirit of disaffection, that the latter part of this monarch's reign was involved in troubles, through the ambition and contention of some powerful noblemen. Sobieski died in 1696, and with him the glory of Poland descended into the tomb.

Most violent contests took place about the succession, but the recital of these would far exceed our limits. At last Frederic Augustus, elector of Saxony, prevailed; but as some of the most essential ceremonies were wanting in his coronation, because the primate, who was in an opposite interest, would not perform them, he found it extremely difficult to keep his subjects in proper obedience; and, to add to his misfortunes, having engaged in a league with Denmark and Russia against Sweden, he was attacked with irresistible fury by Charles XII. Though Augustus had not been betrayed, as indeed he almost always was, he was by no means a match for the ferocious Swede. The particulars of this war, however, as they form great part of the exploits of that northern hero, more properly fall to be related under the head of Sweden. Here, therefore, we shall only observe, that Augustus was reduced to the humiliating necessity of renouncing the crown of Poland on oath, and even of congratulating his rival Stanislas upon his accession to the throne. But when the power of Charles was broken by his defeat at Pultowa, the fortune of Augustus again prevailed; Stanislas was driven out; and the former, being absolved from his oath by the pontiff, resumed possession of the throne of Poland.

De ne- rac f the Po .

Since that time the Polish nation has made no figure, except in the history of political iniquity. Surrounded by great and ambitious powers, it has sunk under the pressure, and now scarcely exists as a nation. On the 5th of October 1763, Augustus III., elector of Saxony and king of Poland, died, and was succeeded by Count Poniatowski, a Polish grandee, who, on the 7th of September 1764, was proclaimed king by the name of Stanislas Augustus, and crowned on the 25th of November the same year. During the interregnum which took place between the death of Augustus III. and the election of Stanislas, a decree had been passed by the convocation-diet of Poland, with regard to the Dissidents, as they were called, or dissenters from the Catholic faith, by which they were prohibited the free exercise of their religion, and excluded from all offices and places under the government. On this occasion several of the European powers interposed, and the courts of Russia, Prussia, Great Britain, and Denmark, tendered remonstrances to the Diet; but, notwithstanding these, the decree was confirmed by the coronation-diet held soon after the king's election.

Int e- ren of fore pow s in beha of the ssi- dent

On the 6th of October 1766, an ordinary Diet was assembled. Here declarations from the courts above mentioned were presented to his Polish majesty, requiring the re-establishment of the Dissidents in their civil rights and privileges, and the peaceable enjoyment of their modes of worship secured to them by the laws of the kingdom, which had been observed for two centuries. These privileges, it was alleged, had been confirmed by the treaty of Oliva, concluded by all the northern powers, and could not now be altered except by the consent of all the contracting parties. The Catholic party contended strongly for a confirmation of some decrees against the Dissidents, made in the years 1717, 1723, and 1736. The deputies from the foreign powers replied, that those decrees had passed in the midst of intestine troubles, and were contradicted by the formal protestations and express declarations of those powers. At last, after a violent contest, the matter was referred to the bishops and senators for their opinion; and upon a report from them, the Diet came to a resolution that they would maintain the Dissidents in all the rights and prerogatives to which they were entitled by the laws of their country and by treaties; and that as to their complaints with regard to the exercise of their religion, the college of archbishops and bishops, under the direction of the prince primate, would endeavour to remove all those difficulties in a manner conformable to justice and charity. In the mean time, the court of Russia, resolved to enforce her remonstrances, marched a body of troops to within a few miles of Warsaw. These resolutions of the Diet were by no means agreeable to the Dissidents. The latter dated the beginning of their sufferings from the year 1717. Referring their grievances to the archbishops and bishops was looked upon as a measure the most unreasonable that could be imagined, as that body of men had always been their opponents, and in fact the authors of the evils which had befallen them. When matters came to be considered in this view, an additional body of Russians, to the number of about fifteen thousand, entered Poland.

Cons quen of this i er- feren

The Dissidents, being now pretty sure of the protection of foreign powers, entered, on the 20th of March 1767, into two confederacies, at Thorn and Sluck. One of these was signed by the Dissidents of Great and Little Poland, and the other by those of the grand duchy of Lithuania. The purpose of these confederacies was, an engagement to exert themselves in the defence of their ancient privileges, and the free exercise of their religion; professing at the same time the utmost loyalty to the king, and resolving to send to him a deputation to implore his protection. They even invited those of the Catholic communion, and all true patriots, to unite with them in maintaining the fundamental laws of the kingdom, the peace of religion, and the rights of men in society. They also claimed, by virtue of public treaties, the protection of the powers who were guarantees of their liberties, namely, Russia, Sweden, Great Britain, Denmark, and Prussia. And they protested, that they had no intention of acting to the detriment of the Roman Catholic religion, which they duly respected, but only asked liberty for their own, and the re-establishment of their ancient rights. The three cities of Thorn, Elbing, and Dantzig, acceded to the confederacy of Thorn on the 10th of April; as did the duke and nobles of Courland to that of Sluck on the 15th of May. In the mean time the empress of Russia and the king of Prussia continued to issue forth new declarations in favour of the Dissidents; and the Russian troops in Poland were gradually augmented to thirty thousand men. Great numbers of other confederacies were also formed in different parts of the kingdom; but these at first took little part in the affair of the Dissidents. They complained chiefly of the administration of public affairs, in which they alleged that innovations had been introduced, and were therefore for some time called Confederations of Malcontents. All these confederacies published manifestos, in which they recommended to the inhabitants to receive and treat the Russian troops as the defenders of the liberties of Poland.

General confederacy.

The different confederacies of malcontents formed in the twenty-four districts of Lithuania united at Wilna on the 22d of June; and that general confederacy re-established Prince Radzivil, who had married the king's sister, in his liberty, estates, and honour, of which he had been deprived in 1764 by the states of that duchy. On the 23d of June Prince Radzivil was chosen grand marshal of the general confederacy of all Poland, which then began to be called the National Confederacy, and was said to be composed of seventy-two thousand noblemen and gentlemen. The general confederacy now took such measures as appeared most proper for strengthening their party. They sent to the several waywodes of the kingdom, requiring that all the gentlemen who had not signed the confederacy should do it immediately; that all the courts of justice should subsist as formerly, but not judge any of the confederates; that the marshals of the crown should not pass any sentence without the participation of at least four of the confederates; and that the marshals of the crown and the treasurers should be immediately restored to the possession of their respective rights. In the mean time the Catholic party were not idle. The bishop of Cracow sent a letter to the Diet assembled at Warsaw on the 13th of August, in which he exhorted them to arm their nuncios with courage, by giving them orthodox and pious instructions, that they might not grant the Dissidents new advantages beyond those which were secured to them by the constitutions of the country and the treaties with foreign powers. The pope also sent briefs to the king, the great chancellor, the nobility, the bishops of the kingdom, and to the prince primate, with such arguments and exhortations as were thought most calculated to ward off the impending danger. Councils in the mean time were frequently held at the bishop of Cracow's palace, where all the prelates at Warsaw assembled. On the 26th of September 1767 the confederacy of Dissidents was united with the general confederacy of malcontents in the palace of

Prince Radzivil, who on that occasion expressed great friendship for the Dissidents. In a few days afterwards the Russian troops in the capital were reinforced, and a considerable body of them was posted at about five miles distance.

Tumults in the Diet.

On the 5th of October an extraordinary Diet was held. But the affair of the Dissidents met with such opposition, that it was thought necessary to adjourn the meeting till the 12th, during which interval every expedient was used to gain over those who opposed Prince Radzivil's plan. This was, to appoint a commission furnished with full power to enter into conference with Prince Repnin, the Russian ambassador, concerning the affairs of the Dissidents. But notwithstanding all the pains taken, the meeting of the 12th proved exceedingly tumultuous. The bishops of Cracow and Kiow, with some other prelates, and several magnates, declared that they would never consent to the establishment of such a commission; and at the same time they spoke with more vehemence than ever against the pretensions of the Dissidents. Some of the deputies replied with great warmth; and this occasioned such animosities, that the meeting was again adjourned till the 16th.

Violent proceedings of the Russians.

On the 13th the bishops of Cracow and Kiow, the palatine of Cracow, and the starost of Domski, were carried off by Russian detachments. The crime alleged against them, in a declaration published next day by Prince Repnin, was, that they had been wanting in respect to the dignity of the empress of Russia, by attacking the purity of her intentions towards the republic; though she was resolved to continue her protection and assistance to the general confederacy united for preserving the liberties of Poland, and correcting all the abuses which had been introduced into the government of that country.

Confederacy of Bar.

It was probably owing to this violent proceeding of the Russians that Prince Radzivil's plan was at last adopted, and several new regulations were made in favour of the Dissidents. These innovations, however, soon produced a civil war, which at last ended in the ruin of the kingdom. In the beginning of the year 1768, a new confederacy was formed in Podolia, a province bordering on Turkey; it was afterwards called the Confederacy of Bar, and the intention of it was to abolish, by force of arms, the new constitutions, particularly those in favour of the Dissidents. The members of the new confederacy likewise expressed great indignation at the carrying away the bishops of Cracow, Kiow, and others, and still detaining them in custody.

Podolia was reckoned the fittest place for the purpose of the confederates, who imagined that the Russians could not attack them there without giving umbrage to the Ottoman court. Similar confederacies, however, were quickly entered into throughout the kingdom. The clergy excited all ranks of men to exert themselves in defence of their religion; and so effectual did their exhortations prove, that even the king's troops could not be trusted to act against these combinations. The empress of Russia threatened the new confederates as disturbers of the public tranquillity, and declared, that if they persisted, her troops would act against them. It was some time, however, before the Russian troops were considerably reinforced; nor did they at first seem inclined to act with the vigour that they might have exerted. A good many skirmishes soon occurred between the contending parties, in which the confederates were for the most part defeated. In one of these encounters, the latter being worsted, and hardly pressed, a number of them passed the Dniester and took refuge in Moldavia. This province had formerly belonged to Poland, but was now subject to the grand signior. The Russians, however, pursued their enemies into Moldavia; but in order to prevent any offence being taken by the Porte, Prince Repnin wrote to the Russian resident at Constantinople, that the conduct of the Russian colonel who commanded the party was quite contrary to the orders of his court, and that he would therefore be dismissed.

War between this confederacy and the Russians.

Great cruelty was in the mean time exercised against the Dissidents where there were no Russian troops to protect them. Towards the end of October 1768, Prince Martin Lubomirski, one of the southern confederates, who had been driven out of Poland, and had taken shelter with some of his adherents amongst the mountains of Hungary, caused a manifesto to be posted up on several of the churches of Cracow, in which he invited the nation to a general revolt, assuring them of the assistance of the Ottoman Porte, with whom he pretended to have concluded a treaty. The unhappy kingdom of Poland became the first scene of this war, and in a short time it was reduced to the most deplorable situation. In the end of the year 1768, the peasants of the Greek faith in the Ukraine took up arms, and committed the greatest ravages, having, as they pretended, been threatened with death by the confederates unless they would become Roman Catholics. Against these insurgents the Russians employed their arms, and made great numbers of them prisoners. The rest took refuge amongst the Haidamacks, by whom they were soon joined, and in the beginning of 1769 they entered the Ukraine, committing everywhere the most horrid massacres. Here, however, they were at last defeated by the Polish troops, at the same time that several of the confederacies in Poland were severely chastised. Soon afterwards, the khan of the Crim Tartars having been repulsed with loss in an attempt on Servia, entered the Polish territories, where he left frightful marks of his inhumanity; which, with the cruelties exercised by the confederates, induced the Polish Cossacks of Braclau and Kiovia, amounting to near thirty thousand effective men, to join the Russians, in order to defend their country against these destroyers. Matters continued much in the same state during the rest of the year 1769; and in 1770 skirmishes frequently occurred between the Russians and confederates, in which the latter were almost always worsted; but they took care to revenge themselves by the most barbarous cruelties on the Dissidents, wherever they could find them. In 1770, a considerable number of the confederates of Bar, who had joined the Turks, and been excessively ill used by them, came to an accommodation with the Russians, who took them under their protection upon very moderate terms. In the mean time agriculture had been so much neglected, that the crop of 1770 proved deficient. This encouraged a number of desperadoes to associate, who, under the denomination of Confederates, were guilty of still greater excesses than those who had been under some kind of regulation; and thus a great part of the country was at last reduced to a mere desert, the inhabitants being either exterminated, or carried off to stock the remote Russian plantations.

New confederacies

In the year 1771, the confederacies, which appeared to have been extinguished, sprang up afresh, and increased to a great degree. This was occasioned by their having been secretly encouraged and supplied with money by France. A great number of French officers also engaged as volunteers in their service; and having introduced discipline amongst their troops, they acted with greater vigour than formerly, sometimes proving more than a match for their enemies. But these gleams of success served only to light them on to their ruin. The Russians were reinforced and properly supported. The Austrian and Prussian troops entered the country, advancing on different sides; and in a short time the confederates found themselves entirely surrounded by enemies, who seemed to have nothing less in view than an absolute conquest of the country, and sharing it amongst themselves.

Attem assassi the king

Before matters came to this crisis, however, the confederates had formed a design of assassinating the king, on account of his supposed attachment to the Dissidents. A Polish nobleman, named Pulaski, a general in the army of the confederates, was the person who planned the enterprise; and the conspirators who carried it into execution were about forty in number, headed by three chiefs, named respectively Lukawski, Strawenski, and Kosinski. These chiefs had been engaged and hired for the purpose by Pulaski, who obliged them to swear in the most solemn manner, either to deliver the king alive into his hands, or, in case that was found impossible, to put him to death. On the 2d of September they obtained admission into Warsaw, unsuspected and undiscovered. On Sunday night, the 3d of September 1771, a few of these conspirators remained in the skirts of the town; but the others repaired to the place of rendezvous, the street of the Capucins, where his majesty was expected to pass about his usual hour of returning to the palace. The king had been to visit his uncle Prince Czartoryski, grand chancellor of Lithuania, and was on his return from thence to the palace between nine and ten o'clock. He was in a coach, accompanied by at least fifteen or sixteen attendants, besides an aide-de-camp in the carriage. Scarcely was he at the distance of two hundred paces from Prince Czartoryski's palace, when he was attacked by the conspirators, who commanded the coachman to stop on pain of instant death. They fired several shots into the carriage, and almost all the other persons who preceded and accompanied his majesty were dispersed; the aide-de-camp having also abandoned him, and attempted to conceal himself by flight. Meanwhile the king had opened the door of his carriage with the design of effecting his escape under cover of the night, which was extremely dark, when the assassins seized him by the hair, exclaiming in Polish, "We have thee now; thy hour is come." One of them discharged a pistol at him, so very near that he felt the heat of the flash; whilst another cut him across the head with his sabre, which penetrated to the bone. They then laid hold of him by the collar, and mounting on horseback, dragged him along the ground between their horses at full gallop for nearly five hundred paces through the streets of Warsaw. But finding that he was incapable of following them on foot, and that he had already almost lost his respiration from the violence with which they had dragged him, they set him on horseback, and then redoubled their speed for fear of being overtaken. When they came to the ditch which surrounds Warsaw, they obliged him to leap his horse over the obstacle.

They had no sooner crossed the ditch than they began to rifle the king, tearing off the order of the Black Eagle of Prussia, which he wore round his neck, and the diamond cross attached to it. Having thus plundered him, a great number of the assassins retired, probably intending to notify to their respective leaders the success of their enterprise, and the king's arrival as a prisoner. Only seven remained with him, of whom Kosinski was the chief. The night was exceedingly dark; they were absolutely ignorant of the way; and, as the horses could not keep their legs, they obliged his majesty to follow them on foot. They continued to wander through the open meadows, without following any certain path, and without getting to any distance from Warsaw. After some time, they again mounted the king on horseback, two of them holding him on each side; and in this manner they were proceeding, when his majesty, finding they had taken the road which led to a village called Burakow, warned them not to enter it, because there were some Russians stationed in that place, who might probably attempt to rescue him. From the time they had passed the ditch, they repeatedly demanded of Kosinski, their chief, if it was not yet time to put the king to death; and these demands were reiterated in proportion to the obstacles and difficulties they encountered, till they were suddenly alarmed by a Russian patrole or detachment. Instantly holding council, four of them disappeared, leaving the king with the other three, who compelled him to walk on. Scarcely a quarter of an hour after, a second Russian guard challenged them anew. Two of the assassins then fled, and the king remained alone with Kosinski. His majesty, exhausted with the fatigue which he had undergone, implored his conductor to stop, and suffer him to take a moment's repose. Kosinski refused, at the same time informing him, that beyond the wood they should find a carriage. They continued their walk till they came to the door of the convent of Bielany. Kosinski appeared lost in thought. "I see you are at a loss which way to proceed," said the king. "Let me enter the convent of Bielany, and do you provide for your own safety." "No," replied Kosinski; "I have sworn."

They proceeded till they came to Mariemont, a small palace belonging to the house of Saxony, not above half a league from Warsaw. Here Kosinski betrayed some satisfaction at finding where he was, and the king still demanding an instant's repose, he at length consented. They sat down together on the ground, and the king employed these moments in endeavouring to soften his conductor, and induce him to favour or permit his escape. His majesty represented the atrocity of the crime he had committed in attempting to murder his sovereign, and the invalidity of an oath taken to perpetrate so heinous an action. Kosinski lent attention to this discourse, and began to betray some symptoms of remorse. The king pursued the advantage he had gained, overcame the fears of Kosinski, and was at length reconducted to the capital. Upon his return to Warsaw he was received with the utmost demonstrations of joy. But neither the virtues nor the popularity of the sovereign could allay the factious spirit of the Poles, nor prevent the dismemberment of his kingdom.

First partition of Poland.

The partition of Poland was first projected by the king of Prussia. Polish or Western Prussia had long been an object of his ambition. Exclusively of its fertility, commerce, and population, its local situation rendered it highly valuable to that monarch; it lay between his German dominions and Eastern Prussia, and, whilst in the possession of the Poles, it cut off at their will all communication between them. The period had now arrived when the situation of Poland seemed to promise the easy acquisition of this valuable province. Frederic, however, pursued it with all the caution of an able politician. On the commencement of the troubles, he showed no eagerness to interfere in the affairs of this country; and although he had concurred with the empress of Russia in raising Stanislas Augustus to the throne of Poland, yet he declined taking any active part in his favour against the confederates. Afterwards, when, in 1769, the whole kingdom became convulsed with civil commotions, and desolated by the plague, he, under pretence of forming lines to prevent the spreading of the infection, advanced his troops into Polish Prussia, and occupied the whole of that district. Though now completely master of the country, and by no means apprehensive of any formidable resistance from the disunited and distracted Poles, yet, as he was well aware that the security of his new acquisition depended upon the acquiescence of Russia and Austria, he planned the partition of Poland. He communicated the project to the emperor, either upon their interview at Niess in Silesia in 1769, or in that of the following year at Nieustadt in Austria, and from him the overture met with a ready concurrence. To induce the empress of Russia to acquiesce in the same project, he despatched to St Petersburg his brother Henry, who suggested to the empress, that the house of Austria was forming an alliance with the Porte, with which she was then at war; that if such alliance took place, it would create a most formidable combination against her; that, nevertheless, the friendship of that house was to be purchased by acceding to the partition; that, upon this condition, the emperor was willing to renounce his connection with the grand signior, and would suffer the Russians to prosecute the war without interruption. Catharine, anxious to push her conquests against the Turks, and dreading the interposition of the emperor in that quarter; perceiving, likewise, from the intimate union between the courts of Vienna and Berlin, that it would not be in her power, at the present juncture, to prevent the intended partition; closed with the proposal, and selected no inconsiderable portion of the Polish territories for herself. The treaty was signed at St Petersburg in the beginning of February 1772, by the Russian, Austrian, and Prussian plenipotentiaries. It would be tedious to enter into a detail of the pleas urged by the three powers in favour of their several demands; nor would it be less uninteresting to lay before the reader the answers and remonstrances of the king and senate, as well as the appeals to the other states which had guaranteed the possessions of Poland. The courts of London, Paris, Stockholm, and Copenhagen, remonstrated against these usurpations; but remonstrances without assistance could be of no effect. Poland submitted to the dismemberment, not without the most violent struggles; and now for the first time that unhappy country felt and lamented the fatal effects of faction and discord.

A Diet being demanded by the partitioning powers, in order to ratify the cession of the provinces, it met on the 19th of April 1773; and such was the spirit of the members, that, notwithstanding the deplorable situation of their country, and the threats and bribes of the three powers, the partition-treaty was not carried through without much difficulty. For some time the majority of the nuncios appeared determined to oppose the dismemberment, and the king firmly persisted in the same resolution. The ambassadors of the three courts enforced their requisitions by the most alarming menaces, and threatened the king with deposition and imprisonment. They also gave out by their emissaries, that in case the Diet continued refractory, Warsaw should be pillaged. This report was industriously circulated, and made a sensible impression upon the inhabitants. By menaces of the same sort, by corrupting the marshal of the Diet, and by bribes, promises, and threats, the members were at length prevailed on to ratify the dismemberment.

The partitioning powers, however, did less injury to the republic by dismembering its fairest provinces, than perpetuating the principles of anarchy and confusion. Under pretence of amending the constitution, they confirmed all its defects, and took effectual precautions to render this unhappy country incapable of ever emerging from the deplorable state into which it had fallen; as was seen in the failure of the most patriotic attempt ever made by a king to reform the constitution of his kingdom.

The kings of Poland originally hereditary, but afterwards elective.

The kings of Poland were anciently hereditary and absolute, but afterwards became elective and limited. In the reign of Louis, towards the end of the fourteenth century, several limitations were imposed on the royal prerogative. In that of Casimir IV. who ascended the throne in 1446, representatives from the several palatinates were first called to the Diet; the legislative power till then having been lodged in the states, and the executive in the king and senate. On the decease of Sigismund Augustus, it was enacted by law, that for the future the choice of a king should perpetually remain free and open to all the nobles of the kingdom; and this law was accordingly observed, to the great injury of the kingdom.

As soon as the throne became vacant, all the courts of justice, and other parts of the machine of government, remained in a state of inaction, and the authority was transferred to the primate, who, in quality of interrex, had in some respects more power than the king himself; and yet the republic took no umbrage at this, because he had not time to render himself formidable. He notified the vacancy of the throne to foreign princes, which was in effect proclaiming that a crown was to be disposed of; he issued the *universalia*, or circular letters for the election; he gave orders to the starosts, a sort of military officers who had great authority, and whose proper business it was to levy the revenue, to keep a strict guard upon the fortified places, and enjoined the grand generals to do the same upon the frontiers, towards which the army marched.

The place of election was the field of Vola, at the gates of Warsaw; and all the nobles of the kingdom had a right of voting. The Poles encamped on the left side of the Vistula, and the Lithuanians on the right, each under the banners of their respective palatinates. The field of election was surrounded by a ditch provided with three gates; one to the east for Great Poland, another to the south for Little Poland, and a third to the west for Lithuania. In the middle of the field was erected a great building of wood, named the *szopa*, or hall of the senate. All who aspired openly to the crown were expressly excluded from the field of election, that their presence might not constrain the voters. The king must be elected *nemine contradicente*, by all the suffrages without exception. The law which prescribed unanimity was founded upon this principle, that when a great family adopts a father, all the children have a right to be pleased. The idea seems plausible in speculation; but if it were rigorously adhered to, Poland could never have had such thing as a lawful king. They therefore gave up a real unanimity, and contented themselves with the appearance or semblance of concord.

No election could possibly be carried on with more order, decency, and appearance of freedom. The primate in few words recapitulated to the nobles on horseback the respective merits of the candidates; he exhorted them to choose the most worthy, invoked heaven, gave his blessing to the assembly, and remained alone with the marshal of the Diet, whilst the senators dispersed themselves into the several palatinates to promote an unanimity of sentiment. If they succeeded, the primate himself went to collect the votes, at the same time naming again all the candidates. "Szoda," answered the nobles, "that is the man we choose;" and instantly the air resounded with his name, together with cries of *vivat*, and the noise of pistols. If all the palatines agreed in their nominations, the primate got on horseback, and then, the profoundest silence succeeding to the greatest noise, he asked three times if all were satisfied, and, after a general approbation, three times proclaimed the king; upon which the grand marshal of the crown repeated the proclamation three times at the three gates of the camp.

The pacta conventa.

Before the king was proclaimed, the *pacta conventa* were read aloud to him, which, on his knees at the altar, he swore to observe. This contract, which had been drawn up, methodized, and approved by the senate and nobility, was deemed the great charter of Poland. It provided that the king should not attempt to encroach on the liberty of the people, by rendering the crown hereditary in his family; that he should preserve all the customs, laws, and ordinances respecting the freedom of election; that he should ratify all treaties subsisting with foreign powers, which were approved by the Diet; that it should be his chief study to cultivate peace, preserve the public tranquillity, and promote the interest of the realm; that he should not coin money except in the name of the republic, or appropriate to himself the advantages arising from coinage; that in declaring war, concluding peace, making levies, hiring auxiliaries, or admitting foreign troops upon any pretext within the Polish dominions, the consent of the Diet and senate should be necessary; that all offices and preferments should be given to the natives of Poland and Lithuania, and that no pretence should excuse or palliate the crime of introducing foreigners into the king's council or the departments of the republic; that the officers of his majesty's guards should be Poles or Lithuanians, and that the colonel should absolutely be a native of Poland, and of the order of nobility;

that all the officers should be subordinate to the authority of the marshal; that no individual should be invested with more employments than the law allows; that the king should not marry without the approbation of the senate; that the sovereign should never apply his private signet to acts and papers of a public nature; that the king should dispose of the offices both of the court and of the republic, and regulate with the senate the number of forces necessary for the defence of the kingdom; that he should administer justice by the advice of the senate and his council; that the expenses of his civil list should be the same with those of his predecessors; that he should fill up all vacancies in the space of six weeks; that this should be his first business in the Diet, obliging the chancellor to publish his appointments in due form; that the king should not diminish the treasure kept at Cracow, but, on the contrary, endeavour to augment it, as well as the number of the crown jewels; that he should not borrow money without the consent of the Diet; that he should not equip a naval force, without the consent and full approbation of the republic; that he should profess the Roman Catholic faith, and promote, maintain, and defend it, throughout all the Polish dominions; and, finally, that all their several liberties, rights, and privileges, should be preserved to the Poles and Lithuanians in general, and to all the districts and provinces contained within each of these great divisions, without change, alteration, or the smallest violation, except by the consent of the republic. To these articles a variety of others were added, according to circumstances and the humour of the Diet; but what has been recited formed the standing conditions, which were scarcely ever altered or omitted.

Th iet of Pol d.

The Diet of Poland was composed of the king, the senate, bishops, and the deputies of the nobility or gentry of every palatinate, called, in their collective capacity, *comitia togata*, that is, when the states assembled in the city without arms and horses; or *comitia paludata*, when they met in the fields armed, as during an interregnum, at the Diet of election. It was a prerogative of the crown to assemble the Diet at any particular place, except on occasion of a coronation, which the custom of the country required should be celebrated at the capital. For a number of years, indeed, the Diet assembled regularly at Warsaw; but, on complaints being made by the Lithuanians, it was agreed that every third Diet should be held at Grodno. When it was proposed to hold a general Diet, the king, or, in case of an interregnum, the primate, issued writs to the palatines of the several provinces, specifying the time and place of the meeting. A sketch likewise was sent of the business to be deliberated on by the assembly; the senate was consulted in this particular, and six weeks were allowed the members to prepare themselves for the intended session. It is remarkable, that the Diet never sat more than six weeks in the most critical conjunctures and pressing emergencies; nay, they have been known to break up in the middle of an important debate, and to leave the business to a future meeting. This custom has been justly esteemed one of the greatest defects of the Polish constitution; but it probably owed its origin to convenience, and was afterwards superstitiously observed from whim and caprice. On receipt of the king's writ, the palatine communicated the meeting of the Diet to all the castellans, starosts, and other inferior officers and gentry within his jurisdiction; requiring them to assemble on a certain day to elect deputies, and take into consideration the business specified in the royal summons. These meetings were called petty diets, *dietines*, or *lantage*, in the language of the country, every gentleman possessing three acres of land having a vote, and matters being determined by a majority; whereas in the general Diet decrees were only valid when the whole body was unanimous. Every palatinate had three representatives, though the business devolved on one called a nuncio, who was elected on account of his ability and experience; and the other two were added only to give weight to this leading member, and by their magnificent appearance do honour to the palatinate which they represented. As these deputies, since the reign of Casimir III. had seats in the Diet, it naturally divided the general assembly into two bodies, the upper and lower; the one being composed of the senate, the superior clergy, and the great officers; and the other of the representatives of the palatinates, who prepared all business for the superior body.

Absurd customs observed in the Diet.

The first business of the assembly was to choose a marshal, upon which occasion the debates and tumults often ran high. After his election the marshal kissed the king's hand; and the chancellor, as the royal representative, reported the matter to be deliberated by the Diet. Then the marshal acquainted the king with the instructions the deputies had received from their constituents, the grievances which they would have redressed, and the abuses they required to be remedied. He likewise requested his majesty to fill up the vacant offices and benefices according to law; and he was answered by a formal speech from the chancellor, who reported the king's inclination to satisfy his people, as soon as he had consulted his faithful senate. In certain customs observed by the Polish Diet, there was something peculiarly absurd and preposterous. One in particular merits attention. Not only was an unanimity of voices necessary to pass any bill, and constitute a decree of the Diet, but every bill likewise required to be unanimously assented to, or none could take effect. Thus, if out of twenty bills one happened to be opposed by a single voice, called the *liberum veto*, all the rest were thrown out, and the Diet had met, deliberated, and debated, during six weeks, to no purpose whatever.

Its venality and corruption.

To add to the inconveniences which attended the constitution of the Diet of Poland, a spirit of venality in the deputies, and a general corruption, had seized all ranks and degrees in that assembly. There, as in some other countries, the cry of liberty was kept up for the sake of private interest. Deputies came with a full resolution of profiting by their patriotism, and not lowering their voice without a gratification. Determined to oppose the most salutary measures of the court, they either withdrew from the assembly, and protested against all that should be transacted in their absence, or else excited such a clamour as rendered it necessary for the court to silence them by some lucrative pension, donation, or employment. Thus the business of the assembly was not only obstructed by its own members, but frequently by largesses from neighbouring powers, and sometimes by the liberality of an open enemy, who had the art of distributing his money with discretion.

The Senate of Poland.

Perhaps the most respectable department of the Polish government was the senate, composed of the bishops, palatines, castellans, and ten officers of state, who derived a right from their dignities of sitting in that assembly, and amounting in all to a hundred and forty-four members, who were styled "senators of the kingdom," or "counsellors of the state," and had the title of excellency, a dignity supported by no pension or emoluments necessarily annexed to it. The senate presided over the execution of the laws, and was the guardian of liberty, the judge of right, and the protector of justice and equity. All the members, except the bishops, who were senators *ex officio*, were nominated by the king, and took an oath to the republic before they were permitted to enter upon their functions. Their honours continued for life. At the general Diet they sat on the right and left of the sovereign, according to their dignity, without regard to seniority. They were the mediators between the monarch and the subject, and, in conjunction with the king, ratified all the laws passed by the nobility. As a senator was bound by oath to maintain the liberties of the republic, it was thought no disrespect to majesty that they reminded the prince of his duty. They were his counsellors, and this freedom of speech constituted an inseparable prerogative of their office.

The Permanent Council.

Such was the constitution of Poland before being new-modelled by the partitioning powers. That it was in all respects a very bad one, needs no proof whatever But those foreign reformers did not improve it. For two centuries at least, the Poles had with great propriety denominated their government a republic, because the king was so exceedingly limited in his prerogative that he resembled more the chief of a commonwealth than the sovereign of a powerful monarchy. That prerogative, already too confined to afford protection to the peasants, groaning under the tyranny of the nobles, was, after the partition-treaty, still further restrained by the establishment of the Permanent Council, which was vested with the whole executive authority, leaving to the sovereign nothing but the name. The permanent council consisted of thirty-six persons, elected by the Diet out of the different orders of nobility; and though the king, when present, presided in it, he could not exert a single act of power without the consent of the majority of persons, who might well be called his colleagues.

That the virtuous and accomplished Stanislas should have laboured to extricate himself and the great body of the people from such unparalleled oppression, and that the more respectable portion of the nation should have wished to give to themselves and their posterity a better form of government, was surely very natural and very meritorious. The influence of the partitioning powers was indeed exerted to render the king contented with his situation. His revenues, which before did not exceed L.100,000, were now increased to three times that sum. The republic likewise agreed to pay his debts, amounting to upwards of L.400,000. It also bestowed on him, in hereditary possession, four starosties or governments of castles, with the districts belonging to them, and reimbursed him for the money which he had laid out on account of the state. It was likewise agreed that the revenues of the republic should be raised to thirty-three millions of florins, or nearly two millions sterling; and that the army should consist of thirty thousand men. Soon after the conclusion of peace with Turkey, the empress of Russia also made the king a present of 250,000 rubles, as a compensation for that part of his dominions which had fallen into her hands.

A new constitution established in 1791.

These bribes, however, were not sufficient to blind the penetration of Stanislas, nor to cool the ardour of his patriotism. He laboured for posterity, and with such apparent success, that on the 3d of May 1791, a new constitution of the government of Poland was established by the king, together with the confederate states assembled in double number to represent the Polish nation. That this constitution was perfect, we are far from asserting; but it was probably as much so as the inveterate prejudices of the nobles would admit of. It deviated as little as possible from the ancient forms, and consisted of eleven articles respecting the government of the republic, to which were added twenty-one sections, regulating the dietines or primary assemblies of Poland.

Substance of the first five articles.

The first article of this constitution established the Roman Catholic faith, with its various privileges and immunities, as the dominant national religion; but to all other people, of whatever persuasion, it secured peace in matters of faith, and the protection of government. The second article guaranteed to the nobility or the equestrian order all the privileges which it enjoyed under the kings of the house of Jagellon. The third and fourth articles granted to the free royal towns internal jurisdictions of their own; and exempted the peasants from slavery, declaring every man free as soon as he set his foot on the territory of the republic. The fifth article, after declaring, that in civil society all power should be derived from the will of the people, enacted that the government of the Polish nation should be composed of three distinct powers; the Legislative, in the states assembled; the Executive, in the king and the council of inspection; and the Judicial power, in the jurisdictions existing or to be established. The sixth and seventh articles, as being of more importance, we shall state the substance of at greater length.

The L to con two ho

According to the former, the Diet, or the legislative power, was to be divided into two houses, viz. the House of Nuncios or deputies, and the House of Senate, where the king was to preside. The former, being the representative and central point of supreme national authority, was to possess the pre-eminence in the legislature; therefore all bills were to be decided first in this house.

House Nunc

Within the competency of the House of Nuncios were included all general laws, constitutional, civil, and criminal, besides perpetual taxes; matters concerning which the king was to issue his propositions by the circular letters sent before the dietines to every palatinate and to every district for deliberation, and which, coming before the house with the opinions expressed in the instructions given to their representatives, should be taken the first for decision. Next, particular laws, viz. temporal taxes; regulations of the mint; contracting public debts; creating nobles, and other casual recompenses; reparation of public expenses, both ordinary and extraordinary; concerning war and peace, with the ratification of treaties both political and commercial; all diplomatic acts and conventions relative to the laws of nations; examining and acquitting different executive departments, and similar subjects arising from the accidental exigencies and circumstances of the state; in all which the propositions coming directly from the throne into the house of nuncios, were to have a preference in discussion before the private bills.

The H of Sen

In regard to the House of Senate, it was to consist of bishops, palatines, castellans, and ministers, under the presidency of the king, who should have but one vote, and the casting voice in case of parity, which he might give either personally or by a message to the house. Its power and duty were clearly defined. First, every general law that passed formally through the house of nuncios was to be sent immediately to this, which either accepted or suspended it till further national deliberation, by a majority of votes, as prescribed by law. If accepted, it became a law in all its force; if suspended, it might be resumed at the next Diet, and if it was then agreed to again by the house of nuncios, the senate must submit to it. Secondly, in every particular law or statute of the Diet touching the matters above specified, as soon as it had been determined by the house of nuncios, and sent up to the senate, the votes of both houses should be jointly computed, and the majority, as described by law, should be considered as the will of the nation. Those senators and ministers who, from their share in the executive power, were accountable to the republic, had no active voice in the Diet, but might be present in order to give necessary explanations to the states.

The *lil rum ve* abolish

These ordinary legislative Diets were to have an uninterrupted existence, and be always ready to meet. The length of sessions was to be determined by the law concerning Diets. If convened upon some urgent occasion out of ordinary session, they were only to deliberate on the subject which occasioned such a call, or on circumstances which might arise out of it. No law or statute enacted by such ordinary Diet could be altered or annulled by the same. The majority of votes was to decide everything and everywhere; therefore the *liberum veto* was utterly abolished, together with all sorts of confederacies and confederate Diets, as contrary to the spirit of the constitution, as undermining the government, and as being ruinous to society. The framers of this constitution, willing to prevent violent and frequent changes in the national constitution, yet considering the necessity of perfecting it after experiencing its effects on public prosperity, determined the period of every twenty-five years for an extraordinary constitutional Diet, to be held for the revision of the constitution, and making such changes and alterations as might be found requisite.

ers of king council spec-

The seventh article proceeds on the principle that the most perfect government cannot exist or endure without an effectual executive power. The happiness of the nation depends on just laws, but the good effects of laws flow only from their execution. The framers of this constitution, therefore, having secured to the Polish nation the right of enacting laws for themselves, the supreme inspection over the executive power, and the choice of their magistrates, intrusted to the king and his council the highest power of executing the laws. This council was to be called *Straz*, or the Council of Inspection. The duty of such executive power was to watch over the laws, and to see them strictly executed according to their import, even by means of public force, should it be found necessary. All departments and magistrates were bound to obey its directions. This executive power could not assume the right of making laws, or of interpreting them. It was expressly forbidden to contract public debts; to alter the repartition of the national income, as fixed by the Diet; to declare war; to conclude definitively any treaty, or any diplomatic act; it was only allowed to carry on negotiations with foreign courts, and facilitate temporary occurrences, always with reference to the Diet.

crown.

The crown of Poland was declared to be elective in regard to families, and it was so settled for ever. But it was resolved to adopt hereditary succession to the throne. Therefore it was enacted and declared that, after the expiration of the present king's life, the elector of Saxony should reign over Poland, and in his person should the dynasty of future kings of Poland commence.

nation

Every king, on his accession to the throne, was to take a solemn oath to God and the nation, to support the present constitution, and to fulfil the *pacta conventa*. The king's person was sacred and inviolable. As no act could proceed immediately from him, he could not in any manner be responsible to the nation; he was not an absolute monarch, but the father and the head of the people; and his revenues, as fixed by the *pacta conventa*, were to be sacredly preserved. All public acts, the acts of magistracies, and the coin of the kingdom, were to bear his name. He had the right of pardoning those who were condemned to death, except the crimes were against the state; and in time of war he had the supreme command of the national forces, but he might appoint the commanders of the army, with the consent of the states. The nomination to all offices and dignities was vested in him.

Coun- In- ion.

The king's Council of Inspection was to consist of the primate as the head of the clergy, and the president of the commission of education, or the first bishop *in ordine;* of five ministers, viz. those of police, justice, war, finances, and foreign affairs; of two secretaries to keep the protocols, one for the council, and another for the foreign department; but both without a decisive vote. The hereditary prince, on coming of age, and having taken the oath to preserve the constitution, might assist at all sessions of the council, but could have no vote therein. The marshal of the Diet had also a right to sit in this council, without taking any share in its resolves, in order that he might call together the Diet, always existing; for, should he deem the convocation of the Diet absolutely necessary, and should the king refuse to do it, the marshal was bound to issue his circular letters to all nuncios and senators, adducing real motives for such meeting. The cases demanding such convocation of the Diet were the following: First, in a pressing necessity concerning the law of nations, and particularly in case of a neighbouring war; secondly, in case of an internal commotion, menacing the country with revolution, or of a collision between magistrates; thirdly, in an evident danger of general famine; fourthly, in the orphan state of the country, by demise of the king, or in case of the king's dangerous illness. All the resolutions of the council of inspection were to be examined by the rules above mentioned.

If it should happen that two thirds of secret votes in both houses demanded the changing of any person, either in the council, or any executive department, the king was bound to nominate another; and when these ministers were denounced and accused before the Diet, of any transgression of positive law, they were answerable with their persons and fortunes. Such impeachments being determined by a simple majority of votes, collected jointly from both houses, were to be tried immediately by the comitial tribunal, where the accused were to receive their final judgment and punishment if found guilty, or to be honourably acquitted on sufficient proof of innocence.

Commissions of education, &c.

In order to form a necessary organization of the executive power, there were established separate commissions, connected with the above council, and subject to its ordinations. These were commissions of education, of police, of war, and of treasury.

Administration of justice.

The eighth article regulated the administration of justice. It constituted primary courts of justice for each palatinate or district, composed of judges chosen at the dietine; and appointed higher tribunals, one being erected in each of the three provinces into which the kingdom was divided, with which appeals might be lodged from the primary courts. It likewise appointed for the trial of persons accused of crimes against the state, one supreme general tribunal for all classes, called a *comitial tribunal*, or court composed of persons chosen at the opening of every Diet. The ninth article provided a regency during the king's minority, in case of his settled alienation of reason, or upon the emergency of his being made a prisoner of war.

The election and duties of nuncios.

The regulation of the dietines contained nothing that can be interesting to a British reader, except what related to the election and duties of nuncios or representatives to the general Diet. And here it was enacted, that persons having a right to vote must all be nobles of the equestrian order; that is, all hereditary proprietors of landed property, or possessed of estates by adjudication for a debt, paying territorial tax to government; brothers inheriting estates before they have shared their succession; all mortgagees who paid a hundred florins of territorial tax per year from their possessions; and all life-holders of lands paying territorial tax to the same amount. All nobles in the army possessed of such qualifying estates had a vote in their respective districts in time of peace, and when absent on leave during war; and legal possession was understood to qualify when it had been acquired and actually enjoyed for twelve calendar months previously. Persons who had no right to vote were those of the equestrian order that were not actually possessed of a property as described in the foregoing article; such as held royal, ecclesiastical, or noble lands, even with right of inheritance, but on condition of some duty or payment to their principals; gentry possessing estates on feudal tenure, called *ordynackie*, as being bound to certain personal service thereby; all renters of estates that had no other qualifying property; those that had not attained eighteen years of age; persons *crimine notati*, and those that were under a decree passed in default, even in the first instance, for having disobeyed any judicial court.

Persons eligible and not eligible.

Every person of the equestrian order that paid territorial tax to government for his freehold, let it be ever so small, was eligible to all elective offices in his respective district. Gentlemen actually serving in the army, even possessed of landed hereditary estate, must have served six complete years before they could be eligible to the office of nuncio only. But this condition was dispensed with in favour of

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those that had before filled some public function. Whoever was not personally present at the dietine; whoever had not completed twenty-three years of age; whoever had not been in any public function, nor passed the biennial office of a commissary in the orderly commission; those that were not exempted by law from obligations of *scarta bellatus*, which subjected all newly-nobilitated persons to certain civil restrictions until the next generation; and, lastly, all those against whom might be objected a decree *in contumaciam* in a civil cause, were not eligible.

This constitution opposed by the Russians.

Such were the heads of the Polish constitution established by the king and the confederates in 1791. It will not bear a comparison with systems which have been matured by long experience; but it is surely infinitely superior to the motley form of government which, for a century previous, rendered Poland a perpetual scene of war, tumult, tyranny, and rebellion. Many of the corrupt nobles, however, perceiving that it would curb their ambition, deprive them of the base means which they had long enjoyed of gratifying their avarice by setting the crown to sale, and render it impossible for them to continue with impunity their tyrannical oppression of the peasants, protested against it, and withdrew from the confederates. This was nothing more than what might have been expected, or than what the king and his friends undoubtedly expected. But the malcontents were not satisfied with a simple protest; they preferred their complaints to the empress of Russia, who, ever ready on all occasions, and on the slightest pretence, to invade Poland, poured her armies into the republic, and surrounding the king and the Diet with ferocious soldiers, compelled them, by the most indecent menaces, to undo their glorious labour of love, and to restore the constitution as settled after the partition-treaty.

General rising.

On the 21st of April 1792, the Diet received the first notification from the king, of the inimical and unjust intentions of Russia. He informed them that, without the shadow of pretence, this power had determined to invade the territory of the republic with an army of sixty thousand men. This formidable force, commanded by Generals Soltikof, Michelson, and Kosakowski, was afterwards to be supported by a corps of twenty thousand, and by the troops then acting in Moldavia, amounting to seventy thousand. The king, however, professed that he was not discouraged; and he declared his readiness to put himself at the head of the national troops, and to terminate his existence in a glorious contest for the liberties of his country. Then, and not before, the Diet decreed the organization of the army, and its augmentation to a hundred thousand. The king and the council of inspection were invested with unlimited authority in everything that regarded the defence of the kingdom. Magazines were ordered to be constructed when it was too late, and quarters to be provided for the army. The Diet and the nation rose as one man to maintain their independence. All private animosities were obliterated, all private interests were sacrificed; the greatest encouragements were held forth to volunteers to enroll themselves under the national standard; and it was unanimously decreed by the Diet that all private losses should be compensated out of the public treasury.

Russian declaration.

On the 18th of May the Russian ambassador delivered a declaration worthy of such a cause. It asserted that this wanton invasion, which was evidently against the sense of almost every individual Pole, was intended solely for the good of the republic. It censured the precipitancy with which the new constitution had been adopted, and ascribed the ready consent of the Diet to the influence of the mob of Warsaw. It represented the constitution as a violation of the principles on which the Polish republic was founded; complained of the licentiousness with which the sacred name of the empress was treated in some speeches of the members; and concluded by professing, that on these accounts, and in behalf of the emigrant Poles, her imperial majesty had ordered her troops to enter the territories of the republic. At the moment when this declaration was delivered to the Diet, the Russian troops, accompanied by Counts Potocki, Rzewuski, Branicki, and a few Polish renegades, appeared upon the frontiers, and, before the close of the month, entered the territories of the republic in several columns.

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The spirit manifested by the nobility was truly honourable to that body. Some of them delivered in their plate to the mint. Prince Radzivil engaged voluntarily to furnish ten thousand stand of arms, and another noble offered to provide a train of artillery. The courage of the new and hastily embodied soldiers corresponded with the patriotism of their chiefs. Prince Poniatowski, nephew of the king, was appointed commander-in-chief; and though his force was greatly inferior to the enemy, it must be confessed that he made a noble stand.

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The perfidy, the meanness, and the duplicity manifested by Prussia on this occasion is probably without a parallel in history. By the treaty of defensive alliance, solemnly contracted between the republic of Poland and the king of Prussia, and ratified on the 23d of April 1790, it is expressly stipulated, that the contracting parties shall do all in their power to guarantee and preserve to each other reciprocally the whole of the territories which they respectively possess; that, in case of menace or invasion from any foreign power, they shall assist each other with their whole force, if necessary; and that if any foreign power whatever should presume to interfere in the internal affairs of Poland, his Prussian majesty would consider this as a case falling within the meaning of the alliance, and assist the republic according to the tenor of the above article, that is, with his whole force. What, then, was the pretext for violating this treaty? It was this, that the empress of Russia had shown a decided opposition to the order of things established in Poland on the third of May 1791, and was provoked by Poland presuming to put herself into a posture of defence. It is ascertained, however, by the most authentic documents, that nothing was effected on the 3d of May 1791, to which Prussia had not previously assented, and which she did not afterwards sanction; and that Prussia, according to the assertion of her own king, did not intimate a single doubt respecting the revolution till several months after it had taken place; in short, to use the king's own words as explanatory of his double politics, "not till the general tranquillity of Europe permitted him to explain himself." Instead, therefore, of assisting Poland, Prussia insultingly recommended to Poland to retrace her steps; in which case, she said that she would be ready to attempt an accommodation in her favour. But this attempt was never made, and probably never intended; for the empress pursued her measures without opposition.

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The duchy of Lithuania was the great scene of action in the beginning of the war. But the Russians had made little progress before the middle of the month of June. On the 10th of that month, General Judycki, who commanded a detachment of the Polish troops between Mire and Swierzna, was attacked by the Russians; but, after a combat of some hours, he obliged them to retire with the loss of five hundred men dead on the field. The general was desirous of profiting by this advantage, by pursuing the enemy, but was prevented by a violent fall of rain. On the succeeding day, the Russians rallied again to the attack; and it then too fatally appeared that the Poles, being young and undisciplined, were unable to contend with an inferior force against experienced troops and able generals. By a masterly manœuvre, the Russians contrived to surround their antagonists, at a moment when the Polish general supposed that he had obliged the enemy to retreat; and though the field was contested with the utmost valour by the troops of the republic, they were at length compelled to give way, and to retire towards Nieswiesz.

On the 14th another engagement took place near Lubar, on the banks of the river Sluez, between a detachment of the Russian grand army and a party of Polish cavalry despatched by Prince Joseph Poniatowski to intercept the enemy. The patriotic bravery of the Poles proved victorious in this contest; but upon reconnoitring the force of the enemy, the prince found himself incapable of making a successful stand against such superior numbers. He, therefore, gave orders to strike the camp at Lubar, and commenced a precipitate retreat. During their march, the Polish rear was harassed by a body of about four thousand Russians. The Polish army next directed its course towards Zielime, where meeting, on the 17th, with a reinforcement from Zaslow, it halted to give battle to the enemy. The Russians were upwards of seventeen thousand strong, with twenty-four pieces of cannon, and the force of the republic much inferior. After a furious contest, from seven in the morning till five in the afternoon, the Russians were at length obliged to retreat, and leave the field of battle in possession of the patriots.

Notwithstanding these exertions, the Poles were obliged gradually to retire before their numerous and disciplined enemies. Nieswiesz, Wilna, Minsk, and several other places of less consequence, fell one after another into their hands. On a truce being proposed to the Russian general Kochowski, the proposal was haughtily rejected; whilst the desertion of vice-brigadier Rudnicki and some others, who preferred dishonour to personal danger, proclaimed a tottering cause. The progress of the armies of Catharine was marked with devastation and cruelty; whilst such was the aversion of the people, both to the cause and the manner of conducting it, that, as they approached, the country all around became a wilderness, where scarcely a human being was to be seen.

In the mean time, a series of petty defeats, to which the inexperience of the commanders, and the intemperate valour of newly-raised troops, appear to have greatly contributed, served at once to distress and dispirit the defenders of their country. Prince Poniatowski continued to retreat; and on the 17th of July, his rear being attacked by a very superior force, it suffered a considerable loss, although the skill and the courage of General Kosciuszko enabled him to make a most respectable defence. On the 18th, a general engagement took place between the two armies. The Russian line extended opposite Dubienka, along the river Bug, as far as Opalin; and the principal column, consisting of fourteen thousand men, was chiefly directed against the division of General Kosciuszko, which consisted only of five thousand men. After a most vigorous resistance, in which the Russians lost upwards of four thousand men, the troops of the republic were compelled to give way before the superior numbers of the enemy, and to retire further into the country.

The king proposes submission.

This unequal contest was at last prematurely terminated. The king, whose benevolent intentions were, perhaps, overpowered by his mental imbecility, and whose age and infirmities, probably, rendered him unequal to the difficulties and dangers which must attend a protracted war, instead of putting himself at the head of his army, determined at once to surrender at discretion. On the 23d of July he summoned a council of all the deputies at that moment in Warsaw, and laid before them the last despatches from the empress, which insisted upon total and unreserved submission. He pointed out the danger of a dismemberment of the republic, should they delay to throw themselves upon the clemency of the empress, and to entreat her protection. He also mentioned the fatal union of Austria and Prussia with Russia, and the disgraceful supineness manifested by every other court in Europe. Four citizens, the intrepid Malachowski, and the Princes Sapieha, Radzivil, and Soltan, vehemently protested against these dastardly proceedings; and the following evening a company of gentlemen from the different provinces attended for the same purpose. The assembly immediately waited upon these four distinguished patriots, and returned them their acknowledgements for the spirit and firmness with which they had resisted the usurpations of despotism. The submission of the king to the designs of Russia was no sooner made known than Poland was bereft of all her best and most respectable citizens. Malachowski, as marshal of the Diet, and Prince Sapieha, grand marshal of Lithuania, entered on the journals of the Diet strong protests against these proceedings, and declared solemnly that the Diet legally assembled in 1788 was not dissolved.

The former constitution restored.

On the second of August a confederation was formed at Warsaw, of which the renegade Potocki was chosen marshal. The acts of this confederation were evidently the despotic dictates of Russia, and were solely calculated to restore the ancient abuses, and to place the country under the aggravated oppression of a foreign yoke. It is remarkable, however, that at the very moment when Poland was surrendering its liberties to its despotic invaders, the generous sympathy of Great Britain was evinced by a liberal subscription, supported by the most respectable characters in the nation, of every party and of every sect, for the purpose of assisting the king and the republic to maintain their independence; and though the benevolent design was frustrated, yet the fact remains on record as a noble testimony of the spirit by which Britons are animated in the cause of freedom, of the indignation which fills every heart in this empire at the commission of injustice, and of the liberality with which all are disposed to assist those who suffer from the oppression of tyrants.

Part of the Polish territory seized.

Not satisfied with restoring the old wretched constitution, the empress of Russia seized upon part of the territory which, at the last partition, she and her coadjutors had left to the republic; and her ambassador entering into the Diet with a crowd of armed men, compelled the king and that assembly to grant the form of legality to her usurpations. The nation, however, did not submit.

Gallant effort of Kosciuszko.

In February 1794 General Kosciuszko appeared in the neighbourhood of Cracow with a small force of armed peasants. He beat some detachments of Russians and Prussians, compelled them to evacuate Cracow, and there proclaimed the constitution of 1791. Everywhere the people and the nobles flew to arms. The Russians, who occupied Warsaw with fifteen thousand men, began to seize suspected persons, and demanded possession of the arsenal. But at that moment the news arrived of a defeat sustained by a corps of six thousand Russians, with the loss of a thousand killed, and their general, Woronzow, made prisoner. Encouraged by this event, the people rose on the garrison, and after forty-eight hours' hard fighting, drove them out, with the loss of six thousand killed, three thousand prisoners, and fifty pieces of cannon. The whole country was now in arms. Russia and Prussia, however, sent a hundred and ten thousand men into Poland. Kosciuszko, pressed by superior forces, made an able retreat upon Warsaw. The king of Prussia, after besieging the city during three months, was compelled to retire towards his own territories with the loss of twenty thousand men. Here he was harassed for some time by Madalinsky with a small corps of cavalry. Kosciuszko, relieved from the Prussians, marched against the new Russian armies, which, during the siege of Warsaw, had reconquered Lithuania and Volhynia. But the battle of Noezylac, on the 10th of October 1794, in which the Poles fought with heroic resolution against overpowering numbers, proved fatal to their unhappy country. Kosciuszko was made prisoner and carried to St Petersburg, where he languished in a dungeon until the death of Catharine. The

Russians, after this event, united their forces and marched upon Warsaw, where the Poles had named Wawrzecky general-in-chief. He had only ten thousand men to oppose to fifty thousand, but an obstinate resistance was nevertheless offered. The last remains of the national army were concentrated at Praga, on the right bank of the Vistula, immediately opposite Warsaw; but they were soon broken by the furious charges of the Russian general Suwarof, who gratified his natural cruelty by the most frightful carnage. The fate of Poland was now decided. After the capture of Praga, Warsaw capitulated. Nine thousand Poles fell in the fight; thirty thousand persons of all ages and either sex were destroyed in cold blood; and thirty thousand more, who still refused to submit, were suffered to leave the place, and afterwards hunted down by the soldiery. The most distinguished chiefs were carried away to distant provinces; and the wretched king was sent to Russia, where he ended his days in 1798.

Treaty of partition.

The two powers were proceeding to divide the remaining provinces between them, when Austria interfered, and declared that she would not permit the destruction of Poland unless she received a share. At that moment it was not thought prudent to raise up a new enemy; and Austria obtained a considerable addition of territory, without having struck a blow or expended a florin. The negotiation continued till 1795, when the definitive treaty of partition was signed, which closed a series of transactions unparalleled for perfidy, cruelty, and infamy in the history of Europe. Austria received Cracow, with the country lying between the Pilitsa, the Vistula, and the Bug. Prussia had the capital, with the territory as far as the Niemen. The lion's share, as usual, fell to Russia. After an existence of near ten centuries, the republic was thus erazed from the list of nations. No people on earth, perhaps, have ever shown so much personal bravery as the Poles. Their whole history indeed is full of wonderful victories. But with such a vicious frame of society as we have already described, the most chivalrous valour, and the most splendid military successes, could avail nothing. It could not enforce obedience to the laws, nor maintain domestic tranquillity; it could not preserve the proud nobles from dissipation, nor prevent them from receiving bribes to repair their shattered fortunes; it could not restrain the powers which lavished the means of corruption from interfering in the affairs of the kingdom; it could not dissolve the union of these powers with the malcontents at home; it could not infuse vigour into a government corrupted by foreign gold, nor avert the invasion of foreign armies to support the factious and rebellious; it could not, while divided against itself, uphold the independence of the nations against foreign and domestic treason; in a word, it could not effect impossibilities, and though it might dazzle by its glory, it could not counteract those slow but sure-working causes which determined the inevitable doom of Poland.

This great crime committed with impunity.

The extinction of the Polish republic afforded ample scope for political declamation. The tribunes of France, the parliament of England, and the press of both countries, resounded with eloquent invectives against the perfidy and violence of the partitioning powers, and general sympathy was awakened in favour of a people whose great actions were entitled to admiration, whilst their misfortunes moved our commiseration. But complete impunity awaited the despoilers of that unhappy country. The troubled state of affairs throughout Europe did not permit any power to interfere in behalf of the oppressed. A selfish and shortsighted policy paralysed every arm, and chilled every heart. The great cause of public justice and national independence found no advocates, whilst the attention of all was absorbed in a narrow and confined struggle for their own preservation. The three potentates were therefore enabled to perfect their common wickedness without the slightest hindrance; to repress the indignant efforts of the sufferers; to crowd their prisons with the best and bravest, who had either distinguished themselves in the recent struggle, or had ventured to express dissatisfaction with the new state of things; to disarm the inhabitants of the great towns, and to establish formidable garrisons of foreign troops, who were ready to crush the very first attempt at insurrection.

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The Poles had no longer a country to fight for or defend; they had lost everything but honour and the feeling of revenge. They carried all they had left, namely, their valour, into the market, and soon entered into a compact with republican France. At Cracow was formed a secret confederation, the members of which offered to the French Directory to sacrifice their lives at the first call of the republic. Nor was this a vain or futile offer. Hundreds of the warlike nobles, escaping from bondage at home, proceeded to Venice or to Paris, and under Dombrowski, their brave leader, were formed Polish legions, in aid of the newly-created Italian republics, and ready to act wherever their services might be required. Their pay and subsistence were to be furnished by the Italian states; they preserved their national arms and dress; and, taking as their motto that all freemen are brothers, they fully participated in that daring spirit which then shook Europe to its centre. That they were allured by the prospect which had been held out to them of their country's restoration, is well known; and if their faith was rather the measure of their own ardent hopes than the result of any rational or well-grounded conviction, it may at least be pleaded in their favour, that the unfortunate are naturally credulous, and that a true Pole can never eradicate from his heart the belief that all his fondest wishes will one day be gratified. But be this as it may, their martial prowess contributed essentially to the success of the republican cause. Their number was increased by fresh recruits, which more than compensated the casualties of the field; their brilliant valour shone resplendent in every battle where they were engaged; patriotism and revenge alike nerved their arms for the conflict. But they soon had occasion to distrust the fair professions of the republican hero. When anxious, by his means, to preserve an entrance to the congress of Rastadt for a representative of Poland, they were coolly told that the hearts of all friends of liberty were for the brave Poles, but that time and destiny alone could restore them as a nation. Still they did not despair. If the day of regeneration was deferred, might it not yet arrive, perhaps at no distant period, when a more favourable conjuncture of circumstances would render it impossible for the French government any longer to evade urging their claims? Where justice, and freedom, and independence were concerned, they could not believe that fortune would always frown on their cause, or that iniquity in high places would secure for itself an immunity from all retribution.

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The connection of the Polish legions with France exhibits the same unvaried picture of gallant services performed, and of hope deferred. Their loyalty was sustained by a strong passion for military fame; to them the tent was their home, the battle-field their country; and though they suffered severely, particularly during the absence of Napoleon in Egypt, yet they repaired their losses with astonishing promptitude, and, in the year 1801, amounted to fifteen thousand. But their blood flowed in vain. In every treaty which their valour had been instrumental in winning, their services were overlooked, and their country was forgotten. In Italy and on the Danube, Generals Dombrowski and Kniaziewiez, with their legions, represented the Polish nation, and maintained its ancient renown in arms, though to little purpose, as far as regarded their country. For five years, their bravery proved unavailing, in as far as concerned the main object for which they had fought and bled.

But with the year 1806 new hopes began to revive. The

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brilliant campaign of that year, the simultaneous victories of Jena and Auerstadt, and the advance of the French army into Poland, seemed an earnest of future success, a sure pledge of approaching restoration. A general burst of enthusiasm followed. Polish regiments were organized with amazing rapidity, and the approach of Kosciuszko was proclaimed. On the 27th of November, Napoleon entered Posen in triumph; in December Warsaw received him with not less enthusiasm; a commission of government was immediately organized; and as his purpose was announced, his armies were recruited by thousands of the best troops in Europe. The battle of Eylau had been a mere butchery, unproductive of any result; but on the field at Friedland, Dombrowski had given signal proofs of his own talents and the valour of the heroes he commanded; and the opening of the negotiations at Tilsit was hailed by the Poles as the dawning of a bright and auspicious futurity. But the result proved that they had been far too sanguine in their anticipations. Napoleon in effect, though not probably in intention, betrayed them, and at the same time lost the opportunity of erecting a powerful barrier against the encroachments of Russia. Instead of restoring the kingdom of Poland in something like its ancient power and dimensions, he contented himself with forming a small portion of his conquests into the grand duchy of Warsaw, which he united with Saxony.

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The duchy of Warsaw, thus established, consisted of the departments of Posen, Kalisch, Plock, Warsaw, Lomza, and Bydgoszez, with a population somewhat exceeding two millions. With this shred and mockery of a country the Poles were highly dissatisfied. They had been taught to expect that the ancient kingdom, if not Lithuania itself, would become irrevocably their own; and their mortification may therefore be conceived on finding that Prussia was to retain several palatinates, that Austria was guaranteed in her Polish possessions, that the provinces east of the Bug were to remain in the power of Russia, and that a considerable portion of the ancient republic west of that river, as far as the department of Bialystok, was ceded in perpetual sovereignty to the czar. Still the establishment of this duchy was probably intended as a point of departure in a new order of things, the ultimate term of which should be the restoration of Poland. By the new constitution, the Catholic religion was declared to be the religion of the state; but ample toleration, and even a community of civil rights, were allowed to the Dissidents. Serfage was abolished. In the king of Saxony, as grand duke of Warsaw, was vested the initiative of all bills or projects of law, the selection of senators, the nomination of the presidents of the dietines and the communal assemblies, and the appointment of all officers, civil and military; and the Code Napoleon was subsequently admitted as the basis of all judicial proceedings.

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Something had thus been gained, though the arrangement was far from being satisfactory; indeed, by some the peace of Tilsit was regarded as the grave of all their hopes. But the greater number, reposing an unexhausted faith in the justice of their cause, consoled themselves with the belief that eventually Poland would be recalled into political existence, and her independence re-established upon a sure foundation. Accordingly, in the war with Austria in 1809, they rendered the most important services to Napoleon. They conquered Gallicia, without the smallest aid from France; they reduced Cracow and the adjoining territory; they regained possession of the capital, which the archduke had temporarily occupied; and they humbled their enemies on every side. What their own arms had won, they conceived that they had a right to retain, and they regarded as inevitable the incorporation of these conquests with their infant state. But they were destined to be speedily undeceived. Not a foot of ground were they allowed to retain in Gallicia; and half of their other conquests between the capital and the Austrian frontier was wrested from their hands. Four departments were indeed incorporated with the grand duchy, viz. Cracow, Pradom, Lublin, and Siedlec. This acquisition, however, afforded but a small compensation for the sacrifices which had been made, the forcible loans which had been raised, the lives which had been wasted, and the misery which afflicted every class of the inhabitants. In truth, the policy pursued by Napoleon in regard to the Poles bore traces of doubt and hesitation; it was always timid, seldom judicious, never generous. He had not the courage to break through the entanglements of diplomacy, by which his inclinations were fettered, and to do a great act of retributive justice, leaving the consequences to Providence. He suffered himself to be paralyzed by conflicting pretensions, and sacrificed his own glory to conciliate powers who took the earliest opportunity of betraying him.

Invasion of Russia in 1812.

Nevertheless, when the war with Russia became inevitable, Napoleon, with the view of interesting the Poles in his behalf, had recourse to all the arts of popular excitement, and, strange as it may seem, with his usual success. The more reflecting portion, wearied out and disgusted, refused to be again deluded. "We are flattered when our services are required," said they. "Is Poland always to be fed on hope alone?" The mass, however, swayed by their feelings, listened to the representations of the imperial agents, and a great body of Poles took the field, whilst a general confederation of nobles declared the republic restored, the declaration being signed by the king of Saxony, in whose house the hereditary monarchy was to be vested. But the enthusiasm thus excited proved short-lived. The reply of Napoleon to the Polish deputation, which had followed him to Wilna, at once dissolved the spell, by showing the deputies that he had guaranteed to the Emperor Francis the integrity of the Austrian possessions in Poland. Illyria therefore could not, as they had hoped, be exchanged for Gallicia; and as to Lithuania, Napoleon not only considered, but even proclaimed it a hostile country, and treated it accordingly. But still the deputation erred egregiously in giving up all for lost. Everything depended on the success of the expedition, which would have enabled Napoleon to give the law to Austria as well as to Russia; and hence, when he exhorted them to fight for their own independence, and assured them that if all the palatinates combined they might reasonably expect to attain their object, he gave them advice which they would have done well to follow. At a moment so critical he could not give Austria a fair pretence for betraying him on the occurrence of the very first reverse; this would indeed have been the height of folly in one who had risked everything upon the issue of a single campaign. But, on the other hand, the success of the expedition must have proved highly beneficial to Poland; and, in chilling the national enthusiasm at this time, the deputation were innocently instrumental in inflicting the greatest evils on their unhappy country.

Results.

This is not the place to dwell on the unexampled disasters of the Russian campaign, which were greatly aggravated by the apathy of the Poles, and their refusal to co-operate in covering the retreat of the French army. The details are in the memory of all. The work of Napoleon was destroyed; the grand duchy of Warsaw ceased to exist; the king of Saxony was stripped at once of it and of a portion of his hereditary dominions; the allied, who were also the partitioning powers, again took possession of the towns which they had held previous to the invasion of Napoleon; and in this state matters remained, awaiting the meeting of a congress, which was to assemble to decide, amongst other things, the fate of this unhappy country.

Treaty of Paris. Poland.

The negotiations which commenced with the downfall of Napoleon, and were completed by the treaty of Paris in 1814, necessarily embraced the future condition of Poland, which, though then occupied by Russian troops, had from previous cession to France become a fit subject of arrangement, not for the eventual benefit of Russia alone, but for that of the whole European commonwealth. Public opinion, the interests of rulers, and the sympathies of the governed, were all in favour of the re-establishment of the kingdom in its ancient integrity; and the side of justice, policy, and humanity was powerfully advocated by France and England, whose ministers regarded the Polish question as one in comparison of which all others were of but secondary importance. But neither of these powers, nor both of them united, were in a situation to control the views of those interested in maintaining the state of things created by the successive dismemberments of Poland. France, exhausted by long wars, and now restricted within her ancient limits, had no longer a voice potential in the decision. Britain, with the right of remonstrance, which her minister freely exercised, was in no condition to brave two great military powers; and although Austria not only expressed a desire for Polish independence, but a readiness to surrender part of her Gallician provinces in order to endow the new kingdom, yet all this might have been easily counteracted by the predominant influence of Russia and Prussia. At that period, indeed, the Emperor Alexander displayed or affected a spirit of liberality, which appears to have owed its origin to various circumstances; but whether he was sincere or the contrary, "an accident," as Madame de Stael described him, or merely the impersonation of hypocrisy and perfidy, it was certain the genius of the Russian system would govern the ultimate determinations of his policy on a subject of so much importance to his empire.

The kingdom of Poland.

At this juncture, however, Napoleon escaped from Elba, and the whole question assumed a new phasis. In the common danger, Poland was scarcely remembered; and the czar, finding that his aid would be indispensable in the approaching contest, was enabled to insist on a measure which he had long contemplated, namely, the union of the grand duchy with Russia as a separate kingdom. The facility with which he carried his object proves the alarm that had been occasioned by the re-appearance of Napoleon, and the anxiety felt to adopt any measure calculated to prevent Polish partisanship from swelling the ranks of the invader. It was therefore decided that the grand duchy of Warsaw should be attached to the empire of Russia, under the name of the kingdom of Poland, and that it should be governed by separate institutions. "The duchy of Warsaw, with the exception of those provinces and districts which are otherwise disposed of, is united to Russia. It shall be irrecoverably bound to the Russian empire by its constitution, to be enjoyed by his majesty the emperor of all the Russias, his heirs and successors, for ever." Such are the expressions employed in an article relating to this point in the treaty of Vienna. The two sovereignties were united by the constitution alone, and not otherwise. This was the connecting link which bound them together. Austria and Prussia acceded to a similar arrangement, and also agreed to confer on their Polish subjects a national representation and national institutions. The concessions required by public opinion were made, and certain bases were solemnly sanctioned by the treaty of Vienna.

Bases of the union between Poland and Prussia.

These were four in number. In the first place, Gallicia and the salt-mines of Wieliczka were restored to Austria. Secondly, the grand duchy of Posen, forming the western palatinates bordering on Silesia, and containing a population of about eight hundred thousand souls, was surrendered to Prussia; which power was also confirmed in the conquests made at the period of the first partition. Thirdly, the city and district of Cracow, about twenty geographical miles in extent, and containing a population exceeding an hundred thousand souls, was formed into a free and independent republic, under the guarantee of the three powers. Fourthly, the remainder of ancient Poland, comprising the chief part of the recent grand duchy of Warsaw, with a population of about four millions, reverted to Russia, and was to form a kingdom irrecoverably bound, by the constitution which the czar had engaged to confer upon it, to the Russian empire. "The kingdom of Poland," said the Emperor Alexander, "shall be united to the empire of Russia by the title of its own constitution, on which I am desirous of founding the happiness of the country." Thus a part of Poland was re-established as a separate state, by the act of all the powers of Europe; and although the emperor of Russia was to be king of that state, still the independence and separate existence of the kingdom were not only recognised in the fullest manner, but at the same time solemnly guaranteed.

The tution charte

The new kingdom of Poland was proclaimed on the 20th of June 1815, and on the 24th of December following a constitutional charter was granted to the Poles. The articles of this charter, by which Poland became united to Russia, were of so liberal a nature as to astonish all Europe. According to some, they prove that, at the time of their promulgation, Alexander was no enemy to liberal institutions. But the more probable supposition seems to be, that the earnest and loyal interposition of Great Britain and France, favoured by the declared disposition of Austria, and strengthened by the public opinion of Europe, had more effect on the mind of the czar than any presumed inclination towards liberal institutions, of which he afterwards became the most uncompromising opponent. The principle articles, which are now only matter of history, were as follow.

The p pal ar of this ter.

The Catholic religion was declared to be the religion of the state; but all dissidents were placed on a footing of perfect equality as to civil rights, with the professors of the established faith. The liberty of the press was recognised in its fullest extent. It was provided that no subject could be arrested prior to judicial conviction. The inviolability of person and property was, in the strictest sense, guaranteed. All public business was to be transacted in the Polish language; and all offices, civil or military, were to be held by natives alone. The national representation was to be vested in two chambers, one of senators and another of deputies. The power of the crown was not greater than seemed necessary to give due weight to the executive. All kings of Poland were to be crowned at Warsaw, at the same time swearing to maintain the full observance of the charter; and during the absence of the sovereign for the time being, the chief authority was to be vested in a lieutenant and council of state. The great public departments of the state were to be presided over by responsible ministers. The legislative power was vested in the king and the two chambers; an ordinary Diet to be held every two years, and to sit thirty days, and an extraordinary Diet to be convened whenever this should be judged necessary by the king. No member of the Diet could be arrested during a session, except for great offences, and not even then without the concurrence of the assembly. The deliberations of the Diet extended to all projects submitted to it by the ministry, affecting the laws and the whole routine of internal administration. The deliberations of the Diet were to be public, except when committees were sitting. All projects of law originated with the council of state, and were laid before the chambers by order of the king; such projects, however, being previously examined by committees of both houses. In the case of all projects or bills, the majority of votes was to decide. The senators were to be nominated by the king, and to exercise their functions during life. The deputies, a hundred and twenty-eight in number, were seventy-seven for as many districts, and fifty-one for communes, or about double the number of senators. To become a member of the second or lower chamber, the qualifications were, citizenship, the age of thirty, possession of some portion of landed property however small, and the payment in annual contributions to the state of a hundred Polish florins. No public functionary was eligible to a seat without the consent of the head of his department. The nobles of each district were to meet in dietines for the purpose of electing one of their body to the general Diet, and returning two members to the palatine assemblies, all dietines being convoked by the king. The class of electors was numerous, comprising, first, all landowners, however small, who paid any contribution towards the support of the state; secondly, every manufacturer or shopkeeper possessing a capital of ten thousand florins; thirdly, all rectors and vicars; and, lastly, all artists or mechanics distinguished for talent. The electors required to be enrolled, and to have attained the age of twenty-one years. The tribunals were to be filled with judges partly nominated by the king, and partly elected by the palatinates; the former being appointed for life, and removeable only for misconduct, or judicial iniquity, in the discharge of their functions.

Re erks th on.

Such were the principal provisions of the charter which was thus conferred on the Poles, and received by them as the first instalment of that restitution which they hoped would one day be made effectual and complete. Its greatest defect consisted in the incompetency of either chamber to propose laws, the initiative being confined exclusively to the executive, or the king and the council of state, and an effectual check thereby applied to legislative amelioration. Nor was any provision made in the charter for the establishment of trial by jury, an institution which, however suitable to our habits and modes of thinking, may not have been equally so to those of the Poles. But it is nevertheless certain that Alexander, on his return from witnessing the prosperity of this country, which he attributed in part to our judicial system, ordained the establishment of trial by jury throughout Poland within six months; being in this carried by mere impulse, without any regard to the fitness or unfitness of the institution to the wants, habits, and prejudices of the people amongst whom he proposed to naturalize it. It is not thus that national benefits are really conferred, or that new systems can ever be advantageously introduced.

Pe lly of R a. Co tan- ti

From the re-establishment of the kingdom in 1815, until the year 1820, the affairs of Poland were conducted apparently in conformity with the constitution. The benefits of the government had to a certain extent disarmed the prejudices and antipathies of the people; the opposition to ministers in the lower chamber was comparatively trifling; the emperor's lieutenant, Count Zayonczek, a Pole, endeavoured to attach the Poles to his sway; and Alexander, congratulating himself on the liberal policy which he had adopted towards his new subjects, declared in full senate at Warsaw, that he only waited to try the effect of the free institutions he had given them, in order to extend those institutions over all the regions which Providence had placed under his sway. But all this fair promise proved hollow and deceptive. From the very first there had been perpetual breaches in the constitution; and after the Spanish revolution of 1820, followed as it speedily was by the establishment of the Holy Alliance, all disguise was thrown aside, and an attempt made to suppress entirely the spirit of national independence in Poland. Count Zayonczek was only nominally the king's lieutenant. The real power was invested in the Grand Duke Constantine, who held the appointment of commander-in-chief of the army. This personage, who played so conspicuous a part in the affairs of Poland, is deserving of notice, in consequence of the position in which he was placed. Although possessed of considerable talents, he was, in fact, an untamed tiger, giving way on all occasions to the most violent paroxysms of passion. He had a strong sense of the rights of his order, and held as nought the feelings of every other class. As soon, therefore, as he found that his brother was no longer the liberal patron of constitutional rights, he gave the most unrestrained license to his natural violence and caprice. The outrages ascribed to him display a mixture of ferocity, cruelty, and cowardice, altogether unparalleled. With him no right was respected, and no condition safe. Females were insulted, abused, sometimes kicked; shaving the heads of such women as displeased him was a common occurrence; and to this was added tarring and feathering, a favourite recreation of the commander-in-chief, whose delight it was to witness these barbarities. He kept in his employment a legion of spies; and the liberty or life of every man was at the mercy of a common informer. With him suspicion was a sufficient warrant to exclude the proof of innocence, and accusation led at once to conviction.

Political tyranny superadded to private oppression.

But whilst acts of private oppression were calling forth all that hatred of Russia which is the birthright of every Pole, political tyranny was superadded, as if it were desirable to concentrate upon one point the entire indignation of a brave and devoted people. The liberty of the press was abolished, and a censorship established, in violation of article sixteenth of the constitutional charter. This was effected by an ordinance dated the 31st of July 1819; and not long afterwards the patriotic association formed by General Dombrowski, who had modelled it almost after the recommendation of Alexander, was suppressed, and a military commission appointed, which tried and condemned civilians without any of the prescribed formalities. "What have we to hope," exclaimed Dombrowski; "what have we not to fear? This very day might we not tremble for the fate which may await us to-morrow?" Meanwhile, the secret police pursued its fatal career, and arbitrary arrests, followed by hidden condemnations, the banishment of many and the imprisonment of more, signalized its hateful activity. The university of Wilna was also visited with severity by the agents of this dreaded institution. Twenty of its students were seized, and subjected to different punishments. Nor were those of Warsaw treated with greater leniency. A state-prison was likewise erected in the capital, and its dungeons were soon crowded with inmates, victims of the execrable system adopted by the government. Nor were these the only grievances of which the people had reason to complain. Although the constitutional charter had provided that Russian troops, when required to pass through Poland, were to be maintained at the sole charge of the Russian treasury, yet for years they had been stationed at Warsaw, and paid by the inhabitants of the capital, whom they were employed to overawe. Further, independently of the violations of individual liberty, the difficulty of procuring passports, the misapplication of the revenue to other objects than those for which it had been raised (as the maintenance of the secret police), and the nomination of men as senators, without the necessary qualifications, or any other merit than that of being mere creatures of the government, were infractions of the charter as wanton as they were intended to be humiliating. But the worst of all yet remains to be told. In the dietines Russian money and influence were unblushingly employed to procure the return to the general Diet of such members only as were known to care less for the honour of their country than the advancement of their own fortunes. Instead of a Diet being held every two years, in accordance with article eighty-seventh of the charter, none was convoked from 1820 to 1825, and only one from the year 1825 until after the accession of Nicolas in 1829. Finally, an ordinance issued as early as 1825 had abolished the publication of the debates in the two chambers; and on one occasion, the most distinguished members of opposition were forcibly removed from Warsaw the night preceding the opening of the Diet. Add to all this the constant irritation produced by the ungovernable temper and consequent excesses of Constantine; the useless but vexatious manœuvres he introduced into the army; his rigorous mode of exercise, exceeding the ordinary measure of human strength and endurance; his overbearing manner towards the best and highest officers in the service; and, above all, that progressive increase in cruelty which a regimen of terror presupposes and almost necessitates: take these matters into consideration, along with all the other circumstances of grievous oppression which have already been stated as affecting the mass of the people, and it will easily be seen that it was vain to whisper peace, and that the grand duke was treasuring up to himself wrath against the day of wrath.

Universal discontent. Favourable moment for rising lost. Revolution of Paris, July 1830.

It has been matter of some surprise to foreigners that the Poles did not take advantage of the Russo-Turkish war to erect the standard of independence. The reverses experienced by the Russian army on the Danube in the campaign of 1828, were so great, that an insurrection in Poland at that critical and perilous moment would have had almost every chance in its favour. But at that period the plan of the Poles had evidently not been matured. That it was even so in November 1830 may reasonably be doubted. In fact, no preparations seem to have been made, and when the explosion actually took place, it was wholly unexpected by the leading patriots, who conceived that the propitious moment had not yet arrived. At the same time it must be confessed, that the French Revolution of July 1830 produced an almost electric effect on the whole Polish nation, and, by its daring character and its splendid success, disposed the initiated to anticipate the time for a general rising. Besides, it is generally believed that emissaries from Warsaw had held confidential meetings with the leaders of the Revolution of July, and were instigated to rouse their countrymen by the promise of immediate aid from the government of the citizen king; and that such aid was confidently relied on by the Polish patriots themselves, must be known to all who have conversed with those who acted a prominent part in the national insurrection, and seems to be further confirmed by the universal impression of the people. Two other circumstances also contributed to accelerate the catastrophe. The army began to entertain a notion, not altogether unfounded, that it was to be removed to the south of Europe, to assist in extirpating freedom in France and other countries; and that its place was to be supplied by a native Muscovite force. The students of the military school likewise found ample cause of apprehension in the previous arrest of several of their number, upon suspicion of being connected with secret associations, which had for their object to promote a general rising. The repugnance of the army to the service intended for them; the apprehensions of the students, who had everything to fear from the grand duke, should he try their companions by martial law, as he had threatened to do, and most probably meditated; the conviction that the whole populace of the capital were friendly to the project of an insurrection; the secret encouragement held out by France; the eagerness of the enterprising to court danger for its own sake; the number of those who had personal wrongs or insults to avenge; and, lastly, the presumed, or rather the certain, approbation of the free in all countries towards the insurrection itself, if not towards the time and the circumstances: all these, therefore, concurred to hasten the opening of the great tragedy, the enacting of which all Europe regarded with such deep and thrilling interest.

The first object of the actors in this enterprise was to seize the person of the grand duke, their most obnoxious enemy, and to detain him as a hostage for their own safety in the event of failure. The students of the military school were the voluntary leaders of the movement, which burst forth on the 29th of November 1830. Early in the evening of that day, several of them repaired to their barrack, in accordance with a preconcerted plan; and having addressed their comrades, summoned them to take up arms. The call thus made was instantly obeyed. On their way to the residence of Constantine, who had established himself at the palace of Belvedere, in the outskirts of the city, their number was increased by the students of the university, and the young men attending the public schools. Constantine had no troops about his residence, but at a short distance from it were the barracks of three regiments of Russian guards. The hour chosen for the attack was seven o'clock, and at that time the assailants proceeded to the bridge of Sobieski, where the main body posted themselves, whilst some of the most determined pressed forward to complete their object. They forced their way into the palace, where they were first opposed by the director of the police, Lubowidizki, who, on being wounded, took to flight. Next they encountered the Russian general, Gendre, a man obnoxious for his cruelties and crimes, who was killed in the act of resisting. Lastly, when on the point of reaching the bedchamber of the grand duke, whom the alarm had just awaked from his evening siesta, they were stopped by a valet, Kochanowski, who, closing a secret door, thus enabled his master to escape undressed through a window. Constantine fled to his guards, who instantly turned out. Disappointed in their prey, the devoted band rejoined their companions at the bridge of Sobieski, where they had been awaiting the result of the attack on the palace. On finding that their first object had failed, they now resolved to gain the city, and at once proclaim a general insurrection. Their retreat was opposed by the Russian guards, close to whose barracks it was necessary to pass. But such was the spirit which animated them, such were the skill and courage they displayed, that they killed three hundred of their opponents, and triumphantly effected their retreat. On reaching the city, they instantly liberated every state-prisoner, and were joined by the school of engineers and the students of the university. A party entered the only two theatres which were open, calling out, "Women, home; men, to arms." Both requisitions were instantaneously complied with. The arsenal was next forced, and in less than two hours from the first movement, so electrical was the cry of liberty, forty thousand men of all descriptions were in arms. The sappers and the fourth Polish regiment declared early in favour of the insurrection; and by eleven o'clock the remainder of the Polish troops in Warsaw, with the exception of two regiments of guards whom Constantine had forced along with him, espoused the popular cause, declaring that their children were too deeply compromised to be abandoned. Never perhaps was any popular movement more universal or more triumphant.

By the morning of the 30th of November the commotion had subsided, and the results could be calmly surveyed. Besides the troops of the line which had joined the patriots, nearly thirty thousand citizens had taken up arms, and now swelled their dense ranks. In twelve hours the revolution had been begun and completed. In vain did the grand duke, who lay without the walls, meditate the recovery of the intrenchments and fortifications. His isolated though desperate efforts to re-enter the city were repulsed with serious loss; and finding it hopeless to contend with the mass opposed to him, he not only desisted from all further attempts of the kind, but removed to a greater distance from the walls. In the excitement consequent on this extraordinary commotion, no one will be surprised to learn that, notwithstanding the regularity with which every part of it was conducted on the part of the principal actors, some excesses were committed. But these were neither many in number nor aggravated in character; and although some Russians lost their lives, as did also several Poles, who were known to have been on terms of intimacy with Constantine, yet these men courted their fate by recklessly intermingling amongst an excited population when their passions were inflamed by the heat of battle, the tumult of victory, and the feverish excitement of revolution.

The functionaries of the government having abandoned their posts, an administrative council was immediately form-story.

ed to preside over the destinies of the new state. It consisted of men distinguished for their talents, their character, or their services, and numbered amongst its members Czartoryski, Radzivil, Niemcewicz, Chlopicki, Pac, Kochonowski, and Lelewel. But no good resulted from this heterogeneous assemblage of persons professing moderate and ultra opinions, or what may be called Whigs and Radicals. The former were not men made for revolutions, though in this instance they obtained the direction of the movement; and, in the hope of accommodation, which, from the first, was desperate, they allowed the grand duke to retire under a convention, when they might have captured his entire army, and detained himself as a hostage. At first they evidently entertained no intention of throwing off their allegiance to the czar. All their proclamations ran in his name, and their claims were confined to a due execution of the charter. On the part of the provisional government, however, this seems to have been the very excess of weakness. Men who engage in revolutions, if they hope or wish to succeed, should, when they draw the sword, throw away the scabbard. Besides, as nothing less than unconditional submission would gratify the czar, it is obvious that negotiation was at once a waste of time, and a confession of indecision. The next blunder of the council was in the opposite direction. As their patriotism appears to have risen with their success, they at length insisted on the incorporation of Lithuania, and the other Polish provinces subject to Russia, with the kingdom; and, as if this had not been enough, they some months afterwards declared the throne vacant, an act which, upon their own principles, was equally rash and impolitic. But, what was worst of all, they lost precious time. The force of the first impulsion was wasted. The great and sudden outburst of national enthusiasm was allowed to exhaust itself. Russia had been braved at a time when all her energies might be concentrated to enforce submission; when neither foreign war nor domestic disturbance distracted her councils or divided her means; yet, so far from profiting by the only advantage resulting from the wild improvisation so rapidly nationalized, the provisional government acted as if their sole object had been to forego the chances which the national movement had, in the first instance, accumulated in their favour.

But all these errors were nobly redeemed. When it appeared that negotiation was vain, and that nothing but unconditional submission would satisfy the czar, they gallantly prepared themselves for the unequal struggle. Their plans were evidently not matured. Neither from Lithuania, nor from any of the other Polish provinces incorporated with Russia, did they receive the aid on which they had relied; yet the honours of the first campaign were exclusively their own. Their efforts were stupendous, and their bravery was worthy the age of Boleslas and Sobieski. The laurels which Diebitsch Zabalkanski had reaped in his campaign against the Turks, protected by mountains and fortresses, were blighted and withered in the plains of Poland. On the 25th of February 1831, his dense masses, first brought into contact with the patriotic forces at Grochow, recoiled from the shock, after one of the most unequal and sanguinary conflicts of modern times. March was illustrated by the victories of Dembewielki and Wawr; and in May was fought the celebrated battle of Ostrolenka, where, after performing prodigies of valour, the Polish army retired from the field, unpursued, towards Modlin. In the mean time, Diebitsch had perished, the victim of disease, chagrin, and fatigue. Paskewitsch, distinguished by his Armenian campaigns, succeeded, and, following the example of his predecessor Suwarof, concentrated all his means for an attack on the capital. On the 5th, 6th, and 7th of September was fought the ever-memorable battle of Warsaw, which ended in the defeat of the patriot forces, and the loss of that city, after a struggle unparalleled in history. This blow proved decisive. European interference had been hoped for, but in vain; the faith of treaties had been appealed to without effect; the interests and the sympathies of the civilized nations of the west and the south had been invoked to no purpose. A powerful force still remained, and, for a time at least, a partisan warfare might have been carried on; but thus abandoned to its own resources, Poland must at last have yielded to her gigantic antagonist. That country had no mountain fastnesses, where her children, when overpowered by numbers, might take shelter; it had no fortresses capable of arresting and breaking the force of her assailants. Nothing could have saved her but a prompt and active interposition, founded on the treaty of Vienna; and such was the situation of France and England at the time, that neither judged it safe or expedient to interfere, otherwise than by remonstrance. What then remained, but the miserable alternative of submission or annihilation?

The Poles did submit. With reluctance they laid down those arms, which they had taken up in the hope of reconquering their national independence, and which they had so gloriously employed in many a hard-fought field. But all former experience of Muscovite vengeance could scarcely have prepared them for the miseries which have since been accumulated, in new and fearful forms, on their unhappy country. To say nothing of proscription and confiscation, her plains have been covered with ruins, her resources exhausted, her industry and commerce destroyed; abundance has given place to wretchedness and want; the countenances of her children, once so happy, are now wan, squalid, and despairing; she has no longer a name or a place amongst the nations; her language, her literature, and her history cannot any more be publicly taught in her schools; terror reigns throughout all her borders; and the victorious czar, using the utmost license of success, has even attempted to break down the ineffaceable distinctions of race, in the hope of destroying that sentiment of nationality which is part of the inheritance of every Pole. And all this has been done, or is now doing, in the face of the public guarantee of the powers of Europe, if not without remonstrance, at least without any effectual opposition, and with a systematic perseverance and determination which in time must produce a marked and decisive change in the national character of the people.

The history of the little republic of Cracow forms an appropriate sequel to that of the unhappy kingdom of Poland. That small state, created by the treaty of Vienna, and having its independence guaranteed by the same general compact, enjoyed the constitution which had been conferred on it by the three powers, until the year 1835, when, on the most frivolous pretences, it was occupied by the troops of these powers. A greater outrage against every principle of public law or public faith was never probably perpetrated. But, as in the case of the kingdom of Poland, the crime has been committed with complete impunity; and we are now given to understand that the military occupation of the republic is to be followed by its dissolution, and the last remnant of Polish independence thus annihilated. This proceeding needs no comment expository of its real character. It is an act of naked despotism, done in defiance of the other powers of Europe, and in open contempt of the most sacred principles of public law and public justice.

STATISTICAL VIEW OF POLAND.

Population.

Population.

The valuable work of Mr Stanislas Plater, published at Posen in one volume octavo, under the title of *The Geography of the East of Europe*, gives the best and most elaborate statistical description of all parts of the ancient kingdom of Poland that has yet appeared. There have been

Population.

more recent works (Mr Plater's having appeared in 1825), but we are not aware of the existence of any on which the same reliance can be placed. It is accordingly from it that the following particulars have, in a great measure, been compiled.

1. In West Prussia, formed by the first partition of Poland under Frederick II., we find, on a space of 400 square Polish miles, a population of 700,000 inhabitants, viz. 350,000 Poles, 330,000 Germans, and 20,000 Jews; of whom 320,000 are Catholics, 350,000 Protestants, 20,000 Israelites, and 10,000 Menonites. West Prussia is divided into two subdivisions; that of Dantzig, which contains eight districts, and that of Marienwerder, which comprises thirteen.

2. The grand duchy of Posen, as it now exists, with the boundaries of the surrounding states as fixed by the treaty of Vienna, contains, on 540 square miles, a population of 980,000 inhabitants, viz. 640,000 Poles, 270,000 Germans, and 70,000 Jews, of whom 580,000 are Catholics, 330,000 Protestants, and 70,000 Israelites. The grand duchy of Posen is divided into two subdivisions; that of Posen, which includes seventeen districts, and that of Bromberg, comprising ten districts.

3. The kingdom of Gallicia, as at present annexed to the Austrian dominions, on a space of 1500 square miles, contains 4,000,000 inhabitants, viz. 1,700,000 Poles, 1,800,000 Rusniaks, 150,000 Walaques, 50,000 Germans, and 300,000 Jews, of whom 1,480,000 are Catholics, 2,000,000 Greek Catholics, 200,000 Russo-Greeks, 20,000 Protestants, and 300,000 Israelites. The kingdom of Gallicia is divided into nineteen districts.

4. The republic of Cracow, whilst it existed, contained, on a space of twenty square miles, a population of 120,000 inhabitants.

5. The kingdom of Poland, as established by the treaty of Vienna, contained, on a space of 2270 square miles, a population of 4,128,289, of whom 3,440,357 were Roman Catholics, whilst the remainder, 787,930, belonged to other religions. Of these, about 3,000,000 were Poles, 200,000 Lithuanians, 100,000 Rusniaks, 300,000 Germans, and 400,000 Jews. The population of the towns is to that of the country as one to five; in other words, there live in villages 3,200,000, and in towns 887,000. This kingdom was divided into eight palatinates, thirty-nine circuits, and seventy-seven districts.

6. Russian Poland, comprising Lithuania, Samogitia, White Ruthenia, Volhynia, Podolia, and Polish Ukraine, contains, on a surface of 7600 square miles, 8,800,000 inhabitants, viz. 700,000 Poles, 880,000 Lithuanians, 5,520,000 Rusniaks, 180,000 Russians, 50,000 Tartars, 120,000 Lettons, 50,000 Moldavians, and 1,300,000 Jews; of whom 2,400,000 are Roman Catholics, 1,640,000 Greek Catholics, 3,233,000 Russo-Greeks, 180,000 Raskolniks (old Russian sectaries), 50,000 Mahommedans, and 1,300,000 Israelites. Russian Poland is divided into the governments of Wilna, Grodno, Minsk, Volhynia, Podolia, Kiow, Mohilew, Witebsk, and the province of Bialystok, comprising four districts.

7. Courland and Semigallia, an integral part of the republic of Poland until the epoch of its dismemberment in 1795, forms, in the actual political state of the Russian empire, the government of Courland, which, on a surface of 450 square miles, contains 600,000 inhabitants, and comprehends ten districts.

It thus appears that, on a surface of about 13,000 Polish square miles, there is a population exceeding 20,000,000. But a much higher estimate is given in the *Polish Monthly Magazine*, which states the superficial extent of Poland at 28,276 geographical square miles, and the population at 33,962,235, or nearly 14,000,000 more than the number above mentioned. The latter, however, so far exceeds every other estimate we have seen, that there is reason to believe it to be greatly exaggerated.

From the numerical statements above given, we find, that no inconsiderable portion of the population of Poland consists of Jews. Their first settlement in that country took place in the tenth century, when they removed thither from various parts of Germany and Bohemia, to escape persecution. In 1264 Boleslas II. granted to them a charter, which was afterwards renewed and greatly amplified by Casimir the Great. Their treatment has varied according to the temper of the times, the character of the reigning sovereign, and the degree of hatred borne towards them at particular periods. But the circumstance which has most surprised the Poles is the numerical increase of this people, whose fecundity, compared with that of Christians, is said to be as two or even three to one. Sigismund Augustus was astonished at this fact; and other sovereigns have been apprehensive that they would in time outnumber the Christian population. It has always been the policy of the Jews to conceal their numbers, by every means in their power; and it seems quite certain that every return yet obtained is much below the truth. There is no trade too vile, or even too dangerous, for a Polish Jew, provided he can profit by it. In 1806 and 1812, they were hired as spies of the French and Polish armies; and they are charged, we fear on good grounds, with betraying their employers whenever they found it their interest to do so. To the Russians, whom they were employed to watch, they rendered far more signal services than either to the French or the Poles; and their perfidy in this particular is believed to have greatly aggravated the disasters of the retreat from Moscow. The amazing fecundity of the Jews has been ascribed to their early marriages; most of them being parents at a very early age, and grandfathers before many Englishmen even think of marrying. But it may very reasonably be doubted whether early marriages are favourable to population; though there can be no question, that one consequence resulting from them is the deterioration of the offspring. In Poland, the proportion they bear to Christians is viewed with alarm, because they are not producers, but live on the produce raised by others; and it is loudly proclaimed by all the native writers, that they have been a curse to the country.

Commerce and Agriculture.

Commerce and Agriculture.

The insignificance of the actual commerce of Poland is no doubt owing to her political position. In former times, the natural resources of the country, and liberal commercial regulations, opened a wide field for the activity and enterprise of foreign merchants. During the fourteenth, fifteenth, and sixteenth centuries, Poland not only carried on a lucrative commerce with the Levant, the Black Sea, and the Mediterranean, and maintained a commercial intercourse with the Italian republics, particularly Venice; but she also exported her corn and other raw materials to the western countries of Europe, especially Holland, Sweden, and Denmark, and formed an entrepôt of oriental merchandise for the northern part of Germany and the countries adjoining. Owing to their commercial activity, Cracow and Dantzig were at an early period admitted into the Hanseatic League.

Besides wood, flax, tallow, and some other products, corn has always been the principal article of export. According to Cellarius, who wrote in the sixteenth century, the amount of corn exported in one year was 10,950,000 korzec, or 4,380,000 English quarters. Opalinski, a writer of the seventeenth century, states, that in his time, Dantzig alone received from the interior of the country more than 6,000,000 korzeg, or 2,400,000 English quarters, of different kinds of grain for exportation. The importation of foreign produce was of course proportioned to the exportation of home produce; and it was abundantly supplied to Poland both by national and foreign bottoms. Holland and Venice were extensively engaged in trade with this country. But with the political misfortunes of Poland its commercial importance declined; and its destruction has been completed in consequence of the system of monopoly pursued by the governments of Russia, Prussia, and Austria. In that part of Poland which is under the dominion of Russia, the consumption of every article of foreign produce is strictly prohibited, and every branch of industry is discouraged; whilst the governments of Austria and Prussia overwhelm their Polish subjects with disproportionate taxes, in the hope of thereby retaining them in more complete subjection. The consequence is, that the farmers have no motive or interest to produce more grain than they require for their own consumption; and hence, if any unforeseen contingency should occur, a famine must ensue. During the last few years this has actually happened in some parts of Volhynia, Podolia, and the Ukraine; countries the soil of which is perhaps the most fertile of any in Europe.

The trade of Poland is at present almost entirely in the hands of Jews and Russians. The exportation of corn, flax, wood, or any other article, whether by the Baltic or the Black Sea, can only be effected by these two classes, who, from the condition of the country, possess an entire monopoly, and being often directly assisted by the government, can fix any price which they deem proper to exact. And as regards importation, no produce can be introduced into Poland, except from Russia, Prussia, or Austria, or after having paid a transit duty amounting to a prohibition. Thus the part of Poland under the dominion of Russia must receive from the Russian manufacturer calicoes and all other cotton goods, beet-root sugar, cutlery, glass-work, paper, tea and coffee, salt (which is obtained from the Polish salt-mines of Wieliczka, now in the possession of Austria, but the trade in this article is, in Russian Poland, a monopoly held by the government), salt fish, and other articles. The case is precisely the same in those parts of Poland which are respectively under the dominion of Austria and Prussia. Every English or French article, and all colonial produce destined for Poland, is subject to a heavy transit duty at Dantzig, at Odessa, or on the Austrian frontier.

Poland has never been, and never will be, a great manufacturing country. Her natural resources consist in the produce of her soil, and her commerce in exchanging these for the cheaper and superior manufactures of other countries. With more than 80,000 square miles of fine wood; with the richest mines of salt Europe possesses at Bochnia and Wieliczka; with the fertile plains of the Ukraine, Podolia, Volhynia, and Landomierz, with the flax of Samogitia, so much employed in the English manufactures, the wool of Great Poland imported into Saxony, fine cattle and horses, abundance of tallow and other products; Poland possesses resources which leave no doubt that, under a good government, she will one day become, not indeed a manufacturing, but certainly one of the most commercial nations of Europe.

Literature and Science.

Before the introduction of Christianity, in the ninth century, the Polish language could boast of numerous traditional tales, warlike songs, and pastoral poems, which have been collected by Wodrich, and show that this language, having already attained to some degree of perfection, had consequently taken the lead of almost all the other Sclavonic idioms. It is no doubt true that the introduction of Christianity at first retarded the natural improvement of the language, by an admixture of foreign terms; but it enlarged and purified the ideas of Polish writers, and opened a new and attractive field for their talents and genius. It may appear surprising to some, that from the ninth till the end of the sixteenth century, Poland should have produced such a number of writers in the native idiom and in Latin; especially considering the continual wars in which she was engaged for the defence of her frontiers. But the wonder will cease when it is known that schools and colleges were then thrown open to every one; that education was eagerly sought after and freely imparted; that the order of St Benedict, assisted by other religious communities, devoted their whole time and attention to the gratuitous education of every class, implanting in all a love of science and literature, a taste for the arts, a knowledge of the classics, and an affection for the muses; and that, under these same orders, the youth of the country were, both by precept and example, trained up to the practice, and excited to aspire to everything that was liberal, generous, and manly. Hence, prior to the foundation of the university of Cracow, which took place during the reign of Casimir the Great, in 1347, and preceded that of the universities of Prague, Vienna, and Leipzig, Poland possessed several historians, and other learned men, whose writings still survive to attest the early cultivation of literature in that country.

Amongst these the first place is due to the chroniclers. Gallus wrote his Chronicle of Poland between 1110 and 1135. Matthias Choleva, bishop of Cracow, who wrote a chronicle of Poland, died in 1165. Kadlubek Vincent, born at Cracow in 1160, enjoyed the favour of Casimir surnamed the Just, and officiated as tutor to Leszek the Fair. He wrote his chronicle under the title of *Historia Polonica*, which was first published in 1612. Godislas Reszko, dean of Cracow, composed Annals of Great Poland. Martinus Polonus is known by his numerous writings, and particularly by his Chronicles of the Popes and Emperors. He died at Bologna in 1278. To this period also belong several men of science. Amongst these may be mentioned Octavian Wolener, of Cracow, an architect, who, a little before 1044, was invited to Vienna, to erect the church now called St Stephen's. Ciolek, in Latin *Vitellio*, a native of Cracow, was celebrated as a naturalist and mathematician. He lived in the middle of the thirteenth century, and was considered as having contributed to improve and extend the science of optics. His works were printed for the first time at Nuremberg, in 1533, under the title of *Vitellionis Perspectivæ libri decem.*

But whilst the intellectual superiority of Poland at this period was owing to her frequent and direct intercourse with Italy, it is to be observed that after the foundation of the university of Cracow, about the middle of the fourteenth century, she herself became the centre and source of civilization to the neighbouring nations. From this time Hungarians, Bohemians, Germans, Swedes, and Danes, who formerly used to repair to Italy for study, resorted almost exclusively to the university of Cracow. Of those who added celebrity to the university, there were some whose reputation was not confined to their own country. George of Sanok, born about 1400 and died in 1477, was first professor of moral philosophy in the university of Cracow, and afterwards archbishop of Leopol. His biography was written by Buonacorsi, surnamed Callimachus, a celebrated Italian philosopher. John of Glogau, born in 1440 and died in 1477, was also a professor in the university of Cracow, and left numerous manuscripts on different subjects, but mostly on the Aristotelian philosophy, several of which were afterwards published. Dlugosz, in Latin *Dlugossius*, born in 1415 and died in 1480, was a statesman and historian. As great treasurer of Poland, he, on many occasions, rendered important services to his native country; he also protected science, established hospitals, and founded an exhibition or bursary in the university of Cracow. Of his numerous writings, the most important is his History of Poland. Brudzewski, born in 1445 and died in 1497, studied at Cracow, and afterwards became professor of mathematics in that university, where he had the distinction of being the master of Copernicus. He left several works, the principal of which treat of astronomical subjects and the construction of the astrolabe. Nicolas Copernik, called in Latin *Coper-*

nicus, born in 1473 and died in 1543, studied at Cracow, and by divining through the mists of error, rendered venerable by time, the true system of the world, established for himself a name which will live whilst sun and moon endure. Martin of Olkusz, the school-fellow and friend of Copernicus, died in the year 1530.

These men, however, with all their individual merits, were only the precursors or harbingers of a period of higher excellence and greater refinement. Free at home, and powerful abroad, Poland, during the sixteenth century, occupied a distinguished place amongst the states of Europe; and the period of her political glory was also the golden age of her literature. Amongst the poets of this period the first place belongs to John Kochanowski, born in 1530 and died in 1584, who is justly regarded as the father of Polish literature. He was the author of works both lyrical and dramatic, and translated Anacreon, Horace, some parts of the Iliad, and also the Psalms of David, which are remarkable for purity and vigour of style. Rey of Naglowice also wrote several works in verse and prose; whilst Peter Kochanowski left translations of Tasso's *Gerusalemme Liberata*, and Ariosto's *Orlando Furioso*, which were printed at Cracow in the year 1618. Miaskowski, Sarzynski, Rybinski, Grochowski, and Klonowitz, were likewise eminent as poets. As prose writers may be mentioned, Michowita, who wrote several important works, particularly on Polish history; Kromer, the son of a peasant, who by his talents obtained the highest ecclesiastical dignity in Poland (that of Prince-Bishop of Warmia), and left important works on the history of his country; Bieliski, who wrote on subjects of moral philosophy and history; Gornicki, an eminent writer on politics and history, and whose style is remarkable for its purity; Stryjkowski, a poet and historian; and Orzechowski, an apostate priest, but a distinguished writer and speaker, who, by his defence of the principles of the Dissidents, attracted the notice of Pope Julius III., with whom he maintained a long and animated controversy.

This period also produced several men distinguished in law, ethics, mathematics and astronomy, the natural sciences, medicine, and agriculture. Amongst the lawyers and jurisconsults may be mentioned Herbert, secretary of Sigismund Augustus, who published a collection of statutes and privileges; Malecki, who wrote a book entitled *The Lawful Marriage of Bishops, Priests, and Monks;* Groicki, a civilian of eminence, the author of a work on the statute law of Magdeburg; besides Ianuszewski, Lazarowitz, and Smiglecki. In ethics, Rey, Koszucki, and particularly Petrycy, distinguished themselves, though in different degrees. Petrycy translated the *Ethics* of Aristotle, and also the *Policy* of the same author, which he published at Cracow in 1618, along with his own commentaries. In mathematics and astronomy, Poland could boast some of the most distinguished men of the age; but as most of them published their works in Latin, it is only necessary to mention here those who wrote in Polish. These were Klos, author of a treatise on Arithmetic, published at Cracow in 1538; Grzebski, professor in the university of Cracow, whose works on Geometry were published in 1656; and the astronomers Latos, Rosciszewski, Zebrowski, and Bernat. Nor were the cultivators of the natural sciences either few in number or inferior in zeal and knowledge. Amongst the more eminent may be mentioned Spiezynski, who wrote several works on Botany, published at Cracow; Martin of Urzadow; Falimierz Syrenski, professor of medicine in Cracow, whose work on the properties and uses of plants, published after his death, is highly esteemed; Peter of Kobylny, Andrew Glader, Valenti of Lubiin, Oleszko, and Umiastowski, skilful physicians, who published important works on different maladies; Trzecieski, author of several works on agriculture and husbandry, published at Cracow in 1540 and 1571; and Dubrawski, whose work on fishes, published in 1600, is still considered as a work of great merit. There were also during this period several writers on the art of war, amongst whom may be mentioned Strubiez, Paprocki, and Cielecki.

This, the golden age of Polish literature, continued from the middle of the fifteenth until the commencement of the seventeenth century. But from the reign of Stephen Batory in 1586 we may date the temporary decline of Polish literature, and the corruption of the Polish language. During the seventeenth century the introduction of the Latin language into official transactions, and the great political crisis which Poland had to undergo, obstructed the tendency of the national literature, and directed the energies of the Poles towards one great object, namely, the preservation of their political existence. Amidst growing internal disorder, at once the cause and the effect of national calamity, the peaceful pursuits of science were neglected; and under the two princes of the house of Saxony, Augustus II. and his son Augustus III., Poland sunk into a state of both political and intellectual degradation; nor was it until towards the end of the eighteenth century that the national mind awakened from its long trance, and a reform was effected which has since produced good fruit. Whilst Konarski and a few others began to combat that maccaronic mixture of Latin and Polish which was then so much in fashion, a number of distinguished men, such as Krasicki, archbishop of Warmia, a poet and political writer; Naruszewicz, archbishop of Luck, a poet and historian; the two brothers Augustus and Michael Czartoryski, Albertandy, Zamojski, Potocki, Kollontay, Czacki, and many others, opened a new career for Poland; and by the impulse thus given the regeneration of literature was assured, although the liberties of the nation have been destroyed.

The first place amongst modern Polish writers is commonly assigned to John Paul Woronicz, born in 1757 and died in 1829, the archbishop of Warsaw, metropolitan primate of the kingdom of Poland, and an eminent poet and prose writer. Julian Ursyn Niemcewicz, distinguished alike as a poet, an historian, and a statesman, has been elevated by his tales to a high place amongst modern Polish writers; whilst in some of his other productions, particularly his *Powrot Posla*, or the Return of a Deputy to his Home, he has exhibited a most lively and animated picture of Polish habits and manners. Karpinski is the Burns of Poland; and Brodzinski, Felinski, and Ossolinski, are likewise popular poets. Of the patriotic bards, Adam Mickiewicz is the head and prince. His effusions are generally of a plaintive character, except when they dwell with rapture on the past glories of Poland. The muse of freedom is indeed the idol of his poetical worship; and, like Schiller and Goethe in Germany, Byron and Moore in England, Lamartine and Delavigne in France, he has taken from the altar of liberty that hallowed fire the divine flame of which warms and animates his strains. Lastly, in the class of modern historical writers, no one can claim precedence of Joachim Lelewel, a name venerable in literature, and honourably known for his strict regard to truth, and the liberality of his political writings.

Lastly, in closing this survey, a melancholy feeling is awakened in the mind. We are in fact writing of the past, without almost any reference to the present. Since the failure of the insurrection of 1830 and 1831, literature may be said to have expired in Poland, or rather to have been destroyed by the barbarous despot who has sought to proscribe her history, and even to eradicate her language; but amongst the exiles there are many men of distinguished literary acquirements, whose talents and learning enable us to form a tolerable estimate of the general state of education in their native country previously to the revolution; and we know from history that high mental cultivation has long co-existed in Poland with that chivalrous heroism for which they have always been pre-eminently distinguished.

(A.)

POLAR SEAS.

Seas,

THE rapid progress which has been made within the last half century in physical science and geography, has thrown a deeper interest on whatever concerns the polar regions, than belongs to the mere commercial speculation in which originated the earliest attempts for discovering a passage through the North Polar Ocean to India and China. It is not here intended, however, to enter into any detail concerning the new objects of natural history, the atmospherical phenomena of temperature, electricity, and magnetism, and various other points of scientific research, which the late expeditions have been the means of collecting and communicating; but to exhibit a sketch of the various attempts which have been made to explore those regions of darkness, long supposed not only to be uninhabitable, but unapproachable, and to take a very concise view of the progressive discovery and geographical information which have resulted from those attempts.

NORTH POLAR SEA.

B daries an xtent of e N a Po- lar ea.

We are now able to draw, with nearly geographical accuracy, the boundaries of the North Polar Sea. A very large portion of the northern shores of Europe, Asia, and America, which circumscribe it, have been visited; and the position of most of their bays, headlands, and rivers, geographically ascertained. By casting our eye over the north polar chart, it will be seen that the Polar Sea of that hemisphere is an immense circular basin, which communicates with the two great oceans of the world, the Atlantic and the Pacific, by two channels, the one separating America from Europe, and the other America from Asia. It will be seen that few points of the coasts of Europe and Asia, which occupy a full half of the circumscribing circle, extend much beyond the seventieth parallel of latitude; and all these points have been passed by water, though at different times and by different persons, with the single exception of the Cape Cevero Vostochnoi, which, on the charts, is made to extend to the latitude $75\frac{1}{2}$°. The northern coast of America, with Old Greenland, and the two channels above mentioned, complete the circle, America extending about 80° of longitude, or just two ninths of the whole circle; and of this portion the whole coast has now been ascertained, with the exception of that part which lies between Cape Turnagain of Franklin, and the land at the bottom of Prince Regent's Inlet, which the gentlemen of the Hudson's Bay Company are now (1838) exploring. This being accomplished, we shall have the whole line of the northern coast of America completed. We may therefore state, that the average of the degree of latitude of this coast is about the same as, or rather lower than, that of Europe and Asia, and the extent of the North Polar Sea may be considered as about 2400 geographical miles in diameter, or 7200 in circumference.

Isl s of this a.

The interior or central parts of this sea are very little known. Several islands are scattered over its southern extremities, the largest of which is Old Greenland, whose northern limit has not yet been passed; the others are, Spitzbergen, Nova Zembla, the islands of Liakhov, or, as some have been pleased to call them, New Siberia; the North Georgian Islands of Parry, and those which form the western land of Baffin's Bay; to which may be added the Boothia Felix of Ross, which there is little doubt is an island. Besides these, there are a number of small alluvial islands formed at the mouths of the several rivers of the two continents; but whether any, or what number of islands may exist nearer to the pole, we must of course remain ignorant till the Polar Sea has been further explored.

Polar Seas.

Object of early voyages to the north. Iceland, Greenland, &c. discovered.

For the little which is known of this sea, we are indebted to that spirit of discovery which showed itself immediately after a passage to the East Indies had been effected round the Cape of Good Hope; not so much, it is true, for the sake of geographical discovery, as that of shortening the passage by sea to the eastern parts of the world. It was obvious that, if a ship could proceed from the Atlantic to the Pacific, on a great circle of the sphere, or nearly so, the distance, compared with the circuitous passage round Southern Africa or Southern America, would be prodigiously shortened. The voyage of Columbus had that object; but it was soon discovered that, from the Straits of Magelhaens to the Gulf of St Lawrence, there was one uninterrupted continuity of land. Of the northern regions, the information obtained has been scanty and discouraging for such an enterprise. One of the Scandinavian pirates had indeed been driven by stress of weather, as early as the middle of the ninth century, upon an island to the north-west, to which, from its appearance, he gave the name of Snowland, which was afterwards changed to that of Iceland by the leader of the Norwegian colonists who took refuge on that inhospitable spot; but it was not till more than a century after this that Eric Rauda discovered the southern part of Old Greenland; and there are grounds for believing that, in the year 1001, some of these colonists discovered Newfoundland and the coast of Labrador.

Greenland colonies.

The colony of Iceland continued to flourish in spite of the storms and tempests, the chilling temperature, the earthquakes and volcanoes, which shook to its centre this *Ultima Thule* of the inhabitable world; but the Greenland colonies were less fortunate. For some time that on the west is said to have succeeded so well as to number one hundred villages, divided into four parishes; but having engaged in hostilities with the natives, whom they named *Skrælings* (the same people as the present Esquimaux), the latter compelled them to abandon their settlements. The eastern colony is supposed to have shared a more deplorable fate; a stream of ice having fixed itself to the coast, about the year 1406, and rendered the whole of it, from that time to this, utterly inaccessible. The existence, however, of any such colony has of late years been called in question; and it is now supposed that all the Danish and Norwegian settlements were confined to the western side of Cape Farewell.

The voyages of Nicolo and Antonio Zeno, and of the Portuguese.

The voyages and adventures of the two brothers Nicolo and Antonio Zeno in 1380, though they added but little to the knowledge of northern geography, are extremely curious, and throw considerable light on the state of Greenland, Labrador, and the Feroe Islands (Friesland), at that early period. It may be doubted, however, if any of the voyages hitherto made were undertaken for purposes of discovery and the benefit of navigation. The Portuguese have unquestionably the merit of being the first to send out expeditions with these views; and it is to their successful discovery of a passage round the Cape of Good Hope that we owe the bold enterprise of Christopher Colon, better known as Columbus, to find out a passage to the East Indies by steering directly to the westward.

Of John Cabota.

It was not till the year 1496 that England was engaged in nautical discoveries. In that year, Henry VII. encouraged John Cabota, a citizen of Venice, to make discoveries, by granting him a patent to search for unknown lands, and to conquer and settle them. His son Sebastian, either alone or in company with his father, discovered Newfoundland, to which was given the name of *Prima Vista*, "the first seen." We say *discovered;* for although the testimonies are in favour of the Scandinavians having settled colonies upon this island, no vestige then remained or has since been found of any such colonies. The object of the voyage was, as stated by himself, that, "understanding, by reason of the sphere, that if I should sail by way of north-west, I should by a shorter tract come into India, I thereupon caused the king to be advertised of my devise, who immediately commanded two caravels to be furnished with all things appertaining to the voyage." He states in his report that he reached the fifty-sixth degree, but finding no opening in the coast, he despaired of a passage, and returned.

Of the Cortereals.

A claim, however, has been set up for the discovery of *Terra de Bacalhaos*, or the Land of Codfish, afterwards called Newfoundland, by John Vaz Costa Cortereal, a Portuguese gentleman belonging to the household of the Infanta Don Fernando, who is said to have touched at that island in the year 1463 or 1464, in an attempt to find a route to India and the Spice Islands by sailing westward round the northern extremity of America. This claim rests on the testimony of Cordeira, and on a patent commission, granting to Cortereal the captaincy of Terceira, in 1464, as a reward for his important discovery. The Portuguese certainly not only fished on the banks, but formed establishments on the island of Newfoundland, towards the end of the fifteenth century.

In the summer of 1500, two ships sailed from Lisbon, under the command of Gaspar Cortereal, on northern discovery. According to Ramusio, they arrived at a region of extreme cold; and, in the latitude of 60° north, discovered a river filled with ice, to which they gave the name of Rio Nevado, that is, Snow River. This land was Labrador, which on an old chart is named Corterealis. In returning he discovered the Gulf of St Lawrence. Gaspar Cortereal was so satisfied of the existence of a north-west passage to India, that he again left Lisbon in May 1501 with two vessels; but his own was separated on the coast of Terra Verde, and never more heard of. A second brother went out the following year, but his ship was also supposed to be lost, and all hands perished. A third expedition was sent out in search of the unfortunate navigators, but no tidings could be obtained of their fate.

Of Auberton Cartier.

The French are the only maritime people who have seen, with apparent indifference, the exertions made by other nations for the discovery of a passage to India either by the north-east or the north-west. Auberton Cartier's voyages to Newfoundland and the Gulf of St Lawrence, between 1508 and 1534, can hardly be considered as voyages of discovery; and the subsequent voyages of Roberval and of the Marquis de la Roche had no other object than the discovery of gold, or of a desirable spot for establishing a colony on the coast of America.

Of Estevan Gomez.

In the year 1524, the jealousy of the Spaniards would seem to have taken the alarm at the attempts which were making by other nations to discover a shorter way to China and the Indies by the north; for it appears that a skilful navigator who had been with Magelhaens, of the name of Estevan Gomez, sailed in that year from Coruña, with the view of discovering a northern passage from the Atlantic to the Moluccas. Gaspar, the only author who has recorded this voyage, enters into no details; but it is supposed he reached no farther than the coast of Labrador, from which he brought away some of the natives. On his return he was asked by a friend what success he had met with? The answer was *esclavos* (slaves), which the inquirer mistook for *clavos* (cloves), and spread the report of his having made, as Purchas calls it, a "spicy discovery." It is evident, however, that his voyage was a complete failure, of which, as the voluminous compiler just mentioned observes, "little is left us but a jest."

Of th Span on the coast Ameri

The alarm of the Spaniards spread to the Pacific; and Cortez, the conqueror and viceroy of Mexico, on receiving intelligence of the voyages of the Cortereals, fitted out three ships, under the orders of Francisco Ulloa, to look for the supposed Strait of Anian, through which they were to pass. In 1542, the viceroy Mendoza sent one expedition by land and another by sea from Mexico to the northward. No discoveries were made by any of these voyages. Two years after this the court of Spain ordered another expedition along the western coast of America, the conduct of which was intrusted to Juan Rodrigues de Cabrillo, a Portuguese in the service of Spain. He reached the latitude of 44° N., and gave the name of Cape Mendocino to the land, about the latitude 42° N., in compliment to the viceroy.

First lish vo

England in the mean time was not inactive. At the suggestion of Mr Robert Thorne of Bristol, King Henry VIII. caused to be sent forth "two faire ships, with divers cunning men, to seek strange regions," which left the Thames in 1527. All that Hakluyt could discover of these ships and the cunning men was, that the name of one of them was Dominus Vobiseum, and that a canon of St Paul's of London, a great mathematician and wealthy man, went on the expedition. One of these ships was cast away in the great opening between the north parts of Newfoundland and Meta Incognita, supposed to be Greenland.

Secon Englis voyag

In the year 1536, two ships, the Trinitie and the Minion, were set forth by Master Hore of London, "a man of goodly stature and of great courage, and given to the studie of cosmographie." Six score persons, we are told, embarked on this expedition, whereof thirty were gentlemen. They reached no higher than Newfoundland; but there is a curious account of their proceedings by Hakluyt, which he procured from Mr Oliver Dawbeny, merchant of London, who was one of the adventurers on board the Minion.

Voyag Sir H Willou by.

On the return of Sebastian Cabot to England, he was constituted Grand Pilot, and "Governor of the Mysterie and Companie of the Merchants Adventurers for the Discoverie of Regions, Dominions, Islands, and Places unknown." At his suggestion a voyage was undertaken, in the year 1553, for the discovery of a *north-east* passage to Cathaia, consisting of three vessels, the crews of which, including eleven merchants, amounted to 113 persons. Numerous candidates stood forward for the command of this expedition; but Sir Hugh Willoughby was appointed captain-general of the fleet, "both by reason of his goodly personage (for he was of tall stature), as also for his singular skill in the services of warre." The fate of this expedition was most disastrous. Sir Hugh Willoughby, with his brave associates, as well as the crew of the second ship, to the number of seventy persons, miserably perished from cold and hunger on the coast of Lapland, at the mouth of a river called Arzina, not far from the harbour of Kegor. The third ship, under Master Richard Chancelor, had parted company, and, by putting into Wardhuys, in Norway, escaped the fate of his companions; and in the following year discovered the port of Archangel, and opened the first intercourse with Russia.

Of Ste Burrou

In the years 1555 and 1556, two ships were sent out to Archangel to carry commissioners to the court of Moscow, and, having landed them, to prosecute discoveries, and "to use all wayes and meanes possible to learne howe men may passe from Russia, either by land or sea, to Cathaia." Stephen Burrough, in the Serchthrift, proceeded easterly as far as the island of Waygatz, where he was stopped by the constant north-east and northerly winds, thick weather, and abundance of ice. The neighbouring country was inhabited by *Samoieds*, who had no houses, but only tents made of deer's skins.

Martin
bisher.

The rapid progress made from this time by land through Russia to Persia and India revived the ardour for discovery by sea, and the pens of the most learned and ingenious men in the nation were employed to prove the existence, the practicability, and the great advantages which would result from the discovery of a north-west passage. Amongst others, Martin Frobisher had laboured for fifteen years, but without the means of setting forth an expedition, till at last, in the year 1576, by the assistance of Dudley, earl of Warwick, and a few friends, he was enabled to fit out two small barks, the Gabriel of thirty-five, and the Michael of thirty tons, and a small pinnace of ten tons. On the 11th of July this little squadron came in sight of Friesland, "rising like pinnacles of steeples, and all covered with snow." This Friesland, being in 61° latitude, was probably the southern part of Old Greenland. He entered a strait which now bears his name, in latitude 63° 8′ N., and had communication with the Esquimaux, whom he describes as "like to Tartars, with long black hair, broad faces, and flatte noses." He brought home one of these "strange infideles, whose like was never seene, read, nor heard of before;" and Frobisher had the satisfaction to find himself "highly commended of all men for his greate and notable attempt, but speceally famous for the great hope he brought of the passage to Cathaia."

second
age.

Some of the crew having brought home a stone which "glistend with a bright marquesset of gold," Queen Elizabeth now gave countenance to a second attempt, and added to the expedition "one tall ship of hir majesties, named the Ayde." In this voyage they proceeded to Mount Warwick, on Resolution Island, in latitude 63½° north, whence they sailed on their return home on the 22d of August, having lost only one man by sickness, and another who fell overboard.

third
age.

Though Frobisher brought home neither gold nor silver, but something which had the appearance of both, the queen and her court, pleased in "finding that the matter of the gold ore had appearance, and made show of great riches and profit, and the hope of the passage to Cathaia by this last voyage greatly increased," determined to establish a colony on Meta Incognita; for which purpose fifteen ships were prepared, carrying 100 persons to form the settlement, with whom three of the ships were to remain, and twelve to bring back cargoes of gold ore. The fleet sailed on the 31st of May 1578; part of it entered Frobisher's Strait, and part were driven towards the coast of Greenland. On the 30th of August, the ships having re-assembled off Hatton's Headland, on Resolution Island, and all hands disheartened by the cold and tempestuous weather, they resolved to make sail for England, where they all arrived at different ports about the beginning of October, with the loss, by deaths, of about forty persons.

Pet and
man.

The progress made by land to the eastward induced the Russian Company to fit out two ships, under the command of Pet and Jackman, to make another attempt at a north-east passage. They left Harwich on the 30th of May 1580, reached Wardhuys on the 23d of June, and the coast of Nova Zembla on the 16th of July; passed the Strait of Waygatz, but were obliged to return on account of the ice.

ir
phry
rt.

Sir Humphry Gilbert and his brother obtained from Queen Elizabeth, in 1578, a patent for making western discoveries, by which they established a corporation under the name of "The Colleagues of the Fellowship for the Discoverie of the North-west Passage." In 1583 Sir Humphry set out to take possession of Newfoundland, but the voyage proved most disastrous; and on his return his little bark foundered at sea, when he and all that were in her perished.

Of John
Davis.

In 1585 John Davis was sent out by the merchants of London, for the discovery of the north-west passage. Two barks, the Sunshine and the Moonshine, one of fifty, the other of thirty-five tons, were fitted out for this purpose. On the 6th of August, Davis had proceeded so high up the strait which now bears his name as latitude 60° 40′, and anchored in Exeter Bay, under "a brave mount," to which he gave the name of "Mount Raleigh, the cliffs whereof were as orient as gold." On the 8th of August they returned to the southward, and arrived in Dartmouth on the 30th of September.

His second
voyage.

In 1586 Davis set sail a second time, and coasted the western shore of Greenland up to the latitude of 66° 33′, stood from thence across to the westward, made the land in 66° 19′, and, turning to the southward, along the coast and numerous islands, anchored in a bay on the coast of Labrador, in latitude 56°, and, sailing from thence, arrived in England in the month of October.

His third
voyage.

A third voyage being determined on, Davis sailed from Dartmouth on the 19th of May, made the land on the west coast of Greenland in latitude 64° on the 14th of June, had advanced as high as latitude 67° on the 24th, and, on the 30th, was in latitude 72° 12′. From thence he crossed to the westward in an open sea, but being driven, as he supposed, by a current, found himself, on the 19th, abreast of Mount Raleigh. After this, Davis advanced sixty leagues up the strait he had discovered on the former voyage, now called Cumberland Strait; passed through Lumley's Inlet, the same, it is supposed, which Frobisher had discovered, and known as Frobisher's Strait; and, standing to the south-east, discovered Cape Chidley, and, returning homewards, arrived in England by the middle of September.[1]

Of the voyage of Maldonado in 1588, and of Jan de Fuca in 1592, it is not necessary to say anything; the latter being at best but problematical, and the former altogether spurious.

Voyages of
William
Barentz.

The next attempts we find in chronological order were three voyages for the discovery of a north-east passage, undertaken by the Dutch, in which William Barentz was chief pilot. The first of these was set forth in 1594; proceeded easterly as far as Waygatz, then along the western coast of Nova Zembla as high as latitude 77° 25′; and returned to the Texel on the 16th of September. On the second voyage, the following year, they did not reach Nova Zembla till the 17th of August, when finding it impossible, on account of the great quantity of ice, and "the weather being misty, melancholie, and snowie," they returned to the westward, and arrived in the Maes on the 18th of November.

The third voyage of Barentz is intensely interesting. The ships left the Texel in May, and on the 9th of June, after sailing amongst much ice, they discovered Bear (since called Cherry) Island. Proceeding northerly, they discovered Spitzbergen, along the western coast of which they had advanced, on the 19th, as high as 80° 11′, opposite the point since known as Hakluyt's Headland. Returning to the southward, Barentz made for the coast of Nova Zembla; doubled the northern extremity; then found himself compelled, by the pressure of the ice and bad weather, to seek for refuge in a small bay, which they called Ice Haven; and here they passed "their cold, comfortlesse, darke, and dreadful winter," in about the seventy-sixth parallel of latitude. The ship was wholly wrecked, and the surviving part of the crew, fifteen in number, left this spot the following year in two open boats; and after an exertion of forty days, in which they suffered the greatest fatigue, famine, and cold, and in which Barentz and two others died, they reached Kilduin in Lapland, a distance of a thousand miles and more from the bay in which they had passed the winter.

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[1] An interesting account of the proceedings of this able and intrepid navigator, by himself, is contained in a very rare and curious little book called *The Worlde's Hydrographical Description*, 1595.

Of George Weymouth.

The merchants of England seem to have lost all hope of a northern passage to the East Indies, till they were once more roused by a supposed piece of information of Captain James Lancaster, that the passage was in the north-west of America, in latitude 62° 30′. Accordingly, in 1602, the Muscovy and Turkey Companies fitted out two fly-boats, the Discovery and Godspeed, the command of which was given to Captain George Weymouth. This voyage, however, proved a complete failure. It is difficult to make out precisely the utmost limit at which it arrived; it was not much beyond Resolution Island in Hudson's Strait; but, to use the words of a subsequent sagacious navigator, Luke Fox, "Davis and Weymouth lighted Hudson into his straits."

Of Hall and Knight.

In 1605, the king of Denmark sent out an expedition of discovery, in which two Englishmen, James Hall and John Knight, were employed. The ships proceeded along the west coast of Greenland, but reached no higher than about latitude 66° 55′; gave the names of Christian's Fiord, and Queen Anne's Cape; traded and quarrelled with the natives; left two malefactors amongst them, and returned to Elsineur. This expedition was followed up by two others in the two following years, neither of which was productive of any discoveries; the first having advanced only to 66° 25′ on the coast of Greenland, and the latter not farther than Cape Farewell.

Of John Knight.

In 1606, the merchants of London sent out the Hopewell, under the directions of John Knight. In latitude 56° 48′, on the coast of Labrador, Knight, with his mate and four others, went on shore, and were supposed to be murdered by the natives, as none of them were ever afterwards heard of. The ship returned home.

The voyages of Henry Hudson.

Henry Hudson made no fewer than four voyages of discovery. The first, in 1607, was along the eastern coast of Greenland, when he reached, in 78° 56′, a higher degree of latitude on that coast than has since been ascended. The second, in 1608, was an attempt to the eastward, where, as in all preceding attempts, he was stopped at Waygatz Strait. Of the third little is known. Its northern limits appear to have been the North Cape on one side, and Newfoundland on the other.

The fourth voyage was fatal to Hudson, but it opened the way to the coast of America in a higher degree of latitude than it had yet been approached. He left the Thames in the Discovery of fifty-five tons, on the 17th of April 1610, and reached the Isle of Godsmercie, in the strait which bears his name, on the 6th of July; on the 2d of August he discovered land, which he named Cape Wolstenholm; and near it, on a cluster of islands, Cape Digges: And here ends Hudson's narrative; for his crew having mutinied, they put Hudson, his son, and seven others, into an open boat, which was never more heard of. The ship returned to England, and, what is most remarkable, the inhuman and atrocious act does not appear to have caused any sensation, nor was any inquiry instituted into the proceedings of the mutineers.

Of Thomas Button.

Two of them, in fact, Abacuk Pricket and Robert Bylot, were employed under Captain (afterwards Sir Thomas) Button, appointed to prosecute the discovery of a north-west passage, in two ships, the Resolution and Discovery. Button followed the tract of Hudson, and succeeded in reaching the coast of America, where he wintered in Nelson's River, in latitude 57° 10′. The following year they stood to the northward, and discovered Southampton Island, as high up as latitude 65°; made some discoveries of islands, and returned to England in the autumn of 1613.

Of James Hall.

In 1612, we find James Hall employed on an expedition up the western coast of Greenland, where he was slain by one of the natives, at Ramel's Point, in latitude 67°. The account of the voyage is written by William Baffin, who was pilot, in which he relates the method of determining the longitude by an observation of the time when the moon came upon the meridian; the first navigator probably who practised this method.

Of C tain Gibb

In 1614, Captain Gibbon was sent out in the Discovery, at the recommendation of Sir Thomas Button. He encountered much ice at the opening of Hudson's Strait, returned to the southward, and was shut up in a bay on the coast of Labrador for five months; and returned without making any progress in north-western discovery. To this bay the ship's company are said to have given, in derision, the name of "Gibbon's his Hole."

Of B ot and B ffin.

In 1615, the Discovery was fitted out a fourth time, and the command of her given to Robert Bylot, who took William Baffin as his mate. They visited Button's Islands, Savage Islands, and Mill Islands, and proceeded along the east coast of Southampton Island to Cape Comfort, in latitude 65°. From thence they returned to the southward, and reached England in the month of September.

In 1616, Bylot and Baffin again set out in the bark Discovery, in search of a north-west passage; and, following their instructions, proceeded up Davis's Strait to Hope Saunderson, the extreme point of Davis's progress, between 72° and 73° of latitude, which they reached as early as the 30th of May. A little to the northward was a group of islands, to which, finding females only, they gave the name of Women's Islands. From hence they stood northerly, between the ice and the land, passing in succession Horn Sound, Wolstenholm's Islands, Whale Sound, Sir Thomas Smith's Sound, in latitude 78°, and at the northern extremity of what has since been called Baffin's Bay; and following the direction of the land, they passed, on the western shore, Alderman Jones's Sound, and lastly, Lancaster Sound; whence the ice compelled them to leave the land, and they therefore shaped their course homewards. This last voyage of Baffin is the most important that had yet been made; and it is quite surprising that the discovery of so many immense openings, which he calls *sounds*, for want of a better word, should not have been followed up, and that not one of them should have been examined until the expedition sent out under that intelligent and enterprising officer Captain Parry.

Of Mu

In 1619, the Danes sent out an expedition under Jens Munck, who penetrated as high up on the coast of America as Chesterfield Inlet, which he named Munck's Winter Harbour; for he wintered in it, and all his people, except two, perished of cold, disease, and famine. Munck and these two survivors with great difficulty fitted out the smaller of the two vessels, and reached Denmark, where they were considered as men risen from the dead. Munck is said to have received the indignity of a blow from the king, on which he took to his bed, and died of a broken heart; but there is an air of romance in the account of this voyage, which makes its authenticity doubtful.

Of Fox

In 1631, Captain Luke Fox, who quaintly calls himself the "North-west Fox," prevailed on some merchants of London to procure from King Charles I. his countenance, and the loan of one of his ships, for attempting the discovery of a north-west passage. Fox was undoubtedly more shrewd and intelligent than all former navigators; and if, when he reached what he calls Fox's Farthest, he had stood across to the westward, the probability is, that he would have got upon the northern coast of America, and succeeded in working his way into the Pacific, by the very route which Parry since pursued.

Of ptain Jan

In the same year the merchants of Bristol fitted out the Maria of seventy tons, the command of which was given to Captain James. In proceeding up Hudson's Strait, somewhere about Resolution Island, he got his ship entangled in the ice; and from that spot to Charlton Island, at the bottom of Hudson's Bay, in latitude 52°, he details a series of disasters which never happened to any navigator before or since. Here he passed the winter, and returned the following year, without making the least progress in discovery.

Captain
niel.

In 1652, the king of Denmark again set forth an expedition under Captain Daniel, to explore the *eastern* coast of Greenland. He stood to the northward of Iceland, but he could not approach the land on account of the ice, though the mountains were visible at least sixty miles. The most northern cape seen was in 65° 30′, to which he gave the name of Cape King Frederick. From this point to Cape Farewell the ice lay between him and the shore, which in no part he could approach within twenty miles; of course, no discovery was made by him.

Wood
Flaws.

After the lapse of more than a century, a paper admitted into the Transactions of the Royal Society of London in 1675 tended to revive the attempt at a north-east passage in England. It contained an account of a Dutch ship, fitted out by a company of merchants in Holland, having passed to the north-eastward of Nova Zembla several hundred leagues, between the parallels of 70° and 80°; and the sea in that direction was found to be perfectly open and free from ice. About the same time it was reported that Spitzbergen had been circumnavigated, and that a Dutch ship had proceeded within one degree of the pole. Upon the strength of these reports, Captain John Wood addressed a memorial to the king, assigning *seven reasons* and *three arguments* for the existence of a north-east passage. Accordingly, two ships were fitted out under Captains Wood and Flaws. They left the Nore in May 1676; on the 22d of June had reached the latitude 75° 79′, and on the 26th got sight of the west coast of Nova Zembla. Three days after this, Wood lost his ship amongst the ice, and after some perils, and the loss of two men in reaching the shore, they were picked up by the other ship, and returned homewards without making the least discovery; when Wood published many peremptory and ill-founded reflections on former navigators, and now found out seven reasons and three arguments *against* the passage to the north-east.

Captain
dleton.

Of the voyages of Knight, Barlow, Vaughan, and Scroggs, from the Hudson's Bay Company's settlements, along the eastern coast of America, little else need be said, than that they did not extend the knowledge of that coast beyond Whale Point; but the observations they made on the strong tide flowing down the Welcome induced a gentleman of the name of Dobbs to press the Board of Admiralty to appropriate a ship of the navy to make discoveries in this quarter. Two ships were accordingly fitted out; the Furnace bomb, and the Discovery pink, commanded by Captain Middleton and Mr William Moor. They left England in 1741, and wintered in Churchill River, in latitude 58° 56′; remained there till the 1st of July; proceeded northerly to the latitude 65° 23′, and entered Wager River, which they examined in an imperfect manner. They then stood to the northward as far as Cape Hope, in latitude 66° 14′, longitude 86° 28′ W.; and, most unaccountably, abandoned all farther search, having seen, or fancied they saw, "a frozen strait" between them and the point round which they had to proceed to the westward. Middleton had been an old servant of the Hudson's Bay Company, who were supposed to be jealous of any discoveries in their neighbourhood, and averse from encouraging them; and he was accused of having taken a bribe from them to defeat the object of the expedition. The lords of the Admiralty refused to approve of his proceedings; and to evince the feeling of the government, an act was passed the very year after his return, offering a reward of L.20,000 to the person or persons, being subjects of his majesty, who should discover a north-west passage through Hudson's Strait to the Pacific. Dobbs, turning these circumstances to the advantage of his favourite project, got up a large subscription, and in 1746 two other vessels were fitted out, and the command of them given to Captain William Moor and Captain Francis Smith.

Of Moor and Smith.

Their first examination was that of the Wager River, which was found to terminate in a broad rapid, beyond which were two unnavigable rivers. They then proceeded northerly, till they came to Captain Middleton's "frozen strait," or opening into Repulse Bay, when a difference of opinion arose amongst the officers, whether they were authorized by their instructions to examine this bay. The fact appears to be, that the officers and men had no taste for the business, and were under no kind of discipline. Instead, therefore, of proceeding, they began to murmur; and although only the 7th of August, they urged the lateness of the season, and wished to return home. After this nothing was done or even attempted; and Repulse Bay remained, till the second voyage of Captain Parry, unexamined.

Of Phipps and Lutwidge.

No farther attempts at either passage appear to have been made by any of the maritime nations for nearly thirty years. But the Honourable Daines Barrington having, in the year 1773, presented to the Royal Society a series of papers on the practicability of approaching the North Pole, the president and council of that society made application to the first lord of the Admiralty (then Lord Sandwich) to send out a ship or ships, to try how far navigation might be practicable towards that quarter. The Racehorse and Carcass bombs were accordingly prepared, and the command given to Captain the Honourable Constantine Phipps and Captain Skiffington Lutwidge. They left the Nore on the 10th of June, passed along the western coast of Spitzbergen, and advanced to latitude 80° 48′, in sight of the Seven Islands; here they were beset in the ice on the 1st of August, and on the 10th, after being forced through it by a north-east wind, they proceeded to the southward, and arrived at the Nore on the 25th of September.

Of Cook and Clerke.

The hopes of a north-west passage were not abandoned by this failure; but it was resolved to make the attempt by a different route to any that had yet been attempted; that is to say, from the Pacific to the Atlantic. Captain Cook was selected for this enterprise, and two ships, the Resolution and Discovery, were fitted out for the purpose, the latter being commanded by Captain Clerke. An amended act was passed for granting the reward of L.20,000 for the discovery of "any northern passage" by sea, between the Atlantic and Pacific Oceans, and also the reward of L.5000 to any ship which should approach the North Pole within one degree. Captain Cook left England in July 1776; entered Behring's Strait on the 9th of August 1779; and on the 17th of August reached latitude 70° 41′ N., and saw the highest point of America, surrounded with ice, and therefore named by him Icy Cape, in latitude 70° 29′, longitude 198° 20′. The main body of the ice drifting down towards the ships, and the weather becoming foggy, they stood to the southward; and as the season was far advanced, Captain Cook determined to pass the winter at the Sandwich Islands, and to renew the attempt at an earlier period the following year. By his death at this place, Captain Clerke became the commanding officer. That he should have failed in reaching as far north as Cook had done, is not at all surprising, after an absence of three years from home, and all hands, as is avowed, "heartily sick of a navigation full of danger." A small vessel had been sent in the year 1776 up Davis's Strait, under Lieutenant Pickersgill, and the same vessel again in 1777, under Lieutenant Young, to render any assistance that might be required, in the event of Captain Cook's reaching Baffin's Bay; but neither of these officers made a progress beyond the 73d degree of latitude.

Admiral Lowe.

In 1786 and 1787, the king of Denmark, at the suggestion of Bishop Egede, sent out an expedition under Captain (afterwards Admiral) Lowenorn, for the purpose of rediscovering the eastern coast of Greenland. This officer persevered for two years, but with no better success than his predecessors. They saw the coast at various points, as high up as 66½°, but could not approach it on account of the ice. No discovery, therefore, of importance resulted from this expedition.

Mr Duncan's voyages.

On the part of England, all further attempts appeared to be abandoned after the failure of Captain Cook. One gentleman, however, Mr Alexander Dalrymple, hydrographer to the Admiralty, considering that three points of the northern coast of America had been clearly established, viz. Icy Cape, by Cook; the north of the Copper Mine River, in 1772, by Hearne; and the mouth of Mackenzie River, by the traveller whose name it bears, in 1789; which three points were supposed to be in or about the 70th parallel of latitude, and that they comprehended within them fully two thirds of the whole of that coast; and combining these discoveries with other circumstances, he was decidedly of opinion that a north-west passage did exist, and that it was practicable. On the strength of this opinion he prevailed on the governor of the Hudson's Bay Company to employ Mr Charles Duncan, a master in the navy, on the discovery. He left England for this purpose in 1790, to join a sloop of the name of the Churchill, then in Hudson's Bay; but he soon discovered that the crew were averse to the intended enterprise, and set up so systematic an opposition to proceeding upon it, that he deemed it prudent to leave them, and to return to England. The governors of the company expressed their regret; and, to prove how much they were in earnest, fitted out a strong ship called the Beaver, and Mr Duncan set out a second time. He wintered in Churchill River, where he remained till the 15th of July, and entered Chesterfield Inlet; but his crew mutinied, encouraged by his first officer, who was a servant of the Hudson's Bay Company; and thus ended his second voyage.

Of the Russian voyages.

We have said nothing of the Russian voyages along the northern coast of Asia. That no one person has performed the whole, either at once or by successive trials, is quite clear; but, with the single exception of one "sacred promontory," called Cape Cevero Vostochnoi, between the Yenisei and the Lena, the whole has been navigated by various persons at different times. In the years between 1734 and 1738, Lieutenants Moroviof, Malgyn, and Skurakof, succeeded in proceeding from Archangel to the Bay of Obe; and in the latter year, Offzin and Koskelef proceeded from that bay to the mouth of the Yenisei. In 1735, Lieutenant Prontshistshef set out in the contrary direction from the Lena, but was stopped by the promontory above mentioned; though some affirm that he passed it, and reached as far as Taimura. From the Lena eastward to the Kowyma the voyage has frequently been performed, and Shaularoff, in 1671, succeeded in reaching the Shelatskoi-noss, but could not double it; and the only instance of its having been passed is that of Deshnef, as far back as the year 1648, who sailed from the Kowyma, through Behring's Strait, to Anadyr.

Of Lieutenant Kotzebue.

The immense distance by sea from St Petersburg to Kamtschatka, and the Russian settlements on the north-west coast of America, would render the discovery of a north-west passage of infinite importance to Russia. Impressed with the magnitude of this importance, an individual of that nation, the Count Romanzoff, fitted out at his own expense a small vessel, named the Rurick, the command of which was given to Lieutenant Kotzebue. She left the Baltic in 1815, passed Cape Horn, and in 1817 entered a deep inlet on the eastern side of Behring's Strait, in which he passed the remaining part of the summer. He found no ice, neither in the strait nor the inlet, and saw nothing to prevent his proceeding up the American coast to Icy Cape but the lateness of the season; and therefore returned to the southward, with the intention of renewing the attempt the following year. An accident, however, which occurred on his second entrance of the strait, though personal only, put an end to the expedition.

Of R and F Buch and F lin.

This voyage of Kotzebue would alone have been sufficient to stimulate England to attempt once more to accomplish the almost only interesting discovery in geography that remains to be made; but other circumstances were reported in the year 1817, which determined the government to fit out two expeditions for northern discovery. A ship from Hamburg, in the summer of that year, made the eastern coast of Greenland, which was supposed to have been shut up with ice for four centuries, in the 70th parallel of latitude, continued along it to the 80th degree, and stood along that parallel to the coast of Spitzbergen. For three years before this, the post-office packets, and other vessels crossing the Atlantic, had fallen in with very unusual quantities of ice floating to the southward. This breaking up of the ice was deemed favourable for the prosecution of northern discovery. For this purpose two separate expeditions were put in preparation. One was intended to proceed by the North Pole, as the nearest route, and, if no interruption from land occurred, probably the most practicable, to Behring's Strait; the other, to attempt a passage by some of the openings leading out of Baffin's Bay. To each were assigned two ships. Those destined for the polar passage were the Dorothea, of 370 tons, commanded by Captain David Buchan, and the Trent, of 250 tons, by Lieutenant John Franklin. Those for the north-west were the Isabella, of 382 tons, commanded by Captain John Ross, and the Alexander, of 252 tons, by Lieutenant William Edward Parry. The polar expedition was rendered abortive by the disabling of the Dorothea in the ice; the other circumnavigated Baffin's Bay, and ascertained that the narrative of that able navigator whose name it bears is substantially true; and that the chart appended to the *Voyage of the North-West Fox* is in fact the chart of Baffin, and wonderfully correct for the time in which it was laid down. Not one, however, of the many great openings which appear in that chart, and were ascertained to exist, was examined; and the only one that was entered was abandoned in a most unaccountable manner, and on grounds which were at once suspected, and subsequently proved, to be utterly without foundation.

Of Pa and L don.

Another expedition was, therefore, immediately fitted out, consisting of two ships, the Hecla bomb and Griper gun-brig, and the command of it given to Lieutenant Parry, Lieutenant Liddon being appointed to that of the Griper. They dropped down the river on the 4th of May 1819; saw Cape Farewell on the 15th of June; and by the 30th of July had succeeded in crossing the ice of Baffin's Bay, and reaching the opening of Sir James Lancaster's Sound, just one month earlier than in the preceding year. To the examination of this sound Mr Parry was particularly directed by his instructions. In proceeding along it to the westward, he met with little obstruction from the ice (though he was evidently navigating through an archipelago of islands, where it usually most abounds) until he came to the western extremity of what he calls Melville Island, the last that was visible on the northern side of the strait or passage through which he had proceeded. Beyond this he struggled in vain, till the 20th of September, to get to the westward, when the severity of the weather made it prudent to look out for a secure spot to pass the winter; and, after cutting a canal through the ice upwards of two miles in length, tracked the two ships into Winter Harbour, the crews "hailing the event with three loud and hearty cheers." The following year, when released from their icy prison, every effort was again made to pass the western extremity of Melville Island, but in vain; and, after many fruitless attempts, the ships returned to the eastward, and reached England in safety, bringing back every man who had embarked on the expedition, with the exception of one, who carried out with him an incurable complaint.

The farthest point reached by Lieutenant, now Captain, Parry in the Polar Sea, was latitude 74. 26. 25. north, and longitude 113. 46. 43. west; a point of western longitude which, by an amended act of parliament, dividing the sum of L.20.000 into a graduated scale, entitled the discoverers to L.5000.

arry Lyon.

On their return to England, there was not an officer or man in the whole expedition that was not satisfied with the practicability of a western passage from the Atlantic to the Pacific, though in some other line of direction, either to the northward or the southward of the extensive group of islands amongst which they had been navigating. The lords of the Admiralty appear to have entertained the same feelings, and accordingly gave directions for two bombs, the Fury and the Hecla, to be prepared for the prosecution of the discovery. To Captain Parry was given, as was justly due, the command of the expedition, and to Captain Lyon that of the Hecla. They left England in May 1821, and on the 2d of August arrived in the channel formed between Southampton Island and the coast of America; passed the *Frozen Strait* of Middleton, and unconsciously entered Repulse Bay, "wherein was not a piece of ice to be seen." They found it entirely surrounded by land. Proceeding to the northward along the coast of America, they examined several inlets, all of which terminated at short distances from their entrance. The arrival of the 1st of October gave sufficient indications of the necessity of finding some place to pass the winter in; and after much research, to a small island selected for that purpose, Parry gave the name of *Winter Island*. Its latitude was observed to be 66¼°, the lowest temperature, during the winter, was — 40°.

On the 2d of July they left Winter Island, proceeded up Fox's Channel, in which, from the strength of the current, and the floating masses of ice, both ships had a narrow escape from being *nipped*, that is, *crushed* between the huge hummocks. At length they reached the latitude of 67° 18′, where they found a considerable opening in the land of America, out of which a strong current was observed to set into the sea. It turned out, on examination, to be the mouth of a fresh-water river. Proceeding still northerly along the coast of America, they came to a strait which had been previously indicated by a party of Esquimaux at Winter Island, and which one of the women, of a very superior cast, had marked down on a chart, with extraordinary correctness. Near it was the island of Igloolik, where (the 30th of October having arrived) they resolved to take up their second winter quarters. Its latitude was 69⅓°, the lowest temperature 45° below zero. That horrible disease, the scurvy, having, in the following spring, made its appearance, both amongst the officers and the crews, which, however, yielded to the universal specific, lemon-juice, Captain Parry, by the advice of the surgeons, deemed it expedient, as soon as the ships could be liberated, to make the best of his way home, where he arrived on the 18th of October, having lost, in the course of the voyage, and the two winters he was shut up in the ice, five of his crew, three by sickness, one of previous disease, and one killed, out of the two ships' companies amounting to 118 men.

The result of this voyage forms a valuable and important addition to our geographical knowledge. The strait near which they wintered was named by Parry the *Fury and Hecla Strait*. The north-eastern termination of the continent of America was for the first time ascertained to be the southern point of land forming its entrance, and is in latitude 69° 41′ north, longitude 82° 35′ west. The narrowest part of the strait is about two miles across; its length about sixty geographical miles, where it joins Prince Regent's Inlet. It is through this strait that the waters of the Polar Sea are poured, in a perpetual current, into the Welcome and Fox's Channel, carrying with them those fields and hummocks of ice that accumulate in the *Frozen Strait*, and amongst the narrows between the islands that occur from this point down to Hudson's Bay. The strait itself is so choked with ice, adhering to its two shores, as to render it unfit for navigable purposes, otherwise it would be the nearest and most direct line to pursue to get into the Polar Sea through the lower portion of Prince Regent's Inlet.

A third attempt was made in the Hecla and Fury in the years 1824–1825, the least successful of all. In this voyage Parry entered Lancaster Sound, and, instead of proceeding westerly, as he had before done, towards Melville Island, he deemed it expedient to strike off to the southward, down Prince Regent's Inlet, on the supposition, that having reached the current which he had previously ascertained to pass through the Fury and Hecla Strait, he would find himself in the direct line of the passage that would bring him to Icy Cape. It was, however, with much difficulty he was enabled to reach Port Bowen on the eastern shore of the inlet, on account of the vast masses of ice that almost filled up this strait or inlet; and it was then so late in the season that he resolved to winter in this port. On the 20th of July following, the ships were released from their winter quarters by the disruption of the ice; but such was the pressure of the vast masses by which they soon found themselves surrounded, that both ships were driven on shore, and the Fury was finally wrecked. Parry was therefore under the necessity of taking on board the crew of the Fury, and as much of her provisions as he could stow, and of making the best of his way to England.

Of Parry and Ross.

Parry was not in the least disconcerted by the unsuccessful issue of the last voyage. He offered his services on a new plan of discovery, which indeed had already been proposed by Sir John Franklin. This was to proceed to the northern extremity of Spitzbergen, and from thence, with boats, to make the attempt to reach the North Pole. These northern voyages had always been popular from the earliest periods of British navigation. The president and council of the Royal Society addressed a letter to Lord Melville, signifying their approval of Parry's proposal, and stating their opinion, that such an enterprise could not fail to afford many valuable scientific results, and to settle points of philosophical inquiry. The Hecla was again put in commission for this service. She left the Nore the beginning of April 1827, and on the 14th of May was abreast of Hakluyt's Headland, and in June was anchored in a bay in latitude 79° 55′ north, longitude 16° 54′ east. From thence Parry proceeded in two sledge-boats, which he named the Enterprise and Endeavour; Parry in the one, and Lieutenant (now Captain) Ross in the other. At first they had to contend with loose and rugged ice, amongst which were pools of water; they then came to floe or field-ice, in places rugged, and sometimes covered with snow. Over these the boats were to be hauled, which proved a most severe and laborious task, the result of which was a progress of four or five miles a day due north, seldom more. But the most mortifying circumstance of all was, that when they thought they had advanced some ten or twelve miles to the northward, they found that they had retrograded as many miles to the southward, the floe on which they were exerting themselves having been carried by the current in that direction. In this way they struggled for thirty-five days, when, having expended half their provisions, and the season approaching to its termination, it was resolved they should return to the ship, the farthest point that they had reached being only 82° 45′ north, longitude 19° 25′ east.

It has been observed, that this unsuccessful attempt "is of so bold and daring a character, that it must stand as a record to the latest posterity, of the patient, persevering, energetic, and undaunted conduct which British seamen are capable of displaying in the most difficult, discouraging, and dangerous circumstances, when under the command of prudent and intelligent officers, in whom they have entire confidence. On their return they met with open water to a considerable extent, and they reached the Hecla in sixty-one days from the time they had left her. If any future attempt to reach the pole be undertaken, it should not be made by boats, which are at the mercy of every current, and of every floe of ice with which they may come in contact; but in a small sailing vessel, that can take advantage of the open water, which every breeze from the northward affords to a vast extent. The distance is so short, that the success of an expedition of this kind is far from improbable.

Of Ross.

Of Captain (now Sir John) Ross's expedition little need be said. It was a bold but inconsiderate undertaking, and every soul who embarked on it must have perished, but for the ample supplies they received from the Fury, or rather from the provisions and stores which, by the providence of Captain Parry, he had ordered to be carefully stored up on the beach; for the ship herself had entirely disappeared. He proceeded down Regent's Inlet as far as he could in his little ship, the Victory; placed her amongst the ice clinging to the shore, and after two winters left her there; and, in returning to the northward, by great good luck fell in with a whaling-ship, which took them all on board, and brought them home. Captain James Ross, by his indefatigable exertions, collected some geographical information, and proceeded along the eastern coast of the land which Sir John Ross has named Boothia, out of compliment to his generous friend Booth, who bore the expenses of the expedition; and in this journey Ross came to the spot on which, he informs us, the magnetic pole was then situated.

Expeditions of Beechey, Franklin, Richardson, Simpson, Back, &c.

Captain Beechey was employed on a surveying expedition along the western coast of North America, and when he had reached Behring's Strait he despatched his master, in the long-boat, round Icy Cape, to endeavour to fall in with Sir John Franklin, who was proceeding westerly from Mackenzie's River towards Icy Cape. These two officers, uncertain of their respective situations, returned each the way they had come, when about one hundred and twenty miles distant from each other. At the same time Dr Richardson had proceeded easterly and surveyed the American coast as far as Hearne's River, Franklin on a previous expedition having surveyed from thence to Cape Turnagain. The interval between the point reached by Beechey's master and that by Franklin on the second journey was, in the summer of 1837, accurately surveyed by Mr Simpson and the servants of the Hudson's Bay Company, who, with a zeal and spirit that cannot be too strongly approved, are in the present summer of 1838 engaged in completing that part between Cape Turnagain and the bottom of Regent's Inlet, which Captain Back was sent by land to complete, but was too late in reaching the coast for the party to undertake it. Captain Back in the year 1837 was sent, in the Terror, to land at Wager River or Repulse Bay, with the view of accomplishing what the Hudson's Bay servants are in the present year engaged upon; but his attempt was a complete failure, owing to the ship being immoveably fixed in the ice which adhered to the shore of Southampton Island.

Probability of a passage, from the information obtained.

The sketch here given of the various attempts which have been made for the discovery of a north-west, a north-east, and polar passage, is purely *historical*. The results have been uniformly unsuccessful; but though they have failed in the main object, it must not be concluded that they have been useless. On the contrary, they have been the means of accumulating a stock of information of the highest importance in almost every department of science, so as to entitle those who, at the expense of every personal comfort, embarked in them, to the gratitude of mankind. From the present state of our knowledge thus acquired, a very probable conjecture may now be formed of the practicability, or otherwise, of a navigation through some part of the Polar Sea.

In the first place, it has been distinctly ascertained that human beings can winter with impunity to their health in the highest possible degree of cold which can exist in any part of the earth's surface; for there is every reason short of actual proof to believe, that the temperature of the atmosphere on the pole itself is not lower than, perhaps not so low as, in the parallel of 75°, where Parry wintered; the spirit in the thermometer having there descended to 55° below zero. So little, indeed, is a high parallel of latitude the sole cause of a decreased temperature, that, in 65° north, ten degrees less than Parry's winter-quarters, Lieutenant Franklin had the spirit in the tube down to 57°, two degrees lower than Parry. This officer, therefore, left England with the impression that he should experience no injury, nor much inconvenience, from passing a second winter in the Polar Sea, if it should be found necessary.

In the second place, it has now been ascertained in what situations it would be a waste of time to look for a passage, and where the only remaining points are deserving of examination. That a communication, if not a practicable passage, does exist between the Atlantic and the Pacific Oceans, through the medium of the Polar Sea, very little doubt can remain. The constant current which the old navigators Button, Fox, Middleton, and since their time Parry, Lyon, and Back, found setting down the Welcome, and which also, in a less degree, prevails in Baffin's Bay and Davis's Strait, together with the current which as constantly sets up Behring's Strait, as appears from the journal of Cook, Clerke, Glottof, and Kotzebue, testifies to this position. The fact of this circumvolving current, which we have no doubt contributes to those permanent movements everywhere existing in the great oceans, has been called in question, because, forsooth, Sir John Ross found it running as much one way as the other in Baffin's Bay. Sir John Ross had no further knowledge of currents than of those which are generally found to agitate the surface of the sea, and which are known to change with every wind. Superficial currents, however, are not here meant, but the uniform motion of that great body of water, which, in spite both of winds and superficial currents, and in the teeth of both, carry icebergs many hundred feet immersed below the surface, and bear them along the coast of America, in direct opposition to the strongest and most extensive current that we know of, the Gulf Stream. How happens it, then, it may be asked, that none of these icebergs, so very commonly met with in the Atlantic, ever come across to the coast of Norway or Denmark, Scotland or Ireland, with the spread of the said Gulf Stream, after it reaches the banks of Newfoundland, and carries with it so many other matters, floating on the surface, to these coasts? Or why do all the bottles which have been launched in Davis's Strait leave the direction taken by the icebergs, and turn up on some of the above-mentioned coasts? Clearly, because there is a body of water acting on those parts of the icebergs under the surface (and which are at least thirty times the magnitude of the parts above the surface) in a contrary direction to that which is in motion above. The fact is so obvious as not to require another word on the subject. It is the icebergs *only* that are subject to this law. The field-ice, which is influenced and drifted about according to the winds and the currents on the surface, gives no indication of the direction in which the great body of water is moved.

In the same manner, we may be satisfied of the constant rush of water from the Pacific, through Behring's Strait, into the Polar Sea, to supply the constant stream which flows down the Welcome into Hudson's Bay. It is this current which, according to the observations of Kotzebue and the naturalist Chamisso, brings the great quantity of drift-wood found in Behring's Strait and Kotzebue's Inlet. It is the same current by which, on the same authority, we are told, the icebergs and fields of ice, which are formed and break up in the sea of Kamtschatka, "do not drift, as in the Atlantic, to the south, but into the strait to the north;" and the strength of this set of the sea is stated to be from two and a half to three miles an hour, and that even in the teeth of a strong northerly wind. The conclusion drawn by M. Kotzebue is this, "that the constant north-east direction of the current of Behring's Strait proves that the water meets with no opposition, and, consequently, that a passage must exist (to the Atlantic), though perhaps not adapted to navigation. Observations have long been made that the current in Baffin's Bay runs to the south; and thus no doubt can remain that the mass of water which flows into Behring's Strait takes its course round the northern shore of America, and returns through Baffin's Bay into the ocean. But we have still more direct and positive information. Two Russian ships doubled the Icy Cape in 1821, and proceeded some forty or fifty miles beyond the point reached by Captain Cook; and such was the strength of the current *to the eastward*, that it was with the utmost difficulty they could stem it on their return, which a want of provisions, and of every requisite to pass the winter or encounter ice, compelled them to do; but they had no doubt whatever of a practicable passage.

An idea has heedlessly been started, that the superficial current in Baffin's Bay, and that which descends along the coast of Labrador, may be owing to the melting of the ice in summer; but if so, why does not the summer current at least descend through Behring's Strait instead of perpetually ascending it? But the supposition is altogether without foundation; for the quantity of ice destroyed *above* the surface will be replaced by very nearly the same quantity rising from *below* the surface; and, therefore, the water produced by the melting of the ice will merely supply the place of the latter, and not raise the surface of the sea above its usual level, nor produce any current. Be it observed, too, that in the arctic regions little or no increase of the ice is occasioned by the fall of rain or snow, which are of trifling amount.

Another objection, equally frivolous, was taken against a communication of the waters of Hudson's Bay and Behring's Strait, on the ground that the continent of Asia overlapped and was united to America, making Behring's Strait to terminate in a great bay. *That* question, however, has been set at rest for ever, even with those who were disposed to doubt of the voyage of Deschreff. The Russian government has recently employed several men of science to determine points of doubtful position on the northern coast of Siberia. In February 1821, Baron Wrangel, a distinguished officer in their service, left his head-quarters on the Nishey Kolyma, to determine, by astronomical observation, the position of Shelatskoi-noss, or the north-east cape of Asia, which was found to be in latitude 70° 5′ north, considerably lower than it is usually placed on the maps. He then proceeded over the ice directly north for eighty miles, without perceiving any other object than a boundless field of ice. The supposed continuation, therefore, of Asia to the eastward, may be considered as an idle speculation.

But the perpetual current from Behring's Strait has been traced along the whole extent of the northern coast of America into Hudson's Bay (with the exception of some 200 miles not yet examined), by Beechey, Franklin, Richardson, Back, and the Hudson's Bay Company, and so distinctly, as not to leave a doubt on the subject; and Parry found it discharging itself impetuously into Fox's Channel, and down the Welcome through the Strait of the Hecla and Fury. These facts, then, being established, it may be assumed that a water communication does exist between the Atlantic and Pacific; and that, from the low latitude of the coast of America, may be inferred the probability that this communication is a navigable one. The question, then, is narrowed to the direction in which it is most probable a passage will be found? The north-eastern route may be given up, were it only for the great distance (just one half of the whole circumference of the Polar Sea) that it would be necessary to navigate, more or less, amongst ice.

Probable direction of the passage.

The tract pursued by Parry on his first voyage through Barrow's Strait, and amongst the islands, must obviously be given up as hopeless. The prevailing north-westerly winds wedge in amongst the islands such a mass of ice, which never melts, as to render all attempts to penetrate it at the western opening of the funnel impracticable; but beyond this ice, Captain Parry had no doubt there was an open sea, as it was observed, that, whenever the wind came to the eastward, the whole body of the ice kept moving to the westward for several days together. And this open sea is probably not inaccessible from some other quarter. Indeed we now know, that from the concurring reports of those who have examined the line of coast which terminates America, and from Captain James Ross when on the western shore of Boothia, that neither land nor ice was visible to the northward in the first case, nor to the westward in the second. It is clear, then, that to effect a passage to Behring's Strait, the route should be through Lancaster Sound (always free from ice), along Barrow's Strait, to the first opening beyond that of Regent's Inlet, proceeding in a slanting direction to the south-west till the coast of America be in sight, and then westerly to Icy Cape. It is much to be wished that a trial were made of this passage. The attempts hitherto made have taught us that straits, and islands, and shores, should be avoided, as the ice is generally found to block up the first, and by grounding to adhere to the others, and render navigation impracticable. Parry, and Lyon, and Back found that to be the case in the straits through which they in vain attempted to pass; whilst, as all the Greenland fishermen know, there is little obstruction in the field-ice of the open sea, which breaks up and is scattered in all directions by moderate breezes of wind.

Probable mean temperature of the pole.

Sir David Brewster, in an ingenious and interesting paper on the Mean Temperature of the Globe, has shown, in a satisfactory manner, by comparing the results of the late expeditions with those he had drawn from a preconceived theory, "that the mean temperature of the north pole of the globe will be about 11°," which, he says, is "incomparably warmer than the regions in which Captain Parry spent the winter." The mean annual temperature of this spot, according to a series of accurate observations for twelve months, was actually 1° 33′; and on shore could not have been more than 1° below zero.

Coast of the Polar Sea inhabited.

In fact, the whole surrounding coast of the North Polar Sea is inhabited; the European part with Laplanders and Finns; the Asiatic shores with Ostiacks, Samoieds, Yuckagires, Tchutskies, and Koriacks, who derive their subsistence from the rein-deer and dried fish. The Tchutskoi bordering on Behring's Strait are a superior kind of Esquimaux, and are no doubt the same race which extend along the northern coast of America, the shores and islands of Baffin's Bay, Davis's and Hudson's Straits, and the coast of Labrador; and as high up on the coast of Old Greenland as latitude 78°, the highest habitable spot, in all probability, on the face of the globe. All these people, distantly as they are removed from each other, speak the same language, wear the same dress, subsist in the same manner, and in all their habits and appearance are precisely the same people. Spitzbergen has no permanent inhabitants; but English, Dutch, Danes, and Russians, have frequently wintered there; and, even as high as 80° north, many hundreds, some say thousands, of graves are met with in two or three particular spots where it was usual with the Dutch and other nations to extract the oil from the whale and other marine animals furnishing blubber. On Nova Zembla, the body of which is five or six degrees lower in latitude, no inhabitants are found, nor, with the exception of Barentz and his associates, have any been known to pass the winter even in the more southerly parts. Such, indeed, is the difference of climate on the same parallels, that whilst on the southern part of Nova Zembla, in latitude 69°, not a shrub is to be found, at Altengoord, in Norway, in latitude 70°, trees grow to a considerable size. Old Greenland, and the islands on the western shore of Baffin's Bay, of Davis's Strait, and of Hudson's Bay, down to the 55th degree of latitude, are barren of trees and shrubs; whilst on the western side of America, as high up as the 60th and even 65th degree, the firs and birch grow to a considerable size. Even in the short distance which separates America from Asia across Behring's Strait, Kotzebue, in passing from the former to the latter, experienced a change like that of summer and winter; in the former all was verdure, in the latter a complete surface of ice and snow. On the south side of Melville Island, in 75° of latitude, the moment that the snow had departed, the ground was enamelled with a variety of brilliant flowers.

Animals of the northern regions.

Nor are these dreary regions entirely destitute of animated nature. Rein-deer are met with on the northernmost part of Spitzbergen. The polar bear, the wolf, the arctic fox, the polar hare, the ermine, the lemming or Hudson's Bay mouse, the musk-bull, and the rein-deer, were all caught on Melville Island, the first six being perpetual residents, the two last migratory. Grouse, ptarmigan, plover, and a great variety of water-fowl, frequent in vast numbers the straits and islands of the Arctic Seas. The following picture, drawn by the naturalist who accompanied Kotzebue, is correct and interesting. "As, on the one hand, in proportion as you advance farther on the land towards the north, the woods become less lofty, the vegetation gradually decreases, animals become scarcer, and lastly (as on Nova Zembla), the rein-deer and the *glires* vanish with the last plants, and only birds of prey prowl about the icy streams for their food; so, on the other hand, the sea becomes more and more peopled. The *algæ*, gigantic species of *tang*, form inundated woods round the rocky coasts, such as are not met with in the torrid zone. But the waters swarm with animal life,—the *medusæ* and *zoophytes*, *molluscæ* and *crustaceæ*, innumerable species of fish, in incredibly crowded shoals; the gigantic swimming *mammalia*, whales, physeters, dolphins, morse, and seals, fill the sea and its shores, and countless flights of water-fowl rock themselves on the bosom of the ocean, and in the twilight resemble floating islands."

SOUTH POLAR SEA.

Confined knowledge of the South Polar Sea.

Of the South Polar Sea little or nothing may be said to be known. Captain Cook, in the years 1773 and 1774, crossed the antarctic circle in *five* places only; in longitude 39½° east, where he advanced to latitude 67½°, and met with fields and detached pieces of ice; in longitudes 101° and 110° west, between which he proceeded to latitude 71° 10′ south, the farthest progress made by him towards the south pole, where he was stopped, or at least deemed it prudent to return, on account of the fields and mountains of ice which were scattered over the surface of the sea; and in longitudes 136° and 148° west, between which he descended to latitude 68°, and saw many floating ice islands. There are, therefore, still remaining about 340 degrees of longitude in which the antarctic circle has not been crossed, and full half the circumference of the globe which has not been visited lower to the southward than the parallel of 60° south latitude.

Mr Weddell, a master in the navy, proceeded some three degrees farther south than Cook; and since that, two ships of Mr Enderby discovered a long tract of land, the extent of which they did not determine. It is understood this spirited gentleman either has or is about to send out other ships to prosecute at the same time the whale-fishery and maritime discovery.

There was little doubt of the existence of high land in the South Polar Sea, though Cook discovered none beyond the Southern Thule, or Sandwich Land, on the parallel of 60°. Without high precipitous land, those large icebergs which he met with floating amongst the fields of ice could not have been formed; the *hummocks* of ice, occasioned by the agitation of the sea and the meeting of the *fields* or *flaws* in opposite directions, seldom rise to the height of twelve or fifteen feet above the surface. The Russians, indeed, on a recent voyage of discovery, are said to have fallen in with many islands about the seventieth parallel of latitude: they also circumnavigated the Sandwich Land, which was left undetermined by Cook, and conjectured that it might be a part of the great southern continent, which occupied so much of the attention of the geographers and philosophers of the last century. This idea was renewed by the recent discovery of a very considerable extent of land to the southward of Cape Horn, in latitude 63°, and seen extending from longitude 55° to 65° west. As the eastern extremity had not been seen, and the winding of the coast was to the north-east, it was conjectured that it might unite with the Southern Thule of Cook, and form the long-sought-for southern continent. It is said, however, that the Russians have also circumnavigated this land, and that it is composed of a great cluster of islands.

The land in question has been called South Shetland, but it is no new discovery. In the account of the voyage of *the Five Ships of Rotterdam*, under the command of Jacob Mahu and Simon de Cordes, to the South Seas, in the year 1599, it is stated, that, on approaching the Strait of Magelhaens, the yacht, commanded by Dirk Gherritz, was separated from all the other ships, and was carried by tempestuous weather to the south of the strait, to 64° south latitude, where they discovered a high country, with mountains which were covered with snow, like the land of Norway. This land of Gherritz was marked on some of the old charts, but discontinued on the more modern ones, from the uncertainty of its position with regard to longitude. There can be no doubt of its identity with the modern South Shetland. It answered to the description of the mountains of Norway, covered with snow, and is wholly barren, having neither tree nor shrub of any kind. It is unnecessary to say that it is uninhabited, there being no such people in the southern hemisphere as the Esquimaux; and it may be remarked, that no human beings are found in the Southern Ocean below the fifty-fifth parallel of latitude, and none beyond the fiftieth, except on Patagonia and Tierra del Fuego. On the shores, the seals and sea-horses, which had remained from the creation undisturbed, were so numerous, that, on the first notice of the rediscovery, a whole fleet of vessels from England and North America crowded thither on speculation; but the loss of several, from tempestuous weather and a dangerous navigation, and the destruction and alarm of the objects of their cupidity, will probably cause it, for some time at least, to remain as much a land of desolation as it had been before. (M.)

POLARISATION OF LIGHT.[1]

Until a very few years since, the greater number of natural philosophers, and almost all mathematical opticians, were agreed in considering the rays of light as composed of extremely minute molecules, darted, in every possible direction, by a luminous body, with very great velocities. The form of these molecules remained undetermined; but as it was inferred from some observations, made long ago, that certain rays had not the same properties in every part of their circumference, it was natural to compare them to little magnets, and to suppose them possessed of poles. Hence the appellation of a *polarised ray* was applied to every ray of light so modified as to exhibit the polar properties of its molecules. We shall begin this article by describing the different methods that have been discovered for obtaining polarised rays.

SECT. I.—OF DOUBLE REFRACTION, CONSIDERED AS A MODE OF POLARISING LIGHT.[2]

Supposing a pencil of *natural light*, that is to say, of light coming directly from a luminous body, without having undergone any change by refraction or by reflection, to fall upon a crystal of carbonate of lime, perpendicularly to one of its surfaces, either natural or artificial: This pencil will in general undergo a bifurcation as it enters the crystal; one half of the incident light continuing its course in a right line, according to the ordinary laws of refraction, and the other exhibiting a very remarkable phenomenon, and assuming an oblique direction, notwithstanding its original perpendicularity. The former half is called the *ordinary pencil* or ray, the latter the *extraordinary pencil* or ray. The plane passing through these two pencils must obviously be perpendicular to the surface of the crystal: this plane is of great importance in the phenomena of polarisation, and it is denominated the *principal section* of the crystal.

According to this definition, it appears that every ray of light, at each point of incidence on a given crystal, will have a principal section corresponding to it; and we have only to observe, that all these sections will be parallel to each other. In a rhomboid of Iceland spar, the principal section cuts the natural faces of the crystal in a line parallel to the diagonal joining the obtuse angles of the parallelogram, and dividing it into two equal parts.

Now, the *ordinary* and *extraordinary* rays both *acquire* within the crystal *new properties*, not inherent in the direct light. In order to show this, it will be sufficient to remark what happens to these rays when they fall on a second crystal which has the properties of double refraction; and, first, with respect to the ordinary ray, which has preserved its rectilinear direction without deviation.

If the principal section of the second crystal *is parallel* to the principal section of the first, the ray will undergo no double refraction in the second, but will continue its course without any subdivision. But if the principal sections of the two crystals are perpendicular to each other, the ray which was *ordinarily* refracted in the *first* crystal, will become an *extraordinary* ray in the *second*, and will be refracted obliquely when its incidence is perpendicular. But when the principal sections are neither perpendicular nor parallel to each other, this same ordinary ray will be subdivided in the second crystal, but its portions will be of different intensities, excepting when the sections form an angle of 45° with each other.

The extraordinary pencil exhibits phenomena of a similar nature. It remains an extraordinary pencil in every crystal of which the principal section is parallel to that of the crystal which has transmitted it, and becomes an ordinary pencil when the principal sections are at right angles to each other. It is subdivided into two pencils of equal intensity if the two sections make an angle of 45° with each other, and, in every other position, into two pencils of unequal intensities.

It is extremely easy to verify these propositions by experiment. We place on a horizontal table a piece of black paper, and draw two very fine lines at right angles to each other, with a white spot of a certain magnitude at their intersection; and we lay on the paper a rhomboid of calcareous spar, and with our eye immediately above the spot we see two images of it, situated in a line parallel to the shorter diagonal of the upper face of the rhomboid. One of these images is seen in the true place of the spot, as is easily ascertained by two lines which cross in it, and of which the portions not covered by the crystal point at it; these rays have therefore undergone no deviation, and have been ordinarily refracted. The other rays have been bent, since they do not pass through the true place of the spot, and therefore afford the extraordinary image.

We now place a second crystal on the first, in such a manner that the shorter diagonals of the faces in contact may be parallel; and we still find only two images of the white spot, but they are more remote from each other. The one retains its natural situation; whence it follows, that the rays which afford it are no more deflected from their course in the second crystal than they are in the first, and that they have always remained ordinary rays. With regard to the second image, since it is more remote from the true place of the object than when seen through the first crystal only, it is obvious that the rays, which have already been extraordinarily refracted in the lower rhomboid, have undergone the same kind of refraction in passing through the upper.

If we only turn the upper rhomboid round the vertical line, so as to remove its principal section from its parallel position, each of the two images will be subdivided into two others. The new images will at first be very weak; but their intensity will augment by degrees at the expense of the original images, in proportion as the angle formed by the two sections becomes greater; and at last, when it is a right angle, the two primitive images will have disappeared, and the new images alone will remain. One of them will be at a distance from the true place of the spot, in the direction of the shorter diagonal of the upper rhomboid, about equal to the result of the double refraction of the second crystal if it were separate from the first. This image is therefore formed by rays which have been refracted ordinarily in the first crystal, and extraordinarily in the second. And it will be equally manifest that the other image is derived, on the contrary, from rays refracted at first extraordinarily, and then ordinarily, in the respective crystals.[3]

As it is difficult to procure very thick rhomboids of carbonate of lime that are quite transparent, the same experiments may be performed by means of two prisms, cut out of doubly refracting crystals, and rendered achromatic by combining them with prisms of common glass placed with their bases in opposite directions. Through two such achromatic prisms placed on each other, the image of a candle appears quadruple or double, according to the relative positions of the principal sections. We thus see very distinctly that the images which disappear are not confounded with the other two, but that they become fainter gradually, whilst the others increase in intensity by the same degrees.

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[1] This article was written by M. Arago of the French Institute, and obligingly translated by his friend the late Dr Thomas Young, for the *Supplement* to the previous editions of this work. Some additions were, with M. Arago's permission, made by the translator.

[2] See the article Optics, vol. xvi. p. 461.

[3] *Ibid.* p. 461, 462.

It appears, then, first, that the direct light is *always divided* into two pencils in its passage through the natural faces of a crystal of carbonate of lime; and, on the contrary, that the light of which either of the two pencils is composed, when submitted to the action of such a crystal, in *some particular positions* of the principal section, *is not divided*, and gives but a single pencil.

Secondly, the two images furnished by the direct light have always an *equal degree* of brightness; but the light of the ordinary or extraordinary pencils, when it undergoes a further double refraction, gives almost always images of unequal intensities.

Hence it follows, that in the act of double refraction this last light has received some new properties, by which it may always be distinguished from natural light. But are these properties necessarily of such a nature as to be inexplicable without supposing the elementary molecules of the rays to possess certain poles? This is a question which we are now to examine.

We will suppose that a rhomboid of carbonate of lime is placed horizontally; that the incident light falls perpendicularly on its upper surface, and that the principal section, which will be vertical, is in the plane of the meridian, or that it runs north and south; observing, however, that these directions are only chosen to facilitate our comprehension of the facts.

The ordinary pencil afforded by this crystal when it is submitted to the action of a new rhomboid similarly placed, that is to say, having also its principal section in the plane of the meridian, passes through it, as we have seen, without lateral refraction, and continues its course in a right line, remaining as an ordinary ray.

But when the principal section of the second crystal, being still vertical, is directed from east to west, the ordinary ray, transmitted by the first crystal, will be refracted laterally in it, although it falls perpendicularly on the surface, and will become an extraordinary ray.

In the first case, the principal section of the second rhomboid intersected the ray, or the luminous molecules supposed to compose it, from north to south; in the second, these molecules were intersected from east to west. It may be remarked, that this is the only circumstance in which the cases differ from each other, the ray falling in both cases on the same point of the crystal, and in the same angular direction. It must therefore be concluded, that in the ray of light, or in the elements of which it is formed, the north and south sides must have different properties from those of the east and west.

When we analyse the extraordinary pencil with the second crystal, if the principal section intersects this pencil from north to south, it undergoes the extraordinary refraction, but it follows the ordinary course when this same plane intersects it from east to west, which is exactly the contrary of what occurs with the ordinary pencil. The north and south sides of this pencil have therefore the properties of the east and west sides of the extraordinary pencil, and the reverse; nor is there any other difference between the pencils; the sides possessed of similar properties are only differently directed, so that if we could cause an extraordinary ray transmitted by any crystal to make a quarter of a revolution on itself, it would be impossible to distinguish it from the ordinary ray that has been separated from it.

When natural philosophers say of a loadstone or a magnet that it has poles, they merely understand by this expression that certain points about the circumference of the magnet possess properties which do not belong, either at all, or in the same degree, to the other parts of the circumference. It was then equally correct to say of the ordinary and extraordinary rays derived from the subdivision of natural light in the crystals of carbonate of lime, that they had *poles*, or were *polarised*. It is only necessary to remark, in order to avoid extending the analogy between the rays of light and the magnet beyond its proper bounds, that for every element of the ray, the sides or poles diametrically opposite to each other, that is, in the position here supposed for illustration, the north and south poles of the ordinary ray, appear both to possess exactly the same properties; and it is at the angular distance of 90° from these points, that is, on a perpendicular to the line that joins them, that we find in the same ray poles possessed of different properties; and if we compare with each other the two pencils transmitted by a given crystal, the poles possessed of the same properties will be situated in directions perpendicular to each other.

Let us once more consider the two rays transmitted by a crystal of which the principal section is supposed to be in the plane of the meridian. There is no reason whatever for assigning the denomination of poles to the north and south sides of the ordinary ray rather than to the east and west; but as it is necessary to make some distinction, it has been generally agreed to apply the name of poles to the north and south sides. Hence it has been usual to say, that the *ordinary ray* is polarised in the *plane of the principal section;* which is as much as to say that the different elements of the ray have the faces, which we have called poles, situated in that plane. The *extraordinary ray is polarised perpendicularly to the principal section;* its poles are situated perpendicularly to that plane, since it becomes perfectly similar to the ordinary ray when it is made to describe a fourth of a revolution round itself.

When we have arrived thus far, it becomes natural to ask whether we are to suppose that the separation of the light within the crystal has *given* poles to the molecules, or that the poles, already *pre-existing*, have merely been turned towards the same points of space. This question is a very difficult one; but we shall find hereafter, if not a demonstration of the second hypothesis, at least some plausible reason for adopting it. It will be here sufficient to remark, that the modification undergone by the rays is entirely independent of the nature of the crystal, provided that it only produce a double image; and that the phenomena presented by two rhomboids of calcareous spar, placed on each other, would be reproduced, with their minutest details, if we combined, for example, one of these rhomboids with a crystal of carbonate of lead; or if the first crystal were of sulphur, and the second of quartz or of sulphate of baryta.

Polarisation of light by reflection.

But it is not only in the phenomena of double refraction that the particular properties of polarised rays are exhibited; the *reflection* of these rays, at the surfaces of *transparent bodies*, affords also a method of *distinguishing* them from *common light*.

When a pencil of natural light falls on a transparent mirror, with any inclination whatever, it is divided into two parts; the one passes through the substance of the mirror, the other is reflected. This latter portion is always found in the plane passing through the primitive pencil, and the line perpendicular to the surface, which is called the *plane of reflection*, and which must be carefully distinguished from the *reflecting surface*.

If we now place the principal section of a doubly-refracting crystal in a vertical position, and throw a pencil of common light perpendicularly on its surface, receiving the two emerging pencils on the horizontal surface of some water;

and let us suppose the ordinary pencil to make with the surface of the liquid an angle of 37° 15′ [the crystal being held in a position inclined to the horizon]; this pencil will undergo a partial reflection like the direct light, while the extraordinary pencil, when its angle of incidence is also 37° 15′, will *enter the liquid completely, without the reflection of any of its molecules;* a character which constitutes a marked distinction between this pencil and the natural light.

All other circumstances of the experiment remaining the same, let us now cause the crystal to make one fourth of a revolution round the incident pencil, so as to bring the principal section into a position perpendicular to its first situation; we shall then find that the ordinary pencil alone will be entirely transmitted by the liquid; the other will undergo a partial reflection, exactly equal to that which we had first observed in the ordinary ray; the experiment affording a new proof, that the two rays only differ in the direction which is assumed by their corresponding sides.

We find also, that in all positions of the principal section, intermediate between these two, the two pencils will both undergo a partial reflection so much the stronger, for the ordinary pencil, as the principal section is the nearer to a coincidence with the plane of reflection, and for the extraordinary pencil, as these planes are more nearly perpendicular to each other.

We shall finish this section with an account of the mathematical law which appears to determine the comparative intensities of the ordinary and extraordinary pencils into which polarised light is separated when it is analysed with a doubly refracting crystal. Let F_o be the intensity of the ordinary pencil transmitted by any crystal, and F_{oo} and F_{oe} the intensities of the ordinary and extraordinary pencil derived from it in passing through the second crystal: let i be the angle formed by the two principal sections: then we shall have $F_{oo} = F_o \cos.^2 i$; $F_{oe} = F_o \sin.^2 i$.

In particular cases we shall have from these formulas, if $i = 0$, $F_{oo} = F_o$, $F_{oe} = 0$; if $i = 90°$, $F_{oo} = 0$, $F_{oe} = F_o$; and if $i = 45°$, $F_{oo} = \frac{1}{2} F_o$, $F_{oe} = \frac{1}{2} F_o$.

These three consequences of the formula, as we have seen, are conformable to observation. It will not, however, be proved to be mathematically exact, until we have also verified it for some values of i, intermediate between these limits.

The formulas belonging to the extraordinary ray are equally simple: F_e being the intensity of this ray, and F_{eo} and F_{ee} those of the two ordinary and extraordinary pencils into which it is divided by the crystal, i preserving its former signification, we shall have $F_{eo} = F_e \sin.^2 i$, and $F_{ee} = \cos.^2 i$. If $i = 0$, $F_{eo} = 0$, and $F_{ee} = F_e$; and in fact there is no ordinary ray in this case, the whole light following the extraordinary path: if $i = 90°$, $F_{eo} = F_e$, and $F_{ee} = 0$; which is again confirmed by observation, since the extraordinary ray, coming from a certain crystal, follows only the ordinary course in passing through another, of which the principal section is perpendicular to that of the first. The same agreement between the calculation and the experiment will be found when $i = 45°$; which, however, does not supersede the necessity of verifying these formulas, as well as the former, by direct experiments at intermediate angles.[1]

SECT. II.—OF REFLECTION, CONSIDERED AS A MODE OF POLARISING LIGHT.

Reflection, at the surface of a transparent body, affords, as we have seen, a *criterion* for the distinction of polarised from ordinary rays: we must also add, that such a reflection is also capable of polarising ordinary light.

Throwing, for example, a pencil of natural rays on a mirror of common glass in a horizontal position, in such a manner that the inclination of the ray to the surface may be about 35°; we shall find that a part of the pencil will pass through the glass, the other part will be reflected, and the reflected portion will be polarised in the same manner as the ordinary pencil transmitted by a crystal of which the principal section coincides with the plane of reflection.

In fact, if we analyse the light thus partially reflected, by the assistance of a crystal of which the principal section coincides with the plane of reflection, it is not subdivided, and affords only a single ordinary image. Nor is it again subdivided in passing through the crystal when the principal section is perpendicular to the plane of reflection; but in this case it only affords an extraordinary image. In every other position we have both an extraordinary and an ordinary image, the intensity of the latter being expressed by the formula, $F \cos.^2 i$; in which F is the total intensity of the pencil subjected to the experiment, and i the angle formed by the principal section of the crystal with the plane of reflection. This formula obviously coincides with that which we have given for the ordinary pencil in the case of two crystals combined. The plane of reflection here performs the office of the principal section of the first crystal; it is therefore in this plane that the ray has become polarised by the reflection.

Before we assert, however, that there is an identity in the species of polarisation effected by partial reflection with given inclinations, at the surface of a transparent body, and that which results from double refraction, we must submit the ray polarised by a first reflection to the test of new reflections.

These second reflections will obviously throw the light downwards if the mirror is above the ray, or upwards if below; from right to left if the mirror receives the ray on its [left-hand] surface, and the reverse if on the [right] surface.

Now, if the second mirror is above or below the ray, so that the new plane of reflection coincides with the old, there is a partial reflection at all incidences. But when, on the contrary, this mirror is presented to the ray on the left or the right side, and in such a manner that the new plane of reflection may be perpendicular to the old one, all reflection ceases at the inclination of about 35°, already mentioned. In the intermediate positions of the mirror, and with the constant inclination of 35°, the intensity of the reflection varies in proportion to the square of the cosine of the angle formed by the two planes of reflection with each other.

The least attention will show how much analogy this experiment has with those which have been made with a rhomboidal crystal. In those experiments, in order to see if the ordinary ray had the same properties with respect to each point of its circumference, we caused the crystal to revolve round the ray as an axis, so as to bring in succession its principal section, and consequently the poles contained in it, into a vertical direction, from right to left, and so forth; in these different positions we threw the ray on a transparent substance. Here we left the first plane of reflection immoveable, and the second turned round the

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[1] See the article OPTICS, p. 462.

Polarisation of Light.

ray, which was thrown on its different sides. This trial is evidently similar to the former, and the result is identical.

We may therefore now affirm, that the ray which is reflected at the upper surface of the glass, with an inclination of about 35°, possesses in all respects the same properties as a ray transmitted by a crystal of which the principal section coincides with the plane of reflection.

We have supposed the substance employed in this experiment to be transparent; but we must add, that some opaque bodies, such as black marble, ebony, and some varnishes, possess in an equal degree the property of polarising rays which are reflected at their surface. These substances, when made to revolve round a polarised ray, exhibit the same effect, with regard to the reflected light, as the transparent substances which have been considered.

SECT. III.—OF RAYS PARTIALLY POLARISED.[1]

Rays partially polarised are those which possess properties that may be called intermediate between the properties of ordinary light and of light completely polarised. They are distinguished from polarised light by affording always two pencils in their passage through a crystal possessed of the property of double refraction; they differ from natural light in not affording always two pencils of the same intensity, in all positions of the principal section of the same crystal.

It may be asked, if a ray partially polarised may not be considered as consisting of a portion A of polarised and a portion B of natural light. This latter portion would *always* be equally divided into an ordinary and an extraordinary pencil, in its passage through a crystal possessing the properties of double refraction; the other would pass *sometimes* entirely as an ordinary or an extraordinary pencil. In a certain position of the principal section, therefore, the comparative intensities of the two pencils would be $\frac{1}{2}B + A$, and $\frac{1}{2}B$; and, after one fourth of a revolution, they would become $\frac{1}{2}B$ and $\frac{1}{2}B + A$ respectively. In all other positions, A would be divided between the two images; the portion belonging to the ordinary image being expressed by $A \cos.^2 i$, i being the angle contained by the plane of polarisation of A and the principal section of the crystal; and when $i = 45°$, the two images would be of equal intensity.

All these consequences of the hypothesis that we have assumed are conformable to experiment; and we may therefore suppose that a ray partially polarised is composed of two separate portions, the one, B, in its natural state, the other, A, totally polarised. (Sir David Brewster's experiments on partial polarisation will be mentioned hereafter.)

In every pencil reflected perpendicularly by a transparent substance, the portion A vanishes: it acquires greater and greater values in proportion as the angle of incidence increases; but at the angular situation of complete polarisation B vanishes, and A comprehends the whole pencil. Still farther from the perpendicular, we find again in the pencil natural light B, and polarised light A. Lastly, when the incident and reflected light sweeps, as it were, the surface of the mirror, A is again very inconsiderable with respect to B.

Metallic mirrors do not completely polarise the rays that they reflect at any angle of incidence. As in the case of transparent substances, A is evanescent for perpendicular rays; but it becomes sensible in every other case, and the light becomes partially polarised. The angle of polarisation of a metal is that which makes the quotient $\frac{B}{A}$ a maximum.

There exist also some transparent bodies, such as the diamond and sulphur, which never produce complete polarisation of the light that is reflected at their surfaces; but the quotient $\frac{A}{B}$ acquires, at least, much greater values for their substances than for the metals.

The mathematical law which connects the value of A with that of the angle of incidence, and of the refractive form of the mirror, has not yet been discovered. It is only known, that at regular angular distances above and below the angle of complete polarisation, the proportion of A to $A + B$ is nearly the same, although the absolute value of A and B may have changed very considerably.

Thus, in the case of the glass of St Gobin, for example, in which the complete polarisation takes place when the inclination of the ray to the surface is about 35°, we find that the reflected pencils contain the *same proportion* of polarised light at the following angles:—

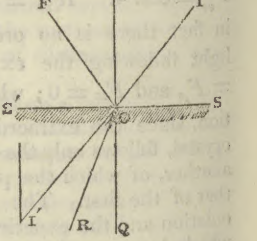
	65° 42′	63° 54′	60° 18′
and	7 12	7 55	11 40
mean	36 27	35 55	35 59

For water, the relation of A to $A + B$ is nearly the same at the angles 3° 29′ and 73° 48′; the mean of these, 38° 36′, exceeds by $1\frac{1}{4}°$ only the true inclination of complete polarisation, though it is deduced from angles which differ from it more than 30°.

In the same manner, therefore, as astronomers determine the instant of the passage of a luminary over the meridian, by corresponding altitudes, observed before and after that passage, we may obtain, with tolerable precision, the angle of complete polarisation, by taking the half sum of the inclinations corresponding to equivalent partial polarisations, especially if we take care not to deviate too far from the angle required; and this method has its advantages, when we make the experiment on bodies which do not polarise the rays of light completely at any incidence.

SECT. IV.—OF THE LAWS WHICH CONNECT THE REFRACTIVE DENSITIES OF BODIES WITH THE ANGLES OF POLARISATION.[2]

It is sufficient to look over the tables which have been published, of the angles of complete polarisation for rays reflected by substances of various kinds, in order to observe that these angles, reckoned from the perpendicular, approach so much the more to right angles, as the refractive densities of the substances are greater; but it was not so easy to detect the remarkable connection which exists between these two elements, and which we shall now proceed to examine.



When a ray of light, IO, passes from a vacuum into a certain medium, SS′, it is refracted at the point of incidence O, approaches to the perpendicular PQ, and follows, for example, the direction OR; the angles POI and QOR being for each medium connected by the proportion sin. POI : sin. QOR $= m : 1$, in which the quantity m is constant for all values of the angles. This quantity, which is always greater than unity, has been called the *index of refraction*, appropriate to the medium. It is necessary to distinguish it carefully from the refractive *power*, a numerical expression depending on m, and on the density, and chiefly relating to the particular properties attributed to refractive substances in the theory of emission.

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[1] See the article Optics, p. 466, col. 2, and p. 469, col. 1.

[2] *Ibid.* pp. 463, 465.

This being understood, if the angle of incidence be supposed such, that the reflected ray OF may be completely polarised, it is found that *the tangent of the angle of incidence will be equal to the index of refraction.*

In the following table, the angles of polarisation, determined by experiment, are compared with those which result from the general law; and the errors are not greater than may be attributed to the unavoidable error of observation.[1]

Substances.	Observed Angle.		Computed Angle.		Difference.
Air	45° to 47°		45°		[1°]
Water	52	45′	53	11′	— 26′
Fluor spar	54	50	55	9	— 19
Obsidian	56	3	56	6	— 3
Sulphate of lime	56	28	56	45	— 17
Rock-crystal	57	22	56	58	+ 24
Topaz	58	40	58	34	+ 6
Iceland crystal	58	23	58	51	— 28
Ruby spinel	60	16	60	25	— 9
Zircon	63	8	63	0	+ 8
Glass of antimony	64	45	64	30	+ 15
Sulphur	64	10	63	45	+ 25
Diamond	68	2	68	1	+ 1
Chromate of lead	67	42	68	3	— 21

This law is capable of being expressed in other two remarkable forms.

Since in all cases sin. POI : sin. QOR $= m : 1$, we have universally sin. POI $= m$ sin. QOR; but for the angle of complete polarisation tang. POI $= m$, and since tang. $= \frac{\text{sin.}}{\text{cos.}}, \frac{\text{sin. POI}}{\text{cos. POI}} = m$, and sin. POI $= m$ cos. POI $= m$ sin. QOR, and sin. QOR = cos. POI, consequently QOR + POI = 90°; hence, *when the polarisation is complete, the inclination of the incident ray to the surface is equal to the angle of refraction; and the reflected and refracted rays are perpendicular to each other.*

It is of consequence to examine some objections which have been made to the accuracy of the law in question. If it were mathematically accurate, the rays of different colours, it has been observed, would not be polarised exactly at the same time, since they enter the refractive medium in different directions. Hence it would follow, that in the usual mode of investigating this angle of complete polarisation by analysing the reflected light with the assistance of a doubly refractive crystal, we ought not, in any case, to lose sight of one of the images; that when we arrived, for instance, at the angle which causes all the red light of the mixed pencil to be polarised, and to pass into the ordinary pencil, the observer ought to see an extraordinary image formed of the *white wanting the red*, that is, *green*; and the same for the other colours. Notwithstanding this, it has been added, in the greater number of cases, the crystal being properly arranged, one of the images is weakened by little and little, as we approach to the appropriate inclination, and at last disappears entirely without presenting any visible traces of colour.

It may be answered, in the first place, that there actually are substances in which this appearance of colour *is* manifest; and which, therefore, do *not* polarise the rays of different kinds at the same angle, but accord with the law of the tangent. Among others may be adduced the instance of specular iron ore, in which the phenomena is very striking; and the oil of cassia, of which the great dispersive power renders it also perfectly distinct. It may be added, too, that there is every reason to hope, that more accurate observations made with homogeneous light from different parts of the spectrum, and more precise measurements of the quantities of light that escape polarisation at inclinations approaching to that of complete polarisation, will hereafter remove the slight appearance of disagreement between experiments and a law too nearly approaching to the whole mass of the phenomena to be considered as otherwise than rigorously accurate.

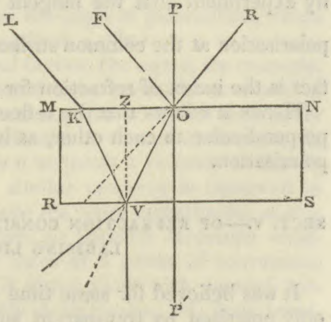
The table already inserted contains the names of several mediums, such as the diamond and sulphur, which do not completely polarise light; the law of the tangent *seems* therefore applicable to such mediums as these, provided that we understand, by the angle of polarisation, that in which the reflected pencil contains the greatest proportion of polarised light. In this case, the observation of this angle for metals would be the more important, as their refractive density has not been hitherto determined.

The angles of greatest polarisation, measured from the perpendicular, appear to be, for mercury, 76½°; for steel, above 71°; hence the index of refraction for mercury and for steel ought to be 4·16 and 2·85. [The oxide colouring the surface of heated steel has been found to give about 2·1 for its index, which agrees sufficiently well with this experiment.]

We have hitherto only spoken of the polarisation which takes place at the first surface of transparent surfaces entered by the light; the second surfaces possess analogous properties with respect to light passing out of them.

The angle measured from the perpendicular at which light is polarised when it is on its passage from a vacuum into a refractive medium, is greater than that in which the same phenomenon is observed when the light coming from the medium tends to pass into the vacuum; it is also shown by experiment that the *sine of the former angle is to the sine of the latter* as the index of refraction is to unity. We might express the same fact by saying, that at the second surface, as well as at the first, *the ray completely polarised* by reflection is perpendicular to the refracted ray. It follows, also, that if a medium is contained between two parallel surfaces, and if we throw a pencil of rays on the first surface, in the angle which affords complete polarisation, the transmitted portion of the pencil will also fall on the second surface in the angle which again produces complete polarisation.

Thus, if MN, RS, be the parallel surfaces, OR the incident ray, n the index of refraction, and OV the refracted ray; the angle of refraction VOP′ will always be equal to the angle OVZ, formed by the refracted ray with VZ, the perpendicular to the second surface. Now, according to the assigned law, when POR is the angle of complete polarisation for the first surface, sin. POR : sin. angle of polarisation at the second surface $= n : 1$, whence sin. POR $= n$ sin. angle of polarisation at the second surface. But from the law of the sines, as in the other cases, we have sin. POR : sin. VOP′ $= n : 1$, therefore sin. POR $= n$ sin. VOP



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[1] See the article OPTICS, p. 464.

Polarisation of Light.

$= n$ sin. ZVO; an equation which, combined with the former, gives the angle of complete polarisation at the second surface = ZVO.

Hence it follows, that if the incident ray, being previously polarised, is such as to escape all partial reflection at its entrance into a substance terminated by parallel surfaces, it will also escape reflection upon its passage out of the substance.

If ROP has the appropriate value, OF becomes completely polarised, and VK likewise: the subsequent refraction in K makes no alteration in this ray; so that when we wish to procure polarised light by reflection from a transparent plate, there is no occasion to blacken the second surface of the plate; supposing it parallel to the first, the polarisation will be equally complete, and the reflected pencil will be brighter. It will only be proper to take care, by placing at a distance from the plate a black substance, as a piece of velvet, for example, to intercept the rays which might be transmitted by the plate from other objects beyond it.

The law from which these consequences have been deduced is only a particular case of a more general law, which may be thus enunciated.

The sine of the angle at which a pencil must be reflected at the first surface of a refractive medium, in order that it may contain a certain PROPORTION *of polarised light, is to the sine of the angle at which a reflection at the second face only would cause an* EQUIVALENT POLARISATION *in the same pencil, as the sine of incidence to the sine of refraction.*

It has been found by experiment, that the sine of the angle at which a certain proportion of a natural pencil is reflected at the first surface of a transparent substance, is to the sine of the angle at which an equal proportion of the same pencil would be reflected at the second surface, if it arrived there immediately, as the sine of incidence to the sine of refraction. This law of photometry, combined with the former, leads to a very simple enunciation.

The first and second surface of a transparent substance polarise light in an equal degree, at the same angles which enable them to reflect light in an equal degree.

We have now seen in what manner light is polarised, either in passing from a vacuum into a given substance, or in returning out of the substance into the vacuum. We must next examine the laws relating to the polarisation which occurs at the surface separating two mediums possessed of unequal refractive powers.

Let m and m' be the indices of refraction for the two mediums: suppose m to be greater than m'; it is proved by experiment that the tangent of the angle of complete polarisation at the common surface is equal to $\frac{m}{m'}$, [which in fact is the index of refraction for that surface].

Hence it follows that the reflected and refracted rays are perpendicular to each other, as in other cases of complete polarisation.

SECT. V.—OF REFRACTION CONSIDERED AS A MODE OF POLARISING LIGHT.[1]

It was believed for some time that the rays of light were only polarised by transparent substances in the act of reflection, and that the refracted pencil always retained the properties of ordinary light. But this opinion was erroneous. It is true, that the simple transmission of light through one or even two surfaces of any known substance is not sufficient for completely polarising a pencil of light; but at certain obliquities it occasions at least a partial polarisation; for, in examining the rays transmitted obliquely by a plate of glass with parallel surfaces, by means of a crystal possessed of the property of double refraction, it is found that the two images differ sensibly in intensity.

Let A' be the part of the transmitted pencil which is polarised, B' the portion of the same pencil not so modified, and A and B the analogous portions of the pencil reflected at the same incidence.

We have already said that A is polarised as an ordinary ray would be, transmitted by a crystal having its principal section coinciding with the plane of reflection; the poles of A', on the contrary, are placed like those of the extraordinary ray of the same crystal. If we analyse with a rhomboid the light reflected by a plate of glass, we find, for example, when in a certain position of the principal section, the image on the right hand is the more brilliant; and the relative position of the plate, the crystal, and the eye, remaining unaltered, it will be the opposite image, on the left hand, that will become the most conspicuous when we examine the transmitted light. All these results may be thus enumerated.

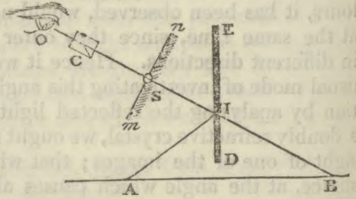
The plane which contains the poles of the transmitted light is perpendicular to that which contains the poles of the reflected light.

These different pencils are therefore polarised in directions at right angles to each other.

If we submit the reflected light $A + B$ to the action of a crystal of carbonate of lime, of which the principal section coincides with the plane of reflection, the intensities of the ordinary and extraordinary pencil will become $A + \frac{1}{2}B$ and $\frac{1}{2}B$.

In the same position of the plate and of the crystal, the intensities of the same images, furnished by the transmitted pencil, will be $\frac{1}{2}B'$ and $A' + \frac{1}{2}B'$.

A will therefore be the quantity by which the *ordinary* image, furnished by the reflected pencil, *surpasses* the extraordinary image, while A' will express, for the transmitted pencil, the quantity by which the *extraordinary* image will surpass the ordinary. With respect to this phenomenon, a remarkable result of experiment may here be noticed; that is, that in every possible inclination $A = A'$, or, in other terms, that the intensities of the two images afforded by the crystal differ in the same degree, whether we consider the reflected or the transmitted pencil.



Let us suppose that a plate of glass ED is placed in the position that the figure represents, before a medium AB of a uniform tint, for instance a sheet of fine white paper. The eye placed at O will receive simultaneously the ray IO, reflected at I, and the ray BIO transmitted at the same point. Place at mn an opaque diaphragm, blackened, and perforated by a small hole at S. Lastly, let the eye be furnished with a doubly refracting crystal, C, which affords two images of the aperture.

If, now, by means of a little black screen placed between B and I, we stop the ray BI, which would have been transmitted, the crystal, properly placed, will give an ordinary image $= A + \frac{1}{2}B$, and an extraordinary image $= \frac{1}{2}B$. But if the screen were placed between A and I, and the ray AI were intercepted, we should still have two images of the hole, and their intensities would be $\frac{1}{2}B'$ and $A' + \frac{1}{2}B'$

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[1] See the article OPTICS, p. 470–473.

respectively. Consequently, without any screen, if the whole of the reflected light AIO and the transmitted BIO are allowed to arrive at the eye, we shall have for the ordinary image, $A + \frac{1}{2}B + \frac{1}{2}B'$, and for the extraordinary, $\frac{1}{2}B + A' + \frac{1}{2}B'$.

Now it appears, from actually making the experiment, that the two images are perfectly equal, whatever may be the angle formed by the ray AI with the plate of glass, which can only be because A is always equal to A'. Consequently,

The quantity of polarised light contained in the pencil transmitted by a transparent plate, is exactly equal to the quantity of light polarised at right angles, which is found in the pencil reflected by the same plate.[1]

Hence it follows, that at the angle of complete polarisation by reflection, the two images of the transmitted pencil given by a crystal properly placed, differ in intensity by a quantity equal to the whole of the reflected pencil. So that if ever a body should be discovered that could reflect half of the light incident at this angle, the pencil transmitted, at the same inclination, would also be completely polarised.

In order to simplify this reasoning, we have supposed throughout that there was only one efficient surface in the plate ED; it would be entering into too much detail if we proceeded to demonstrate in what manner this supposition might be justified; and it will be sufficient to remark, that the experiment in question succeeds equally well when ED is a simple plate of glass with parallel surfaces, which implies that the second surface polarises also equal quantities of light by reflection and by refraction. But, lastly, in order to remove every doubt respecting the accuracy of these results, it may be added, that when some natural light, and some light that had passed through a rhomboid of carbonate of lime, was thrown on a plate of glass reflecting at one of its surfaces, or at both, it was found that the reflected light contained the same quantity of polarised rays in both cases. Now the reflecting plate exercises no particular action on the two equal pencils of light transmitted by the rhomboid, and polarised in directions perpendicular to each other; it only divides them unequally; and if the reflected pencil contains an excess of rays polarised in one direction, there will be found in the transmitted pencil an excess precisely equal, of rays polarised in the direction perpendicular to it. In this case, the law here laid down must necessarily be true; and in order to extend it to natural light, it is sufficient to have assured ourselves, as we have done, that it is affected in the act of reflection and in that of refraction, precisely in the same manner as the combination of two equal pencils polarised at right angles to each other.

One of the best modes of verifying the accuracy of physical laws is, to inquire what their results are in extreme cases. The law now in question, supposing it universally true, leads us, for example, to this conclusion, that where there is no transmission of light, there can be no polarisation; and, in fact, if we cause a pencil of light to fall on the interior surface of a prism, at an inclination which produces complete reflection, we shall find no trace of polarisation in the reflected pencil, although, at incidences but little different, a considerable part of the light, and even the whole, may have been polarised.

Let us represent by A the part of the pencil I which is polarised by reflection, at the angle of 35° from the two surfaces of a plate of glass; the pencil transmitted will be $I - A$: now in this quantity of light there will be, according to the law laid down, A rays of which the plane of polarisation is perpendicular to that of the reflected rays, so that the quantity of natural light remaining will be $I - 2A$, which we may call $= I'$. Then the pencil $I' + A$ falling on a second plate, parallel to the first, and consequently at the same angle as before, A will entirely escape the partial reflection, and, abating what may be lost by absorption, will be found entire in the pencil transmitted by the second plate; I' will be divided in the same manner as I was at first; a portion A' of I' is polarised by reflection, the remaining portion $I' - A'$ is transmitted, and will contain A' of polarised rays, so that the natural light, after passing through the second plate, will be reduced to $I' - 2A'$, and the quantity polarised by refraction will be $A + A'$. Making $I' - 2A' = I''$, the light $I'' + A + A''$ will furnish, in its passage through a third plate, parallel to the two former, a new quantity A'' of light polarised by refraction, which will be added to $A + A'$, and so forth.

The pencils, I, I', I'', and so forth, consisting of natural light, are polarised in equal *proportions* by the respective plates: the quotients $\frac{A}{I}, \frac{A'}{I'}, \frac{A''}{I''}$, will constantly have the same value. If, for instance, $\frac{1}{6}$th part of the pencil I is polarised by reflection at the surfaces of the first plate, $\frac{1}{6}$th of I' will be polarised at the surfaces of the second, $\frac{1}{6}$th of I'' by the third, and so forth; and the pencils transmitted by these same plates will contain respectively of natural light, or of light possessing the same properties, $\frac{4}{6}$ths of I, $\frac{4}{6}$ths of I', $\frac{4}{6}$ths of I'', and so forth. Hence, whatever may be the number of plates employed, the pencil ultimately transmitted will contain, mathematically speaking, a certain quantity of natural light; but this quantity will be rapidly diminished, and will finally become completely insensible. [Sir David Brewster, on the contrary, maintains that it wholly disappears after transmission through a finite, and even a moderate number of plates.]

It may be said, in this sense, that a pile of parallel plates polarises the light which passes through them, in a direction perpendicular to the plane in which the rays would be polarised by reflection at the same surfaces.

We have here supposed the incident light to meet the plate of glass at the inclination capable of polarising it completely by reflection; but the same result is obtained whatever the inclination may be. It is only necessary that it should be composed of a number of elements, so much the greater as the direction of the rays is nearer to the perpendicular.

With a given inclination, the number of plates necessary to produce by transmission a polarisation nearly complete, depends also on their reflective power: we have already observed, for example, that a single plate, capable of reflecting half the incident light at the angle of polarisation, would of itself be sufficient to constitute a pile.

There are certain natural bodies, the agate, for example, which modify the transmitted light precisely as a pile of plates would do. If we cut a plate of agate sufficiently thick, in a direction perpendicular to that of its laminæ, the light which passes through it acquires a polarity in the direction of the plates. A similar property is observed in the tourmaline, and it is here the more remarkable, as this mineral, when pure, exhibits no lamellar structure whatever. If the two opposite faces of a prism of tourmaline are polished so as to form it into a plate with parallel surfaces about $\frac{1}{25}$th of an inch in thickness, the light transmitted by it, whatever its angle of incidence may be, will be polarised in a direction perpendicular to the axis of the column.

It will be proper to mention here the phenomena exhibited by piles of plates when they are exposed to rays that have been previously polarised: supposing always that the pile is formed of parallel plates of glass; and, besides, that the angle of inclination to the first surface is about 35°, reckoning from the surface itself.

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[1] See the article OPTICS, p. 473.

If the primitive plane of polarisation of the incident ray coincides with the plane drawn through this ray and the perpendicular to the first plate at the point of incidence, a part of this ray more considerable than if we employed natural light will be reflected; at the point of incidence on the second plate, the luminous pencil transmitted by the first will undergo reflection in the same proportion as the former pencil; the same effect will take place in the third plate, and so forth. The transmitted ray, however intense it may have been in the first instance, will thus be gradually weakened in a geometrical progression, and at last will become insensible; so that if we look at the pile on the opposite end, it will appear to be an opaque body, perfectly impervious to light.

Everything else remaining in the same state, if we turn the pile round the ray as an axis through an angle of 90°, the new plane of reflection will be perpendicular to the former, and the plate will have reached the situation which has been already mentioned, in which the reflective property wholly disappears, and the whole of the light will pass through it. But the second plate, the third, and all the following plates, which are parallel to the first, will be found in the same circumstances possessing the same properties, and will not reflect any of the incident light; so that, setting aside the effect of absorption, the apparatus actually transmits light without weakening it.

The pile of plates possesses, therefore, with respect to polarised light, the singular property of being either completely opaque or perfectly transparent, according to the side which it presents to the light, notwithstanding that the inclination of the light to the first surface remains constantly 35°. In the intermediate positions the quantity of transmitted light increases gradually as we proceed from that in which nothing is transmitted, to the other extreme in which the light is only weakened by absorption.

Tourmalines and agates appear to be true piles of plates, so that they must produce similar effects; and, in fact, a plate cut, for example, in a direction parallel to the axis of a column of tourmaline, transmits rays which are polarised in a plane perpendicular to the axis, and totally stops, on the other hand, rays of which the primitive plane of polarisation is parallel to that axis.

When we place such a plate between the eye and a reflecting surface of water or glass situated in the open air, and look at it with an inclination producing complete polarisation, it appears either fully enlightened or quite dark, or in intermediate states, according to the situation of the plate in its own plane. A circumstance which adds to the singularity of this experiment is, that it succeeds completely even when the incidence on the plate is perpendicular; while for a pile properly so called, unless it be composed of an immense number of plates, it is necessary that the distance of the ray from the perpendicular should be very considerable.

Whatever may be the cause of these phenomena, it results evidently, from what has been mentioned, that two plates of tourmaline placed so that their axes form a right angle, must compose a system perfectly opaque with respect to light of all kinds. If, for example, the incident light is in its natural state, it is obvious that the portion transmitted will be polarised in the direction of the axis of the plate, and that the second plate, situated in a perpendicular direction, will consequently stop the whole of the light so polarised.

SECT. VI.—OF THE DEPOLARISATION OF LIGHT.[1]

After having examined in what manner ordinary light is converted into polarised light, we must now proceed to study the modifications which this latter undergoes in its turn when it is subjected to reflection or refraction at surfaces of different natures, and differently situated with respect to its poles.

When a polarised pencil falls on the surface of a well-polished mirror, in such a manner that its plane of polarisation coincides with the plane of reflection, or is perpendicular to it, the light regularly reflected at this surface is completely polarised, like the incident pencil, in a direction parallel or perpendicular to the plane of reflection; and this happens whatever the nature of the mirror may be.

But whenever the primitive plane of polarisation of the incident pencil is any otherwise situated, it will be found that the reflected pencil is modified, and the modification will depend on the nature of the mirror.

When we employ for these experiments a mirror either transparent or opaque, which is capable of *completely polarising natural light*, the rays previously polarised which fall on this surface will *again be completely polarised*, after their reflection, but *not in the plane of their primitive polarisation.* This *deviation* of the plane of polarisation of a luminous pencil, produced by its reflection at the first surface of a transparent mirror, depends both on the angle of incidence and on the direction of the plane of reflection with regard to the poles of the ray.

For given inclination, the deviation is so much more considerable as the plane of reflection makes with the plane of primitive polarisation an angle more nearly approaching to 45°.

Let us first suppose, in order to assist the imagination, that the reflecting surface is horizontal; that the eye of the observer, and the rhomboid which is to furnish the polarised pencil, remain constantly situated, the one to the north, the other to the south of the point of reflection, so that the plane of reflection may always coincide with the meridian; and that, lastly, the principal section of the crystal, which contains in its plane the poles of the ordinary pencil, makes an angle of 45° with the meridian.

When this ordinary pencil falls perpendicularly on the mirror, it will be reflected without any deviation of its plane of polarisation: so that this plane, having at first formed, by the suppositions, an angle of 45° with the meridian, the inclination to the meridian will remain the same after the reflection.

If we cause the direction of the incident light to vary more and more from the perpendicular, we shall first remark that the plane of polarisation of the reflected light approaches by degrees to the plane of reflection, and that it coincides exactly with it when we have arrived at the angle of complete polarisation; that afterwards the reflected ray is polarised in a plane which is more remote from the plane of reflection in proportion as it forms a smaller angle with the surface of the mirror; and that at last, when the ray is nearly parallel to the surface, its plane of polarisation coincides with that of the incident light, as it did when the incidence was perpendicular.

Let us call the angle of incidence, reckoned from the perpendicular, i, the corresponding angle of refraction for the substance concerned, i'; the tangent of the angle formed by the plane of polarisation of the reflected light with the plane of reflection will be expressed by $\frac{\cos.(i+i')}{\cos.(i-i')}$.

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[1] See the article OPTICS, p. 470.

This formula may be illustrated by applying it to particular cases. If $i = 0$, i' being also $= 0$, $\frac{\cos.(i+i')}{\cos.(i-i')} = 1$; but the angle of which the tangent is unity is an angle of 45°. Consequently, if the formula is correct, the plane of polarisation for the reflected ray, when the incidence is perpendicular, must coincide with the primitive plane of polarisation of the light employed; and this is conformable to observation.

The angle of which the tangent is $\frac{\cos.(i+i')}{\cos.(i-i')}$ becomes also 45° when $i = 90°$; that is to say, when the rays are parallel to the surface concerned, since then $\cos.(i+i') = -\cos. i'$, and $\cos.(i-i') = +\cos. i'$. The light preserves, therefore, in this case also, its primitive plane of polarisation, as the experiment had shown.

If $i+i' = 90°$, the angle of i, as it has already been observed (Sect. III.), is that of complete polarisation, and $\frac{\cos.(i+i')}{\cos.(i-i')}$ is $= 0$; so that the plane of polarisation of the reflected ray coincides with the plane of reflection, which has already been shown by experiment.

The following table will show that, for intermediate angles of incidence, the agreement between this mode of calculation and the observation is as satisfactory as it was possible to expect.

On Glass.

Angles of Incidence.	Observed Deviation of the Plane of Polarisation.	Computed Deviation.	Difference.
24°	38° 55′	37° 54′	+1° 1′
39	24 35	24 38	—0 3
49	11 45	10 52	+0 53
56½	0 0	0 0	0 0
60	5 15	5 29	—0 14
70	19 52	20 24	—0 32
80	32 45	33 25	—0 40
85	38 55	39 19	—0 24
87	40 55	41 36	—0 41
88	41 15	42 44	—1 29
89	44 35	43 52	+0 43

On Water.

Angles of Incidence.	Observed Deviation.	Computed Deviation.	Difference.
53°	0° 0′	0° 0′	0° 0′
60	10 20	10 51	—0 31
70	25 20	24 48	—0 32
80	36 20	35 49	+0 31
85	40 50	40 32	+0 18

The formula, thus compared with experiment, supposes that the primitive plane of polarisation of the light employed *makes an angle of* 45° *with the plane of reflection;* but a slight addition is sufficient to accommodate it to all other cases. If we make a the angle of which the particular value is here assumed 45°, i and i' retaining their values, the tangent of the angle expressing the deviation of the plane of polarisation of the incident pencil, after reflection, will in general be represented by $\frac{\cos.(i+i')}{\cos.(i-i')}$ tang. a.

It is easy to observe, that, in the most material cases, this formula correctly corresponds with the experiments; but we are still in want of an experimental demonstration of its truth for any very diversified combinations of the values of a and i.[1]

The deviations of the planes of polarisation follow the same gradations when the reflection takes place at the second surface of transparent mirrors, from the position of perpendicular incidence to that of the beginning of total reflection. But beyond that inclination the phenomenon acquires a character totally different: we have then no longer a simple change of the direction of the primitive poles of the ray; for unless the plane which contains the poles either coincide with the plane of reflection or be perpendicular to it, the ray will undergo a true depolarisation, so that however we place the rhomboid through which we cause it to pass, we shall always observe that two images are formed. The same happens also when the mirror is metallic. The particular and very remarkable modifications which the light undergoes in these two cases will shortly be mentioned.[2]

SECT. VII.—OF THE PHENOMENA OF INTERFERENCE, SO FAR AS THEY ARE MODIFIED BY A PREVIOUS POLARISATION OF LIGHT.[3]

It has long been known [having, however, first occurred to the translator of this article in the room and at the table on which he is now writing], that if, after having cut in a thin plate of metal two very fine slits very near to each other, we cause them to be enlightened by a pencil proceeding from the same radiating point, we may observe behind the plate a formation of iridescent fringes, derived from the action exerted by the rays scattered from the left-hand slit on the rays scattered from the right-hand slit, in the points where these two parcels of rays are intermixed.

This experiment, when studied in all its details, has led to the simple law, which may be thus enunciated: Two rays of homogeneous light, *proceeding from the same source*, and arriving from a given point of space by two different routes, a little unequal in length, co-operate with each other, or are destroyed, and form, on a screen which receives them, either a bright or a dark spot, according to the magnitude of the difference of their routes.

The two rays always co-operate completely when they are united after passing through a route of equal length. If the smallest difference of routes, which will cause them again to co-operate, be called d, they will co-operate whereever the distance is any member of the series $2d$, $3d$, $4d\ldots$; and the intermediate values $0+\frac{1}{2}d$, $d+\frac{1}{2}d$, $2d+\frac{1}{2}d\ldots$, will show the cases in which the two rays, when combined, produce darkness. The magnitude of the quantity d varies with the species of light concerned, and with the nature of the medium which transmits it.

If two rays destroy each other after having passed through routes differing, for example, by the quantity d', they will also destroy each other after having passed through, either perpendicularly, or with the same obliquity, two plates of *the same nature, and of the same thickness.*

A difference of thickness, or of refractive density, in the two plates interposed, may produce the effect of an inequality in the routes described: the difference will give rise, in certain cases, to a displacement only of the fringes; but in others they will entirely disappear.

These laws relate to the rays of light in their natural state; if we employ polarised light, we obtain results which, independently of the numerous applications of which they are susceptible, deserve for their singularity to arrest our attention.

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[1] Such experiments will be found in the article OPTICS, p. 465, 466; and in the same article the reader will find a new formula, confirmed by numerous experiments, exhibiting the deviations of the planes of polarisation produced by *refraction.*

[2] See the article OPTICS, p. 505.

[3] Ibid. p. 426 and 497.

Let us first suppose, that instead of enlightening *the two* slits of the plate of metal with natural rays, we employ polarised light, the fringes will be formed equally in both cases.

If we then try the effect of the light polarised in one direction and transmitted by one of the slits on the light polarised in a perpendicular direction, and transmitted by the other; an arrangement which may be obtained by placing two piles properly directed in the passage of the different rays; we shall find, that when the directions are correctly perpendicular, there is no trace of fringes behind the perforated plate.

It has been remarked, that any material difference in the mediums through which the two rays pass, is sufficient to annihilate the effects of interference which would otherwise be observable. The experiment now mentioned would therefore be wholly inconclusive, if we had not previously assured ourselves that the piles, which are supposed to be of the same nature, are also exactly of the same thickness. The best mode of ascertaining this is evidently to render the two planes of polarisation parallel: if in this case we perceive fringes, and if, after having turned one of the piles one fourth of a revolution round its axis without changing their mutual inclination, we find that they disappear, we may fairly conclude that this disappearance must be attributed to the direction of the polarisation of the rays of light concerned.

This experiment would be a very difficult one to make with success if the piles had any considerable thickness; but they may be made very thin by means of plates of mica, or of bits of glass blown in a lamp; and then, by dividing them in the middle, we may obtain a pair of piles of thicknesses perfectly equal. Besides, nothing prevents our varying gradually the inclination of one of the piles, so as to compensate in this manner for the effect of a slight difference of thickness, if it exists.

But there is another mode of observation which is more convenient. We take a crystal of tourmaline cut in a direction parallel to its axis, so as to form a plate with parallel surfaces; we divide it into two parts, and apply the two portions, one to the slit on the right hand of the plate, and the other to that on the left. We then find that fringes are produced when the two axes of the fragments are parallel, and that no traces of them are left when they are perpendicular to each other; and that in changing the positions of the portions of tourmaline from one of these relations to the other, the intensity of the fringes gradually disappears.

Supposing now the piles to remain fixed to the slits in perpendicular directions, so that no fringe may be visible; and placing a third pile before the eye of the observer, in a plane that forms an angle of 45° with the planes of incidence of the two former; this last plane must reduce to a similar polarisation the rays coming from the two slits, which before they met were polarised at right angles; so that there seems to be no reason why the rays should not again interfere: and yet whatever pains we take in the experiment, we shall discover no trace of fringes. [Might there not, however, be fringes if the rays met behind the third pile rather than before it? Tr.]

It is unnecessary to remark, that a tourmaline of any kind may be substituted for the third pile, as the two former may be exchanged for the two halves of a piece of tourmaline with parallel surfaces: the result will be precisely the same.

Let us lastly suppose, in order to exhaust all possible combinations, that the plate of metal is illuminated with polarised light, and that two piles or two tourmalines are so placed as to transform the rays passing through the two slits from rays polarised in the same direction, into rays polarised in directions at right angles to each other; and that, before the interference of the rays, we bring them back to a similar polarisation, either by the assistance of a third pile, or by that of a tourmaline, as in the former experiment: the observer will then find, and no doubt with great surprise, that the rays are again susceptible of interference, or that in mixing together they produce a very visible group of iridescent fringes.

The series of experiments here related leads us to the following conclusions.

1. Two pencils converted from natural light into light polarised in the same direction, retain, after this modification, the property of interfering with each other.

2. Two pencils, which are made to pass directly from the state of natural light to that of light polarised in two perpendicular directions, are no longer capable of interference, either while they remain in this state, or after they have been restored to a similar polarisation.

3. Two pencils polarised in contrary directions do not interfere, whatever may have been the modifications that they have undergone before they arrive at this state from that of natural light; but when restored to a similar state of polarisation, they become capable of interfering, provided that, in their passage from the natural state to that of polarised light, THE FIRST planes of polarisation of the two pencils were parallel.

Thus it appears, that in these phenomena the mode of action of the rays does not depend on *what they are* only when they meet, but also *on what they have previously been.*

SECT. VIII.—OF THE KIND OF POLARISATION WHICH IS EXHIBITED IN THE APPEARANCE OF COLOURS, AND WHICH HAS THEREFORE BEEN CALLED COLOURED POLARISATION.[1]

We may first examine the *nature* of the new modification of light that is concerned in these appearances; and, secondly, the *means* of producing it.

Supposing a ray of direct light to be polarised in any of the ways that have been described, and then to pass through a plate of rock-crystal cut perpendicularly to the edges of the hexaedral prism, about a quarter of an inch in thickness, and having both its surfaces perpendicular to the ray: when it emerges from the surface, it will no longer possess the properties of common polarised light; and yet it will not have re-assumed the characters of direct light: for if we submit it to the action of a rhomboid of carbonate of lime, instead of affording one image only in a particular position with respect to the principal section of the crystal, it will be *constantly* subdivided into two pencils; so that it cannot be identical with common polarised light.

Neither is it simply natural light; for a white pencil of natural light is always divided, by a doubly refracting crystal, into two white pencils of equal intensity. The white pencil which has passed through the plate of quartz, on the contrary, gives always two images, but they are distinguished by the most vivid colours. If the ordinary image is red, the extraordinary is green, and the reverse: and the case is the same with regard to the other prismatic colours; that of the ordinary pencil is complementary to the tint of the extraordinary pencil, and they both vary according to the position of the principal section of the rhomboid which causes the separation.

The prismatic telescope of M. Rochon affords an apparatus perfectly adapted to the performance of these experiments, and which requires to be mentioned, first, because it exhibits the tints with great brilliancy; secondly, because it gives us the means of assuring ourselves that the images viewed lose nothing of their distinctness by the interposition of the plate, and that its effect is not owing to any irregular dissipation of the light concerned; and, thirdly, on account of the facility with which it allows us to show that the tints are complementary to each other.

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[1] See the article Optics, p. 476–501.

This instrument is nothing more than an ordinary telescope, furnished, between the object-glass and the eye-glass, with a prism of rock-crystal or of carbonate of lime rendered achromatic. This prism being moveable at pleasure along the axis of the telescope, the observer is enabled to separate more or less, at his pleasure, the two images of the object which he is viewing.

Having, then, before the object-glass of this telescope the plate of quartz in question, and adapting besides to the eye-glass a greenish dark glass of a particular kind, which is much employed by astronomers because of its property of absorbing a good deal of light, without sensibly colouring the transmitted pencil; if we observe the sun directly with this instrument, we shall see two images of the sun, both white, and of equal brightness, whence it follows that the plate produces no particular effect on natural light; but if, on the contrary, we look at the sun's image as reflected by a plate of glass not silvered, we shall perceive two more suns, each of them coloured; and whilst the telescope performs half a revolution on its axis, they will both run through nearly the whole series of the prismatic colours. Thus, the image that was red, will become successively orange, yellow, greenish-yellow, bluish-green, and violet: and at this period the telescope will have made half a turn; its movement being continued, the violet image will become first red, then orange, and so forth. The second image will always give us the complementary colour; for if, instead of completely separating the images, we allow them to overlap each other, the part common to both the discs will remain constantly white, while the remaining lunular portions will exhibit the most vivid colours.

The reflection of a transparent plate may also be employed for more directly exhibiting the distinctive properties of the light transmitted by the plate of quartz.

If we cause a plate of glass to turn round a pencil of natural light forming with its surface an angle of about $35\frac{1}{2}$°, the reflected pencil will be directed in succession to all the points of the horizon, but it will constantly preserve *the same intensity*.

But if the incident pencil is polarised, we shall find, on the contrary, two positions diametrically opposite to each other, in which the mirror will not reflect *a single ray*.

Making, now, a similar experiment with the light that has been transmitted by a plate of rock-crystal, we shall see that it becomes coloured by reflection, though it falls white on the plate, and that the nature of the *colour* depends on *the side of the ray* that is presented to the reflecting surface. These reflected colours succeed each other during the revolution of the plate, in the same order as in the prismatic spectrum; and they are also observed in the transmitted light, being always complementary to those of the light reflected at the same time.

If the properties of polarised rays depend, as is supposed by the partisans of the system of emission, on the particular arrangements assumed by the molecules of which they are formed, it will be easy to describe the intimate composition of the ordinary polarised ray, and that of the same ray after it has passed through the plate of rock-crystal: in the former, the axes of all the molecules of the different colours must be parallel; in the latter, the molecules of different tints must have their poles turned towards different parts of space.

It now becomes necessary to examine according to what law the direction of these poles is varied, both as they depend on the particular tint of each molecule, and on the greater or less thickness of the crystal that they have passed through.

If we employ homogeneous polarised light, we shall readily find, that, supposing a given plate of quartz to turn the poles of a certain ray of light through an arc of 20° from their primitive direction, a plate of the same crystal twice as thick will cause a double deviation, and will turn the pole through an arc of 40°; a plate of thrice the thickness will cause a triple deviation, amounting to 60°; and so forth, without limit.

With regard to the simple rays of different colours, in passing through a given plate, they undergo deviations so much the more considerable as they are more refrangible, and this in the inverse proportion of the numbers which Newton calls the lengths of the fits; or, what comes to the same result, in the inverse proportion of the quantities which have been designated in this article by the letter *d*. (Sect. VII.)

When, therefore, we know the deviation for a given plate, we may find the effect of a thicker or thinner plate of the same substance by a simple proportion.

Table of the Deviations of the Planes of Polarisation of the different "Homogeneous" Rays in passing through a Plate of Rock-Crystal perpendicular to the Axis of the Prism, of which the thickness is a millimetre, or ·03937 E. I. [according to the Newtonian division of the spectrum].

Extreme red	17·50°
Limit of red and orange	20·48
...... orange and yellow	22·31
...... yellow and green	25·68
...... green and blue	30·05
...... blue and indigo	34·57
...... indigo and violet	37·68
Extreme violet	44·08

There is no reason to suppose that the angular deviations will undergo any alteration in their values when all the molecules pass through the crystal at the same time. Consequently, in the white pencil transmitted by a plate of a millimetre, the axes of the elementary red rays will form an angle of 8° with the axes of the first orange rays, of about 5° with those of the first yellow rays, and of 26·5° with the axes of the extreme violet rays; and if we analyse this white pencil by means of a rhomboid, the differently coloured rays will not be divided in the same proportions between the two images: hence there will necessarily be appearances of colour. It is obvious, for example, that when the rhomboid is so placed that its principal section shall coincide with the poles of the red ray, this ray will remain altogether in the ordinary pencil, and the red tint will be wholly wanting in the extraordinary image.

We may obtain an exact idea of the modification which a plate of quartz produces in a white pencil of polarised light, by conceiving a combination of red rays polarised by reflection at the surface of a certain transparent substance, of orange rays polarised by a second surface placed in a different angular situation, of yellow rays polarised by a third surface, and so forth. The necessity of the intimate mixture of all these kinds of molecules in each line of white light, and some other obstacles, would render it impossible to realise this fiction without a very complicated apparatus; while a simple plate of quartz is sufficient, on the other hand, to give to the different constituent parts of the white pencil these individual polarisations situated in different azimuths.

The phenomena which have been described are produced by plates of quartz with parallel surfaces cut perpendicularly to the axis of the hexaedral prism. Now, in a direction perpendicular to these surfaces, quartz exhibits no double refraction; so that the causes which in this case produce the deviation of the planes of polarisation of the luminous molecules, are different from the causes which occasion the separation of the two pencils in other sections of the crystal. And it is remarkable that the properties of these plates have been found in bodies not possessed of regular crystallization, as flint-glass, and even in perfect fluids, such as the essential oils of turpentine and of lemons, or the solution of camphor in alcohol, the simple syrup of sugar, and so forth. The only difference is in the absolute value of the thicknesses which afford the same tints, the other laws remaining the same. Thus the thickness of oil of turpentine must be sixty-nine times as great as that of a plate of rock-crystal to produce the same effect; and the action of the oil of lemons is to that of the oil of turpentine as seventeen to ten [or to that of crystal as one to forty-one].

We have seen that a plate of quartz a millimetre in thickness causes the poles of the red molecules to describe an arc of 17·5°. We may suppose this motion to have taken place from right to left: then every other plate, of whatever thickness, cut out of *the same* crystal, will cause the poles to deviate still farther in the same direction, that is, to turn still from right to left; whilst other plates, on the contrary, cut out of a different crystal, may turn them from left to right. This phenomenon, at first sight, must appear very singular; but if we reflect that the rays pass through the plates in a direction which affords no double refraction, we shall be aware that a deviation of the poles directed constantly the same way in every specimen of the crystal would be not at all less astonishing.

It has not hitherto been possible to point out any exterior signs which shall indicate the direction of the deviation that will be produced by a given crystal, except in one very remarkable case. In some varieties of quartz, the solid angles, situated at the base of the pyramid by which the prism is terminated, are replaced by as many facets placed obliquely with respect to the edges. Now the direction of the deviation which these *plagiedral* crystals give to the poles of the luminous molecules, is constantly that of the obliquity of these little facets.

When a polarised ray passes successively through two plates producing contrary rotations, the ultimate deviation of the poles is the difference of the effects which each plate would have produced separately. The ray exhibits exactly the same tints as if it had passed through a single plate, of a thickness equal to the difference of the thicknesses of the two plates.

If the plates thus combined are equal in thickness, the pencil transmitted, having been turned first in one direction, and then turned back in the contrary direction, seems not to have its polarisation ultimately changed.

The essential oil of turpentine causes the axes of the molecules of the polarised ray to turn from the right to the left of the observer receiving the ray; the essential oil of lemons from left to right. These fluids do not lose their peculiar properties when they are mixed; so that if their proportions in the mixture are inversely as their rotatory forces, the ray which has passed through them retains its primitive polarisation.[1]

SECT. IX.—ON THE PHENOMENA OF DEPOLARISATION, AND OF COLOURS PRODUCED BY CRYSTALLIZED PLATES NOT CUT PERPENDICULARLY TO THE AXIS OF DOUBLE REFRACTION.[2]

We are next to inquire how a white pencil, polarised in a single direction, is modified in passing through a crystalline plate possessed of double refraction.

For this purpose we may place the principal section of a rhomboid of calcareous spar in the plane of polarisation of a white pencil, which of course will be subjected to the ordinary refraction only: we may then place the plate in question before the rhomboid, so that the rays may pass through it perpendicularly. If now the principal section of this plate is parallel to that of the rhomboid, we shall still see but one white image; and the same will happen if the principal sections are perpendicular to each other; but in every other situation of the plate, the rhomboid will furnish two pencils, and they will be distinguished by *complementary tints.*

The motion of the plate in its own plane does not alter the *nature* of the tints: their brightness only varies, and becomes greatest when the angle formed by the two sections is equal to 45°.

These tints vary with the thickness of the plate, and degenerate into perfect whiteness when the thickness becomes considerable. In the sulphate of lime, the appearances are no longer observable when the thickness is about half a millimetre, or one fiftieth of an inch.

Supposing O to be the tint of the ordinary pencil, and E that of the extraordinary; the experiment shows that the tint E is nearly that of one of the coloured rings seen in the light reflected from two object-glasses touching each other, as in the celebrated experiments of Newton; and that the tint O is that of the corresponding transmitted ring. This rule, however, is not perfectly general; for in many crystals the tints E by no means resemble those of the rings.

When the regular sequence of the Newtonian rings is observable, the successive thicknesses of the same crystal, which afford the respective colours E, are proportional to those which Newton has assigned for substances not crystallized: it is only found that, for any given density, the absolute values of these thicknesses greatly surpass the thicknesses shown in the Newtonian tables.

We find also a remarkable relation between the tint E, the thickness of the plate, and the elements of its double refraction, which it is important to point out. The image E only appears when the principal section of the plate is neither parallel nor perpendicular to the primitive plane of polarisation of the ray which passes through it. If we suppose this plate to possess only the ordinary properties of double refraction, the ray will in general be divided by it into two pencils, one of which will be refracted ordinarily, the other extraordinarily; so that two pencils from the same origin meet, after having passed through different routes, and *interfere.* There is a certain inequality of the lengths of these paths at which the red rays destroy each other; at another interval the yellow rays, the green, the blue, and so forth. If we determine, from these principles, the tint resulting from the interference of the different rays, taking into account the thickness and the intensity of the double refraction of the plate, we shall always find a very satisfactory agreement between the calculation and the experiment. (See the article CHROMATICS.)

The singular deviation which these thin plates seem to produce in the poles of the molecules of different colours which constitute white light, was extremely difficult to be discovered; and nothing shows this difficulty better than the general assent of natural philosophers to the laws which have been the foundation of the *theory of moveable polarisation.* It is not therefore sufficient to explain here the true principles on which these phenomena are founded: the confutation of an erroneous theory becomes absolutely necessary in this stage of the investigation, especially when it is plausible in appearance, and when it is brought forward with confidence in the latest works, notwithstanding the decisive objections which had been opposed to it.

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[1] See the article OPTICS, p. 504, col. 2.

[2] Ibid. p. 476.

The fundamental theorem of this *moveable polarisation* has been thus enunciated. "When a ray of natural light, polarised in a certain fixed direction, passes perpendicularly through a crystallized plate, which is parallel to the axis of double refraction, the molecules of light penetrate at first to a certain distance without losing their primitive polarisation: after this they begin to perform periodical oscillations round their own centres, so that their axis of polarisation is carried alternately on each side of the principal section of the crystal, or of the line perpendicular to it, like a pendulum passing from one side to the other of the vertical line which is its quiescent position. Each of these oscillations is performed in a given thickness $2e$, twice as great as that in which the molecule had made its excursion in one direction. *Thus, from the thickness zero to a certain fundamental thickness* e', *the homogeneous molecules of which the ray passing through the crystal is composed, are affected, after their emergence, as if they had not quitted their primitive polarisation; from* e' *to* $2e$ *they are affected as if they had assumed a new polarisation, differing from the former by the azimuth* $2i$; i *being the angle which the principal section of the plate forms with the original plane of their polarisation;* and they appear, in short, alternatively polarised in their former azimuth, and in an azimuth at the distance $2i$ from it."

To this law it may be objected, first, that whenever the light emerging from a crystal with one axis, whether thin or thick, is composed of two distinct pencils, we find that they are polarised in directions at right angles to each other, whether the incident light may have been natural or polarised; and no exception to this rule has yet been discovered. Now it is difficult, if not impossible, to conceive, in the system of moveable polarisation, how the transition can be made from that state into the state of polarisation in two directions at right angles, which, for the sake of distinction, has been called the fixed polarisation.

But there is a still more direct objection to this theory. If we place a plate of sulphate of lime in such a manner that its principal section may make an angle of 45° with the primitive plane of polarisation of homogeneous light that is to pass through it, the angle $2i$ being then equal to 90°, the transmitted pencil, according to the doctrine of moveable polarisation, *would be* ENTIRELY *polarised either in the primitive plane or in the plane perpendicular to it,* and, when analysed by means of a rhomboid, it would exhibit, in two positions of the principal section of this crystal, only a single image. But this is so far from being true, that *if the plate is of a proper thickness*, the pencil will be constantly divided into two images of equal intensities, whatever the direction of the principal section of the rhomboid may be.

When two pencils, derived from the same origin, and possessing the same velocity, are made to intersect each other at a very small angle, after having travelled by different paths, of which the lengths are slightly different, they may destroy each other completely, as we have already seen; and this destruction would as readily take place if they came by the same path with different velocities. Let d be the difference of the paths which determines, in the first case, the periodical series of the points of space in which two rays of a certain homogeneous light produce complete darkness by their interference; the same letter d will express, in the second case, the quantity by which one of the rays will require to be more advanced than the other by the excess of its velocity, in order that the light may again be destroyed. When, in a crystallized plate, the difference of the tracks described by the ordinary and extraordinary rays of a given kind of light, or when the effect of the difference of velocity is 0, nd, or $(n + \frac{1}{2})d$, n being a whole number, a pencil previously polarised, and transmitted by the plate, WILL APPEAR *entirely polarised in the primitive plane, or in the azimuth* $2i$, as the principles of the doctrine of moveable polarisation require.

When the plate has such a thickness that the difference of the paths described by the ordinary and extraordinary pencils is included in the general formula $(n + \frac{1}{4})\,d$, the *transmitted light will appear to have become common light,* if the principal section of the plate makes an angle of 45° with the primitive plane of polarisation of the incident light, which, as we have already seen, by no means agrees with the doctrine of moveable polarisation.

Lastly, when the thickness of the plate employed is not comprehended in any of the preceding expressions, *the completely polarised rays, which pass through it, emerge with the characters of a partial polarisation.* This result is no less inconsistent than the former with the laws of moveable polarisation; since, according to these laws, the polarised incident ray ought always to emerge completely polarised, with a simple change of the azimuth of its poles.

It is not, therefore, generally true, that a pencil of polarised homogeneous light, which passes through thin crystallized plates, either preserves its primitive polarisation, or assumes a new one at the angular distance of $2i$; and with this falls the whole fabric of the oscillatory motions attributed to the molecules of light. With respect to the objection already made to this theory, regarding the connection to be established between the phenomena of thin plates and those of thick crystals, it seems to retain its full force, since it has not been established by experiment that the rays concerned in the phenomena of thin plates are polarised in two rectangular directions.

Supposing, however, for a moment, that this were the case, and that a luminous pencil, passing through a thin plate of sulphate of lime, is divided into two rays, the one ordinary and the other extraordinary, polarised at right angles: let us examine what would be the consequence. Mathematically speaking, these two rays follow in general different routes within the crystal; but it is not possible to separate them physically, because the imperfection of our organs forces us to contemplate objects of a certain extent. The advocates of a moveable polarisation will examine this light *in a mass.* They will find in certain cases that it appears to have preserved its primitive polarisation, and in others that it seems to be polarised in an azimuth differing by $2i$, and they will hence conclude that thin plates act very differently from a thick crystal.

This conclusion, however, may be disputed. When we make use of a thick crystal, the ordinary and extraordinary images are separated; we study the properties of each apart. In the case of the thin plates the observer has to do with light which is mixed and complicated. Now, who can affirm, without having made the experiment, that two rays really polarised at right angles, will not seem, in cases of interference, to have lost their primitive polarisations, and will not exhibit an intermediate polarisation, the *result* of the others, which might be considered as *composing* it?

The reader will now have conjectured, that, in order to elucidate these mysterious phenomena, it will require to be proved, first, that two pencils are actually formed in the thin plates of crystallized substances, as well as in thicker crystals, polarised at right angles to each other; and, secondly, that these pencils, when they are mixed, may exhibit the *appearance* of a polarisation intermediate between the two separate directions. Such, then, is the object of the very delicate experiments which are now to be related.

A pencil of homogeneous solar light being concentrated into a very small point, by the aid of a lens of a short focus, fixed in the shutter of a dark room, the pencil of diverging rays is to be received on two plates of glass slightly inclined to each other, and making an angle with the ray of about 35°: the pencils reflected by the two plates will then be completely polarised, and where they intersect each other they will form light and dark stripes; and whatever the position of the plates may be, the stripes will be polarised in the same direction as the two pencils which afford them.

If we now take a very transparent plate of sulphate of lime, and divide it in the middle, so as to have two plates of exactly the same thickness; if we fix one of the halves of this plate before the mirror, in such a situation that it may transmit that pencil only which is reflected by the first mirror, and so that the principal section may make an angle of 45° with the primitive plane of polarisation; and then the other half of the plate in the way of the polarised light reflected by the other mirror, but with its principal section at right angles to that of the other plate, and making an angle of 45° with the primitive plane in a contrary direction: *then, if these plates act in the same manner as thick plates*, however small the measure of their double refraction may be, they must divide the reflected rays which pass through them into two pencils of the same intensity, and polarised at right angles to each other; but, in the positions here assigned to them, it will evidently happen, that the plane of polarisation of the ordinary pencil, coming, for example, from the right-hand plate, will be parallel to the plane of polarisation of the extraordinary pencil of the left-hand plate; and the same will be true of the two remaining pencils of the respective plates.

This being admitted, it is easy to see what will happen at the points in which the two pencils intersect each other. The ordinary rays of the right-hand plate will at once interfere with the extraordinary rays of the left-hand plate, since they are polarised in the same direction, and will form a group of light and dark stripes; and a second group will be afforded by the extraordinary rays of the right-hand plate and the ordinary of its companion. The two groups will be the farther separated from each other as the plates are thicker, and as their double refraction is more strongly marked. In the intermediate space we find the rays of the same description furnished by the two plates; but as they have now received contrary polarities, they intersect each other without exhibiting any of the phenomena of interference, and the eye has the sensation of a uniform light only.

A fact which is no less evident than the existence of the two systems of stripes, is, that when we employ the sulphate of lime, each of the systems is completely polarised in a plane perpendicular to the principal section of the plate which is nearest to it.

Now, there is no one of the consequences of the supposition with which we set out, that is, the supposition that every plate divides polarised light passing through it *into two pencils polarised at right angles*, that is not fully confirmed by this experiment. The truth of the hypothesis is therefore demonstrated; for every other mode of separation or of polarisation of the rays, that for example which is deduced from the principles of moveable polarisation, would lead to phenomena totally different from those which have been described.

A little attention to the passages (Sect. VII.) containing an account of the circumstances under which polarised rays are capable of occasioning appreciable effects of interference, will be sufficient to convince the reader that the two systems of stripes which have been the subjects of these experiments, can only have been the result of the interference of the ordinary rays of one plate with the extraordinary rays of the other. But if any doubts were entertained on this subject, they might be removed in the following manner.

We might substitute for the two thin plates which have been employed, two thick crystals, for example two rhomboids of carbonate of lime, in which the double refraction would be manifest. As we might then follow separately the course of each pencil, and intercept them in turn by screens, it might thus be proved, by the most direct evidence, that, for the formation of the two groups of stripes, it is necessary and sufficient that the ordinary pencil of one of the crystals should meet the extraordinary pencil of the other, and the reverse. The direction of the polarisation of these fringes, determined by the aid of a rhomboid, would also be exactly the same as in the case of the employment of thin plates. The only remarkable difference between the two experiments would be in the degree of separation of the two groups of fringes. This distance, depending on the difference of the paths described by the ordinary and extraordinary rays, would be " greater" [or rather smaller] with the crystals than with the plates. It might even happen, if the crystals were very thick, that in order to " bring the stripes within the field of view" [or to render them visible], it would be necessary to compensate for a part of the difference of the lengths of the paths, or of the velocities, by the assistance of a plane glass, fixed in the way of one of the pencils; but in every case the results of the experiment would be equally clear and decisive.

It may also be added, in the last place, as a full answer to every objection that might be raised against this explanation of the formation of the two groups of stripes in the thin plates, that the interval which separates the two systems is always so dependent on the double refraction of the plates, that its exact numerical value may always be deduced from the elements of the double refraction, as obtained by experiments on other portions of the same substance. (See the article CHROMATICS.)

We must now consider how it will be possible to reconcile the experiment which has been related, and which proves the subdivision of the light into two pencils, polarised at right angles to each other, with the other fact, which seems to be opposed to it, that when the plate is of a proper thickness, the whole group of polarised rays that pass through it shall appear to be polarised either in the primitive plane or in another making with it an angle of $2i$.

We make, in a dark room, a very small radiant point of homogeneous light, by means of a lens, as already mentioned. We receive the diverging pencil on a plate of glass, having its posterior surface covered with a black varnish; supposing the plate to be in a vertical position, and the diverging pencil to be nearly horizontal, and to make an angle with the surface not much differing from that of complete polarisation: when this arrangement is completed, we place in the way of the reflected light a rhomboid of calcareous spar, its principal section making with the horizon, or with the plane of reflection, an angle of 45°. In this position of the rhomboid the light passing through it is divided into two pencils, the one ordinary and the other extraordinary, polarised at right angles, and of equal intensity. After having passed through the first rhomboid, the two pencils fall on another rhomboid of the same thickness, but having its principal section perpendicular to that of the former. The ordinary pencil will then be subjected to the extraordinary refraction in it, and the reverse; and the two pencils will emerge from the second rhomboid, one polarised in the plane of its principal section, and the other perpendicularly to it.

Let us now follow the course of each of the pencils. In the first place, it is evident, that on account of their divergence they will intersect each other in a space so much the wider as they become more remote from the rhomboid: their points of emergence being distinct and sensibly separated, the observer may intercept, in turn, with a screen, either the ordinary or the extraordinary pencil, and enlighten at pleasure any other object, either with the one or the other separately, or with both at once.

This delicate and complicated experiment being so far advanced, let us place a glass slightly roughened in a part of the field of view common to the two pencils; marking, by a very fine opening in an opaque plate covering the glass, the precise spot on which we fix our attention; and employing, as usual, a doubly-refracting crystal to analyse the different kinds of light, which, after passing through the slit in the diaphragm, depict an image within the eye.

It will now easily be observed that the ordinary ray, when it arrives alone at the aperture, wherever it may be placed, undergoes no modification, and remains polarised as it was before; and the same is true of the extraordinary ray: but if both these rays intersect each other in the slit, and enter the eye together, the phenomenon is by no means so simple, and its nature changes according to the place occupied by the slit; so that moving this slit gradually by means of a screw, we soon find the point where the light, composed of the two pencils that pass through it, seems to be wholly polarised, in the same manner as the pencil was at its first reflection from the plate of glass; further on, the plane of polarisation seems to be perpendicular to the primitive plane; and in a position intermediate between these the rays transmitted afford no material traces of polarisation at all.

This experiment, therefore, offers us the singular phenomenon of two pencils, polarised at right angles, which, after having intersected each other in the ground glass, unite within the eye, and form together, as the test of the rhomboid shows, a pencil polarised sometimes in one direction and sometimes in an opposite one, or sometimes without any sensible trace of polarisation, according to the magnitude of the difference of the paths described by the two pencils.

It is only to assist the imagination that the piece of ground glass has been supposed to be employed, for its presence is not necessary to the success of the experiment. A lens alone may be used for observing the stripes formed in the air by the interference of the luminous pencils. If, however, we merely placed ourselves with this lens before the two rhomboids, the eye would only receive a uniform and continued light; but as soon as a doubling crystal is perfectly *interposed* between the lens and the rhomboids, or between the lens and the eye, we shall observe two systems of dark and bright stripes, the bright stripes of one of the images corresponding always with the dark stripes of the other. The middle stripes, for example, will be bright in the ordinary image, *if the principal section of the interposed crystal is parallel to the primitive polarisation of the rays on the blackened glass;* and in the same case the middle stripe will be dark in the extraordinary image. The point of space occupied by the middle of the image seems therefore to transmit to the eye, through the crystal, only such light as is polarised in the primitive plane, because it affords only an ordinary image of the light; and this circumstance shows also that the effects of interference in the extraordinary image require, for their computation, the addition of $\frac{1}{2}d$ to the difference of the paths described.

When the principal section of the crystal interposed between the eye and the rhomboid is perpendicular to the original plane of polarisation, the two kinds of pencils interchange their effects; and in this case the central stripe of the ordinary image is bright, and that of the extraordinary image is completely dark, as if the difference of the paths of the rays forming it were $\frac{1}{2}d$.

It has been hitherto supposed that the original pencil contained only homogeneous light, so that it produced only bright and dark stripes. But if we employ white light, the stripes will be coloured; because d has different values for the rays of different tints, and these tints are precisely the same as are developed by polarised light in their passage through crystallized plates of all possible thicknesses.

A few words will now be sufficient to show the mode of action of these plates in the phenomena of the colours first described.

A polarised ray passing through a crystallized plate which possesses the power of double refraction is divided by it, mathematically speaking, into two pencils polarised at right angles; but two pencils of this description do not interfere; the plate will therefore not exhibit colours to the naked eye, whatever its thickness may be, even when it is only exposed to polarised light; and this result is confirmed by experiment.

Each of the ordinary and extraordinary pencils transmitted by the plate will again be divided into two when it passes through an achromatic prism of crystal, or a rhomboid of calcareous spar. Of these four emergent pencils, the two which follow the ordinary path will be no more separated than they were at their emergence from the plate; and the same is true of the two extraordinary pencils, so that the eye will ultimately perceive but two distinct images.

Of the two pencils which thus concur in the formation of the ordinary image, the one was ordinary in its passage through the plate, and has remained ordinary in the rhomboid placed near the eye, while the action of this rhomboid has been required for bringing the other pencil from the extraordinary to the ordinary refraction. The different kinds of rays have different velocities in crystals capable of double refraction; and an inequality of velocity gives rise to the phenomena of interference, as well as an inequality of distance described. If, in the plate employed, the difference between the velocities of the ordinary and extraordinary ray corresponds, either on account of its thickness or of the diversity of the two refractions, to a certain quantity, d, or its multiple, the kind of rays of which the interval nd determines the destruction, n being a whole number, will be wanting in the ordinary image transmitted by the rhomboid. And this effect, it must again be repeated, depends on the interference of the two pencils of which this image is really formed, and which, *in the plate*, possessed different velocities.

If the experiment with the two rhomboids had not taught us, that, in order to calculate the mutual actions of the luminous rays, which in passing through different crystals possessed of doubly refractive powers, have several times changed their planes of polarisation, the ordinary laws of interference require some modification, we should have found ourselves arrested by a considerable difficulty.

The difference of the velocities being the same for the two pencils of which the extraordinary image afforded by the rhomboid consists, and for the two which concur in the formation of the ordinary image, it would seem that the rays of the same colour ought to be destroyed at once in both the images, and that they ought to exhibit the same tint; but if we recollect that, after having calculated for one of the images the effect of interference corresponding to the difference d in the path, we are obliged, when we proceed to the other image, in order to obtain results conformable to experiment, to add $\frac{1}{2}d$ to the difference of the paths, or to the effect of the difference of the velocities, this difficulty will disappear. Supposing "d" [nd] in the ordinary image to occasion the destruction of the red rays, "$d + \frac{1}{2}d$" [$nd + \frac{1}{2}d$] will correspond, on the contrary, to their most complete agreement in the extraordinary image, and these two images will exhibit tints rigorously complementary to each other, as the experiment shows.

The colours developed by polarised light, in passing through crystallized plates being only, to speak correctly, portions of stripes produced by interference, we must expect to find in them, by varying the thicknesses of the plates, the same apparent deviations of the planes of polarisation as we found in the experiment on the narrow stripes produced by means of the rays transmitted by two plates of sulphate of lime, of which the principal sections were perpendicular to each other; and it has already been remarked that this analogy is supported by observation.

It can scarcely be doubted that this explanation will readily be adopted as fully satisfactory, by all those who will give themselves the trouble to examine it with sufficient attention; and the subject may now be concluded with the formulas which express the intensities of the ordinary and extraordinary images for the case of a polarised ray which has passed through one or two crystallized plates, with a perpendicular incidence, whatever may be the situation of their principal sections.

For a single plate, making unity the intensity of the primitive homogeneous pencil; i the angle made by the principal section of the plate with the primitive plane of polarisation; s the angle made by this same plane with the principal section of the rhomboid or of the achromatic prism, by means of which we analyse the emergent light; $o-e$ the difference of the paths of the ordinary and extraordinary rays at their emergence; d the interval already explained; and π the circumference of the circle of which the diameter is unity: we shall then have,

for the ordinary image, $\cos.^2 s - \sin. 2i \sin. 2(i-s) \sin.^2 \pi . \frac{o-e}{d}$;

for the extraordinary image, $\sin.^2 s + \sin. 2i \sin. 2(i-s) \sin.^2 \pi . \frac{o-e}{d}$.

When the polarised pencil has passed through two plates, there must be an additional element in the formula, that is, the angle formed by the principal section of this second plate with the primitive plane of polarisation. Let this angle be t, all the others retaining the same symbols, and let $o'-e'$ be the difference of the paths belonging to the second plate; the intensity of the ordinary image afforded by a pencil of homogeneous light will then be represented by

$$\cos.^2 s + \sin. 2t \sin. 2i \cos. 2(t+i-s) \sin.^2 \pi \frac{o-e}{d} - \sin. 2t \cos. 2i \sin. 2(t+i-s) \sin.^2 \pi \frac{o'-e'}{d} - \cos.^2 t \sin. 2i \sin. 2(t+i-s) \sin.^2 \pi . \frac{o-e+o'-e'}{d} + \sin.^2 t \sin. 2i \sin. 2(t+i-s) \sin.^2 \pi . \frac{o-e-(o'-e')}{d};$$

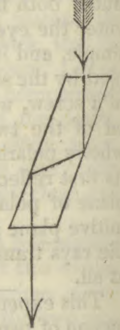
and the intensity of the extraordinary image is found by subtracting this expression from unity.

If we calculate separately, according to these formulas, the intensities of the rays of the different colours which compose white light, we obtain the *tint* of the ordinary or of the extraordinary pencil, whether the light, previously polarised, has passed through one or two crystallized plates; and if, in this calculation, we employ for $o-e$ and for $o'-e'$ the values corresponding to the *individual* double refractions to which the different species of rays are subject, we shall find the *most perfect agreement* between the formulas and the experiments, even in those crystals which afford tints that appear to bear *no resemblance* to those of the coloured rings of Newton.

The phenomena of these thin plates, therefore, which seemed to some persons to afford an unexceptionable demonstration of the system of emission; which seemed to require the assistance of the most singular oscillations of the molecules of light; which seemed to enable them to discover, in those particles, an axis of rotation, a pair of poles, and an equator; and even a kind of precession of the equinoctial points: these phenomena are in fact only, as we have just seen, the immediate and unavoidable consequences of the simple but inexhaustible laws of interference.

SECT. X.—ON CIRCULAR POLARISATION.[1]

The kind of polarisation which is now to be considered differs essentially from those which have been hitherto examined.



Suppose that, having polarised a pencil of light, we cause it to undergo twice over, at the angle of 54°, a total reflection within a parallelopiped of glass, as seen in the figure; the new planes of reflection being also supposed to be inclined at an angle of 45° to the plane of primitive polarisation; the emergent pencil will then have acquired some particular properties, which are very remarkable.

When this emergent pencil is analysed with a rhomboidal crystal, it is *constantly* decomposed into two rays of the same intensity, whatever may be the direction of the principal section. From this circumstance it might be supposed that it had resumed the character of ordinary light; but if it be transmitted through a crystallized plate before it is subjected to the action of the rhomboid, we shall soon perceive a distinction: for, in this case, common white light would afford two white images of the same intensity, while the light of the parallelopiped is divided into two pencils, both strongly coloured.

This new kind of rays has also some other peculiarities. It has already been remarked (Sect. V.), that one or more total reflections make no difference in the properties of ordinary light; but they modify, on the contrary, in a remarkable manner, the pencil which has passed through the parallelopiped: for this pencil resumes all the qualities of polarised light when it has been subjected to two total reflections similar to the first, whatever may be the azimuth of the latter planes of reflection with regard to the former.

The pencil of light in question is decomposed, then, into two coloured images, when it is only analysed by a rhomboid after having been transmitted through a crystallized plate; but it must be remarked, that the colour of each of these images, on the chromatic circle of Newton, is about one fourth of the circumference distant from the place which the colour of the same image would have occupied if we had employed only common polarised light.

It may also be added, as another distinguishing character, that this last kind of light gives rise to no phenomena of colour after being transmitted through plates of rock-crystal perpendicular to the axis, or through columns of oil of turpentine, or of other essential oils.

A polarised ray, modified by two total reflections, has therefore some very particular characters, which distinguish it equally from a direct ray and from an ordinary polarised ray; and as these characters have no relation to the different sides of the ray, the modification thus obtained has received the name of *circular polarisation*. If any person should think the denomination too little supported by the facts described, he may be informed, that it has been partly derived from some theoretical considerations, which appear to justify it.

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[1] See the article OPTICS, p. 501.

The mode of obtaining the circular from the ordinary polarisation by means of two total reflections having been described, there remains to be mentioned a very remarkable method of procuring the circular polarisation more immediately from common light.

We cut out of a column of rock-crystal a very obtuse prism, with its two faces forming an angle of about 150°, and equally inclined to the axis of the column, and we make it achromatic as well as we can, with two prisms of glass cemented to its opposite faces: or, since this method must always be imperfect, we employ, instead of the glass, two other prisms of rock-crystal, taken from pieces which possess the opposite qualities which have been described in speaking of plagiedral crystals; and this arrangement has also the advantage of a separation of the images to a double distance. We obtain by means of this little combination the effects of double refraction; but the two pencils to which it gives birth, when they have been transmitted in a direction parallel to the axis of the column, have not acquired the same modification which Iceland spar, for example, would produce in them, but they are *circularly* polarised. Thus, if we analyse them with a rhomboid, they are always divided into two pencils of equal intensity; and when they have undergone two total reflections within a parallelopiped of glass at an angle of incidence of 54°, they are found completely polarised in two planes inclined 45° to the plane of reflection, the plane of polarisation of the one being to the right, and that of the other to the left.

There exists, therefore, a particular kind of double refraction, which communicates to the rays of light a circular polarisation, as the double refraction of the Iceland crystal produces in them the ordinary polarisation.

It follows, besides, from all the phenomena of this class, and from the general laws of interference, that a pencil circularly polarised may be considered as composed of two ordinary pencils polarised at right angles, one of them, however, being supposed to be retarded in its path, in comparison with the other, by a quarter of the interval which has been already noted by *d*.

The properties of rays circularly polarised afford us a very curious mode of reproducing exactly all the phenomena of colours, that we have observed in the plates of rock-crystal cut perpendicularly to the axis, and in certain liquids.

For this purpose we must place a thin crystallized plate between two parallelopipeds of ordinary glass crossed at right angles, and similar to that which has been already represented by a figure. A pencil, passing perpendicularly through the first parallelopiped, undergoes within it two total reflections at the angle of 54°; after its emersion, it is transmitted by the crystallized plate, and further on it enters the second parallelopiped, and is again twice reflected within it, but in a plane perpendicular to that of the former reflections: at last it emerges into the air, perpendicularly to the last surface of the parallelopiped. Now we may always obtain, in the emergent ray, the appearances of a polarised ray which passed through a plate of rock-crystal cut perpendicularly to the axis, or a certain depth of the essential oil of turpentine; and it will be sufficient for this purpose, that the pencil incident upon the first parallelopiped should be previously polarised, and that the axis of the interposed crystalline plate should make an angle of 45° with the two planes of the total reflections.

[SECT. XI.—ENUMERATION OF THE PRINCIPAL MINERALS WHICH ARE POSSESSED OF PARTICULAR PROPERTIES WITH RESPECT TO POLARISATION. ADDED BY THE TRANSLATOR.[1]

i. All such regular crystals as belong to the rhomboidal or pyramidal systems of crystallization, described by Mohs, are found to have one axis of double refraction, coincident with the crystallographic axis of these solids.—(Edinburgh Encyclopædia, article OPTICS, p. 572.) The axis of a refraction governed by the law of the *oblate* spheroid is called by Sir David Brewster a *negative axis*, by M. Biot a *repulsive axis*, and the axis of the oblong spheroid a *positive* or an *attractive* axis; the crystals are distinguished by the signs — and + respectively.

1. Rhomboid with obtuse summit.

— Carbonate of lime.
— Carbonate of lime and magnesia.
— Rubellite.
+ Dioptase.
— Carbonate of lime and iron.
— Tourmaline.
Ruby silver.

2. Rhomboid with acute summit.

— Corundum.
— Sapphire.
— Ruby.
Cinnabar.

3. Regular hexaedral prism.

— Emerald.
— Beryl.
— Phosphate of lime.
— Nepheline, or Sommite.
— Arseniate of copper.
— Arseniate of lead.

4. Octaedron with a square base.

+ *Z*ircon.
+ Oxyd of tin.
+ Tungstate of lime.
— Mellite.
— Molybdate of lead.
— Octohedrite.

5. Right prism with a square base.

+ Titanite.
— Idocrase.
— Wernerite.
— Meionite.
Uranite.

6. Bipyramidal dodecaedron.

+ Quartz.
— Phosphate of lead.
— Phosphato-arseniate of lead.

ii. Besides the erystals belonging to these classes, there are others of which the primitive form has not been determined, but in which the position of the single axis of double refraction has been ascertained.

Crystals.	*Axis of Double Refraction.*
— Mica from Kariat.	Perpendicular to the laminæ.
— Mica with amianthus.	Perpendicular to the laminæ.
— Hydret of strontia.	Perpendicular to the quadrangular plate.
— Arseniate of potass.	Axis of quadrangular prism.
— Muriate of lime.	Axis of hexaedral prism.
— Muriate of strontia.	Axis of hexaedral prism.
— Nitrate of soda.	Axis of obtuse rhomb.
— Subphosphate of potass.	Axis of quadrangular prism.
— Sulphate of nickel and copper.	Axis of quadrangular prism.
— Hyposulphate of lime (*Herschel*).	Axis of hexagonal tables.
+ Boracite.	Axis of cubical rhomb.
+ Apophyllite from Uton.	Axis of prism.
+ Apophyllite surcomposée.	Perpendicular to the plate.
+ Sulphate of potass and iron.	Axis of hexaedral prism.
+ Superacetate of copper and lime.	Axis of prism.
+ Hydrate of magnesia.	Perpendicular to the laminæ.
+ Ice.	Axis of hexaedral prism or rhomb.

iii. The crystals which have been enumerated appear to be symmetrical with respect to a single axis, so as to have similar properties in every plane passing through that axis; but Sir David Brewster discovered, in 1816, that in a great multitude of crystals the refractive powers are different in different planes passing through the principal axis; the phenomena and the laws of refraction being such as may be explained from the combined effects of two axes perpendicular to each other, and unequal in the ellipticity of the spheroids to which they belong.

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[1] See the article OPTICS, p. 457.

"All regular crystals which belong to the *primitive* system of Mohs, or whose primitive forms are the *right prism*, with its base a rectangle, a rhomb, or an oblique parallelogram; the *oblique prism*, with its base a rectangle, a rhomb, or an oblique parallelogram; or the *rectangular and rhomboidal octaedron;* have *two* axes of double refraction, coincident with some permanent line in the primitive form."

1. Thus, all the combinations of the sulphuric, tartaric, and acetic acids, with single earthy, metallic, and alkaline bases, have two axes of double refraction.

2. The two *apparent* axes of crystals with two axes [or the lines in which the double refraction seems to be neutralised] have no symmetrical relation either with the faces or prominent lines of the primitive or secondary forms of minerals.

3. The two *rectangular* axes, the principal one of which is in the same plane with the two apparent axes, and *equidistant* from them, have a constant symmetrical relation to the faces and axes of the primitive forms in which they crystallize.

4. The line exhibited at any point of the sphere, by the joint properties of two axes, is represented by the diagonal of a parallelogram, of which the sides correspond to the tints belonging to the separate axes, and make with each other an angle twice as great as the angle formed by the planes passing through the given point and the two axes; and the increment or decrement of the square of the velocity of the light may be computed in the same manner as this line representing the tint.

iv. The necessity of any very minute investigation of the properties of particular substances, with regard to double refraction, is in great measure superseded by the very important facts, first observed by Sir David Brewster in 1814 and 1815, relating to the effects of heat and compression in producing double refraction and polarisation. He found that compression was capable of producing colour when a soft animal jelly was only touched by the finger; and that when a "negative" crystal, like that of the carbonate of lime, is compressed in the direction of the axis, the tints that it affords "descend," and that they "rise" when it is dilated: whence it seems to follow, that simple dilatation of a homogeneous substance in a given line will constitute that line the axis of an oblate spheriod; but the results require to be distinguished by a greater variety of experiments. M. Fresnel has succeeded in exhibiting not only colours by a strong pressure, but a very manifest reduplication of the image of a line, seen through a piece of glass strongly compressed by screws; and he performed this experiment very successfully at a meeting of the Parisian Academy of Sciences in 1822.]

SECT. XII.—HISTORICAL DETAILS RESPECTING THE DISCOVERY OF THE DIFFERENT PROPERTIES OF LIGHT CONCERNED IN POLARISATION.

It will now be necessary to enumerate the natural philosophers to whom we are indebted for the discoveries of which the importance has been explained in this article; and it will be convenient to do this in the order of the sections.

i. Huygens appears to be the first person that observed, in the two pencils derived from a single one, by means of double refraction, the existence of particular properties after their passage through the crystal, which they did not possess when they entered it. "It seems," he says, "that we are obliged to conclude, that the undulations of light, by passing through the first crystal of Iceland spar, acquire a certain form, or a certain disposition, by which, when they fall on the substance of a second crystal, in a certain position, they are enabled to affect both the kinds of matter which serve for the two species of refraction; and when they fall on it in another position, they only act on one of these substances."

Thus, according to this great philosopher, in the act of double refraction, the undulation, or the ray, changes its *form*, and loses its symmetry, so as to give room for the distinction of its different *sides*, or, changing the expression only, its different *poles*.

Huygens is therefore the first that observed a phenomenon of polarisation, and this discovery was made in 1678, though it was not published till 1690. From the time of Huygens to the year 1809, no observer, with the exception of the immortal author of the *Opticks*, had studied the subject of double refraction in this point of view; and it must even be acknowledged that, with respect to the facts in question, nothing was added by Newton to what the Dutch mathematician had discovered. He only insisted much more strongly on the necessity of admitting poles in each of the rays derived from the subdivision which light undergoes in passing through an Iceland crystal. To Malus belongs the honour of having brought back the attention of natural philosophers to the properties of light which form the subject of this article. It was he that first pointed out the singular phenomena exhibited by the ordinary and extraordinary rays when they meet with transparent reflecting surfaces at certain inclinations; and it is to him that we are indebted for the mathematical law which appears to connect intensities of the different pencils into which the light is divided when it passes through two rhomboids of the spar in succession.[1]

ii. The anecdote, which has been often told, of the fortunate circumstance that led Malus to the discovery of the polarisation of light by reflection from transparent substances, is perfectly correct. This philosopher, so early arrested in his pursuit of science by a premature death, and so universally lamented by his friends, has often related to the author of this article, that as he happened to be decomposing, by means of a rhomboid of carbonate of lime, towards the end of the year 1808, the light of the setting sun, reflected from the glass of the windows of the Luxembourg, he first observed the difference of the intensity of the two images in different positions of the rhomboid; but it is not true, as has sometimes been stated, that one of the images actually disappeared in this observation; for the polarisation of the light, at the moment of the experiment, was only partial. A similar difference of intensity must have been before the eyes of mineralogists whenever they had been trying to examine the double refraction of crystals, and had projected the needle which they used for an object of view on a clear and serene sky, which affords a curtain of polarised light. But the fact had not excited their attention. Malus observed it, was struck with all its importance, completely analysed it in all its forms, with the most singular sagacity, and thus became the creator of a new branch of optics. It is to this celebrated observer that we are indebted for all the experiments related in the second section.[2]

iii. The measurements related in the third section, which appear to show that, at equal angular distances above and below the angle of complete polarisation, the reflected rays contain nearly equal quantities of polarised light, were obtained by M. Arago.

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[1] *Mémoires d'Arcueil*, ii. 8vo, Par. 1809.

[2] *Ibid.* ii.

iv. It was Sir David Brewster that discovered the remarkable law which connects the angle of complete polarisation with the refractive density of the substance. It was communicated to the Royal Society on the 16th March 1815.[1]

The relation of the angle of complete polarisation, at the second surface of a transparent medium, to the angle belonging to the first surface, had before been shown by Malus.[2] The same relation may be extended to the angles, at the same surfaces, which afford polarisation of *equal proportions* of the light falling on them. So that the rule given by Malus is only a particular case of a general theorem, which M. Arago has deduced from a long series of experiments that have not been published.

v. It was discovered also by Malus, that the pencil *transmitted* by a transparent plate is partially polarised in a plane at right angles to the plane of polarisation of the reflected pencil. This fact was communicated to the Institute on the 11th March 1811, and published the next day in the *Moniteur*. See also the Memoirs of the Mathematical Class for 1810. The photometrical experiments of M. Arago have established a relation between these two kinds of polarisation which had been unobserved by Malus; it is contained in this simple enunciation. "The quantity of polarised light contained in the pencil which any transparent plate transmits, is exactly equal to *the quantity* polarised in the contrary direction, which is found in the light reflected by the same plate." These experiments were made in 1812, but they were first published in 1814 by M. Biot, to whom M. Arago had communicated them.[3]

It follows from this law, as M. Arago had also observed, that at the angle of total reflection, and at all greater obliquities, the light wholly escapes polarisation.

The phenomena exhibited by piles of plates were analysed by Malus immediately after his discovery of polarisation by refraction.

The observation that some natural bodies, agates, for example, act on light precisely like these piles of plates, is due to Sir David Brewster.[4]

vi. The laws and experiments related in the sixth section belong to M. Fresnel. Malus had before attempted to discover in what manner the planes of polarisation changed their directions; but there are several inaccuracies in the results which he has published.[5] The formulæ of M. Fresnel are some of the most valuable additions that have been made of late to the science of optics. A general account of the deviations undergone, in reflection, by the plane of polarisation of a ray previously polarised, is found in two memoirs presented to the academy by M. Fresnel, on the 24th November 1817, and the beginning of January 1818; but the mathematical laws of the phenomena were not discovered and published till 1821.[6]

vii. M. Arago and M. Fresnel are hitherto the only philosophers who have examined the effect of polarisation in modifying the phenomena of interference. The memoir in which they first recorded the results which are inserted in the seventh section, appeared in the *Annales de Chimie* for 1819, vol. x.

viii. It was M. Arago that first observed the changes in the properties of polarised rays when they pass through crystalline plates. He showed that they acquire the property of being divided by calcareous spar into two coloured pencils, and of being reflected by transparent substances with tints which vary according to the angular position of their surfaces. His memoir was read to the Institute on the 11th of August 1811, and printed in the volume of the *Mémoires* of that year.

Sir David Brewster published some similar experiments in his Treatise on Philosophical Instruments, which appeared in 1813.

The phenomena exhibited by plates cut perpendicularly to the axis were also described by M. Arago in the same memoir.

We are indebted to M. Biot for the rule, according to which the deviation of the poles is effected, whether on account of the particular kind of "each luminar molecule," or on account of the more or less considerable thicknesses of the plates by which these "molecules" have been transmitted. His memoir was read to the Institute in September 1818, and printed shortly afterwards.

Mr Herschel is the author of the curious observation relating to the facets of plagiedral crystals.[7]

The extension of the properties of plates perpendicular to the axis, by which they are assigned to the strata of certain liquids, was made by M. Biot in 1815.[8]

ix. The laws of the depolarisation produced by crystallized plates, parallel to the axis, are reduced to the three following.

1. The motion of the plate in its plane does not alter the tints of the images furnished by a rhomboid. This result is implicitly comprehended in the first memoir of M. Arago; since in the description of all the motions which cause a change of the tints, the motion of the plate in its own plane is not included.

2. The tints of the two images are those of the coloured rings of Newton, seen by reflection or by transmission. This law had been laid down by M. Biot; but Mr Herschel has shown in the Cambridge Transactions that it is not universally true,[9] so that its theoretical importance is lost.

3. In a crystal of variable thickness, the same phenomena of polarisation are reproduced at thicknesses which form a series like that of the coloured rings of Newton. When we examine with a rhomboid a crystal cut in a proper manner, so that two of its faces form an angle, and which is projected on a back ground affording polarised light, each image appears bordered by regular streaks, parallel to the angular edge of the prism, and separated by equal spaces. M. Arago, when he described this phenomena in August 1811, advanced it as a sufficient proof of this third law. The Academy of Sciences, and M. Laplace in particular, did not admit the conclusion as demonstrated, and a direct admeasurement of the thicknesses was required. Count Rumford, who was present, offered the use of an instrument which he had employed for some other purposes, and which seemed to promise a sufficient degree of precision: the common comparer was also mentioned as proper for the purpose. M. Arago, upon these suggestions, undertook to make these further experiments. But M. Biot anticipated him; and he has *therefore* a claim to the *first direct demonstration* of the law of the thicknesses.

4. The brilliant tints of each of these images may be calculated from the laws of interference, according to the difference of the paths and of the velocities of the ordinary and extraordinary rays. This important remark is due to Dr Thomas Young, who is believed to have published it in the Quarterly Review, xi. 1814, p. 42–49.

It affords the true key of all these phenomena. It must however be added, that Dr Young had not explained either in what circumstances the interference of the rays can take place, nor why we see no colours unless the crystallized plates are exposed to light previously polarised. The new properties which required to be combined with the ordinary laws of interference, in order to obtain a *complete* explanation of the facts, were discovered by M. Arago and M. Fresnel, as they have been described in the seventh section. The dates of the memoirs in which M. Fresnel published this explanation are 1816 and 1818.

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[1] Philosophical Transactions, 1815.

[2] *Mém. d'Arcueil*, ii.

[3] See *Recherches Expérimentales et Mathématiques sur les Mouvemens des Molécules de Lumière*, 1814.

[4] Treatise on New Philosophical Instruments, 8vo, Edinburgh, 1813.

[5] *Mém. Inst.* 1810.

[6] See *Annales de Chimie et de Physique*, xvii.

[7] Transactions of the Philosophical Society of Cambridge, i.; see also the article Optics, p. 502.

[8] *Bulletin des Sciences*, Dec. 1815; see also the article Optics, p. 504.

[9] Phil. Trans. 1818, p. 243, 252; see also the article Optics, p. 487.

The ingenious and delicate experiments which have been employed as tests of the inaccuracy of the theory of moveable polarisation are also due to M. Fresnel, one of the most inventive theorists as well as one of the most skilful experimenters that have devoted themselves to science in this or in any age: the formulæ found at the end of the section are also M. Fresnel's.

x. The phenomena of circular polarisation were discovered by M. Fresnel, who described and analysed them in a memoir read to the Academy of Sciences in November 1817 and in January 1818. His later researches on this subject are inserted in the *Bulletin* of the Philomathic Society, December 1822 and February 1823.

There are a few other particulars, relating to the development of tints by repeated reflections at the surfaces of metallic mirrors,[1] to the rings seen in crystallized plates cut perpendicularly to the axis when examined with a rhomboid held very near them, and to the phenomena of the absorption of polarised light by certain crystals.[2] The first have hitherto been reduced to no *direct* analogy with other affections of polarised light; the second seem to be derived from a modification of the laws already explained in the ninth section; and the discovery of the scattered phenomena belonging to the third head has been disputed by M. Biot and Sir David Brewster, but they appear to have been first observed by M. Arago in 1814.[3]

[SECT. XIII.—THEORETICAL INVESTIGATIONS INTENDED TO ILLUSTRATE THE PHENOMENA OF POLARISATION. ADDED BY THE TRANSLATOR.

We are led, from the facts which have been enumerated in the eleventh section, to the remarkable coincidence between the discoveries of Sir David Brewster respecting crystals with two axes, and a theory which had been published a few years *earlier* in order to illustrate the propagation of an undulation in a medium compressed or dilated in a given direction only, and to prove that such an undulation must necessarily assume a spheroidal form, upon the mechanical principles of the Huygenian theory. As every contribution to the investigation of so difficult a subject may chance to be of some value, it will be worth while to copy this demonstration here, from the Quarterly Review for November 1809, vol. ii. p. 345.

"The proposition to be demonstrated was this: *An impulse is propagated through every perpendicular section of a lamellar elastic substance in the form of an elliptic undulation.*

"When a particle of the elastic medium is displaced in an oblique direction, the resistance produced by the compression is the joint result of the forces arising from the elasticity in the direction of the laminæ, and in a transverse direction; and if the elasticities in these two directions were equal, the joint result would remain proportional to the displacement of the particle, being expressed, as well in magnitude as in direction, by the diagonal of the parallelogram, of which the sides measure the relative displacements, reduced to their proper directions, and express the forces which are proportional to them. But when the elasticity is less in one direction than in the other, the corresponding side of the parallelogram expressing the forces must be diminished, in the ratio which we may call that of 1 to m; and the diagonal of the parallelogram will no longer coincide in direction with the line of actual displacement, so that the particle displaced will also produce a lateral pressure on the neighbouring particle of the medium, and will itself be urged by a lateral force. This force will, however, have no effect in promoting the direct propagation of the undulation, being probably employed in gradually changing the direction of the actual motions of the successive particles; and the only efficient force of elasticity will be that which acts in the direction in which the undulation is advancing, and which is expressed by the portion of the line of displacement, cut off by a perpendicular falling on it from the end of the diagonal of the parallelogram of forces; and the comparative elasticity will be measured by this portion, divided by the whole line of displacement. Calling the tangent of the angle formed by the line of displacement with the line of greatest elasticity t, the radius being 1, the force in this line being also 1, the transverse force will be expressed by mt, the line of displacement by $\surd(1+tt)$, its diminution by $\frac{(1-m)\,tt}{\surd(1+tt)}$, the diminished portion, which measures the force, by $\surd(1+tt)-\frac{(1-m)tt}{\surd(1+tt)}$, and the elasticity, in the given direction, by $\frac{1+mtt}{1+tt}$. Hence it follows, that the velocity of an impulse, moving in that direction, will be expressed by $\surd\frac{1+mtt}{1+tt}$.

"It is next to be proved, that the velocity of an elliptical undulation, increasing so as to remain always similar, by means of an impulse propagated always in a direction perpendicular to the circumference, is such as would take place in a medium thus constituted. It is obvious that the increment of each of the diameters of the increasing figure must be proportional to the whole diameter; and this increment, reduced to a direction perpendicular to the curve, will be proportional to the perpendicular falling on the conjugate diameter, which will measure the velocity. We are therefore to find an expression for this perpendicular when it forms an angle with the greater axis, of which the tangent is t. Let the greater semiaxis be 1, and the smaller n; then the tangent of the angle formed with the greater axis by the conjugate diameter being $\frac{1}{t}$, the tangent of the angle subtended by the corresponding ordinate of the circumscribing circle is found $\frac{1}{nt}$, and the semidiameter itself, equal to unity, reduced in the ratio of the secants of these angles, that is, to $n\surd\frac{1+tt}{1+nntt}$; but, by the known property of the ellipsis, the perpendicular required is equal to the product of the semiaxis, divided by this semidiameter, that is, to $\surd\frac{1+nntt}{1+tt}$; we have therefore only to make $nn=m$, and the velocity in the given medium will always be such as is required for the propagation of an undulation, preserving the form of similar and concentric spheroids, of which the given ellipsis represents any principal section.

"If the whole of the undulation were of equal force, this reasoning would be sufficient for determining its motion; but when one part of it is stronger than another, this superiority of pressure and motion will obviously be propagated in the direction of the actual resistance produced by the displacement of the particles, since it is this resistance which carries on the pressure, and consequently propagates the motion. It is very remarkable that the direction of the resistance will be found, on the supposition which has been advanced respecting the constitution of the medium, to coincide everywhere with the diameters of the ellipsis when the displacement is perpendicular to the surface. For it is proved by authors on conic sections, that the subnormal of the ellipsis is to the absciss as the square of the lesser axis is to the square of the greater, that is, in this case, as nn to 1, or as m to 1; but if we divide the ordinate to the same ratio of m to 1, and join the point of division with the extremity of the subnormal, this line, which will evidently be parallel to the diameter, will express, as we have already seen, the direction of the force when the normal represents that of the displacement. An immediate displacement in the direction of any diameter, making an angle with the axis of which the tangent is t, would give a velocity of $\sqrt{\frac{1+mtt}{1+tt}}$, while the increment of the diameter would require a velocity of $\sqrt{\frac{m+mtt}{m+tt}}$, which does not vary in the same proportion. It must, however, be remembered, that the rectilinear direction of the beam is not supposed to depend on this circumstance alone. Huygens considers each point of the surface of the crystal, on which a beam of light impinges, as the centre of a new undulation, which spreads in some measure in every direction, but produces no perceptible effect except where it is supported by, and co-operates with, the neighbouring undulations, that is, in the surface which is a common tangent of the collateral undulations; but if this principle were applied to extraordinary refraction without the assistance of the obliquity of force, which may be deduced from the supposition of a stratified medium, it would lead us to expect that the elementary impulses, being propagated in a curvilinear trajectory, might be intercepted by an object not situated in the rectilinear path of the beam; a conclusion which is not warranted by experiment."

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[1] See the article OPTICS, p. 505.

[2] Ibid. p. 493.

[3] See Biot's *Recherches sur les Mouvemens des Molécules de Lumière*, 4to, Paris, 1814, p. lxxxvi.

However satisfactorily this mode of viewing the extraordinary refraction may be applied to the subsequent discoveries relating to the effects of heat and compression, there is another train of ideas, which arises more immediately from the phenomena of polarisation, and which might lead us to a more distinct notion of the separation of the pencil into two or more portions, though it does not seem to comprehend so entirely the phenomena depending on spheroidal undulations.

We may begin this mode of considering the subject in the words which have already been employed in the article CHROMATICS, vol. vi. p. 649. "If we assume as a mathematical, postulate, in the undulatory theory, without attempting to demonstrate its physical foundation, that a transverse motion may be propagated in a direct line, we may derive from this assumption a tolerable illustration of the subdivision of polarised light by reflection in an oblique plane. Supposing polarisation to depend on a transverse motion in the given plane; when a ray completely polarised is subjected to simple reflection in a different plane, at a surface which is destitute of any polarising action, and which may be said to afford a neutral reflection, the polar motion may be conceived to be reflected, as any other motion would be reflected, at a perfectly smooth surface, the new plane of the motion being always the image of the former plane; and the effect of refraction will be nearly of a similar nature. But when the surface exhibits a new polarising influence, and the beams of light are divided by it into two portions, the intensity of each may be calculated, by supposing the polar motion to be resolved instead of being reflected, the simple velocities of the two portions being as the cosines of the angles formed by the new planes of motion with the old, and the energies, which are the true measure of the intensity, as the squares of the sines. We are thus insensibly led to confound the intensity of the supposed polar motion with that of the reflected light itself; since it was observed by Malus, that the relative intensity of the two portions into which light is divided under such circumstances, is indicated by the proportion of the squares of the cosine and sine of the inclination of the planes of polarisation. The imaginary transverse motion might also necessarily be alternate; partly from the nature of a continuous medium, and partly from the observed fact, that there is no distinction between the polarisations produced by causes precisely opposed to each other in the same plane." Another analogous hint is found in the Philosophical Transactions for 1818, p. 273. "Supposing the experiments to be perfectly represented by [Dr Brewster's] general law, it will follow that the tint exhibited depends not on the difference of refractive densities in the direction of the ray transmitted, but on the greatest difference of refractive densities in directions perpendicular to that of the ray. These two conditions lead to the same result where the effect of one axis only is considered, but they vary materially where two axes are supposed to be combined...... There can be little doubt that the direction of the polarisation, in such cases, must be determined by that of the greatest and least of the refractive densities in question:" a "supposition" which Dr Brewster finds "quite correct."

We may add again to these hints the consideration, that when simple pressure or extension in the direction of any given axis produces a spheroidal undulation in a medium before homogeneous, this state is always accompanied by the condition, that a ray describing the axis, while the densities in all transverse directions remain equal, undergoes no subdivision; but that a ray moving in the plane of the equator, to which the perpendiculars are the axis and another equatorial diameter, undergoes the greatest possible separation into parts that are respectively polarised in the planes passing through these directions.

From these phenomena we are led to be strongly impressed with the analogy of the properties of sound, as investigated cursorily by Mr Wheatstone, and in a more elaborate manner by the multiplied experiments of M. Savart, which have shown that, in many cases, the elementary motions of the substances transmitting sound are transverse to the direction in which the sound is propagated, and that they remain in general parallel to the original impulse.

The next transition carries us from the *mathematical postulate* here mentioned, to the *physical condition* assumed by M. Fresnel, that the relative situation of the particles of the ethereal medium with respect to each other, is such as to produce an elastic force tending to bring back a line of particles which has been displaced, towards its original situation, by the resistance of the particles *surrounding the line*, and at the same time to impel these particles in its own direction, and in that direction only, or principally, while the aggregate effect is propagated in concentric surfaces.

This hypothesis of M. Fresnel is at least very ingenious, and may lead us to some satisfactory computations; but it is attended by one circumstance which is perfectly *appalling* in its consequences. The substances on which M. Savart made his experiments were *solids* only, and it is only to solids that such a *lateral* resistance has ever been attributed; so that if we adopted the distinctions laid down by the reviver of the undulatory system himself in his Lectures, it might be inferred that the luminiferous ether pervading all space, and penetrating almost all substances, is not only highly elastic, but absolutely solid. The passage in question is this:—

"The immediate cause of solidity, as distinguished from liquidity, is the lateral adhesion of the particles to each other, to which the degree of hardness or solidity is always proportional. This adhesion prevents any change of the relative situation of the particles, so that they cannot be withdrawn from their places, without experiencing a considerable resistance from the force of cohesion, while those of liquids may remain equally in contact with the neighbouring particles, notwithstanding their change of form. When a perfect solid is extended or compressed, the particles, being retained in their situations by the force of lateral adhesion, can only approach directly to each other, or be withdrawn farther from each other; and the resistance is nearly the same as if the same substance, in a fluid state, were enclosed in an unalterable vessel, and forcibly compressed or dilated. Thus the resistance of ice to extension or compression is found by experiment to differ very little from that of water contained in a vessel; and the same effect may be produced even when the solidity is not the most perfect that the substance admits; for the immediate resistance of iron or steel to flexure is the same, whether it may be harder or softer. It often happens, however, that the magnitude of the lateral adhesion is so much limited as to allow a capability of extension or compression, and it may yet retain a power of restoring the bodies to their original form by its re-action. This force may even be the principal or the only source of the body's elasticity. Thus, when a piece of elastic gum is extended, the mean distance of the particles is not materially increased...and the change of form is rather to be attributed to a displacement of the particles than to their separation to a greater distance from each other, and the resistance must be derived from the lateral adhesion only. Some other substances, also, approaching more nearly to the nature of liquids, may be extended to many times their original length, with a resistance continually increasing; and in such cases there can scarcely be any material changes of the specific gravity of these substances. Professor Robison has mentioned the juice of bryony as affording a remarkable instance of such viscidity.

"It is probable that the immediate cause of the lateral adhesion of solids is a symmetrical arrangement of their constituent parts. It is certain that almost all bodies are disposed, in becoming solid, to assume the form of crystals, which evidently indicates the existence of such an arrangement; and all the hardest bodies in nature are of a crystalline form. It appears, therefore, consistent both with reason and with experience to suppose, that a crystallization more or less perfect is the universal cause of solidity. We may imagine, that when the particles of matter are disposed without any order, they can afford no strong resistance to a motion in any direction; but when they are regularly placed in certain situations with respect to each other, any change of form must displace them in such a manner as to increase the distance of a whole rank at once; and hence they may be enabled to co-operate in resisting such a change. Any inequality of tension in a particular part of a solid is also probably so far the cause of hardness, as it tends to increase the strength of union of any part of a series of particles which must be displaced by a change of form."

It must, however, be admitted, that this passage by no means contains a demonstration of the total incapability of fluids to transmit any impressions by lateral adhesion, and the hypothesis remains completely open for discussion, notwithstanding the apparent difficulties attending it; which have appeared to bring us very near to the case stated in the same lectures as a possible one, that there may be independent worlds, some existing in different parts of space, others pervading each other unseen and unknown in the same space. We may perhaps accommodate the hypothesis of M. Fresnel to the phenomena of the ordinary and extraordinary refraction, by considering the undulations as propagated through the given medium in two different ways; some by the divergence of the elementary motions in the direction of the ray, and others by their remaining parallel to the direction of the impulse or of the polarisation. The former must be supposed to furnish the spheroidal, the latter the spherical refraction. It would indeed follow that the velocity of the spherical undulation ought to vary by innumerable degrees, within certain limits, according to the direction of the supposed elementary motion; whilst in fact the actual velocity of the spherical undulations seems to be uniformly equal to the velocity in the direction of the axis; but this objection may be obviated by supposing the surface so constituted, that for some unknown reason the parallel elementary motion can only be propagated in the regular manner when it takes place in the direction of the axis, or when it is made to assume that direction; a condition not very simple or natural, but by no means inconceivable, unless we saw any reason to consider the adhesion as a constant force, independent of the direction, and equal to the least or greatest elasticity, or unless it were possible to derive the phenomena of two supposed axes of polarisation, which M. Fresnel has explained on the hypothesis of two spheroids, from the supposition of two spherical undulations propagating oblique elementary motions in the direction of the actual polarisation, as already determined for these crystals.

If these conjectures should be found to afford a single step in an investigation so transcendently delicate, it will be best to pause on them for a time, and to wait for further aid from a new supply of experiments and observations.] (T. T. T. T.)

POL DE LEON, a city of France, in the department of Finisterre, and arrondissement of Morlaix. It is situated on a hill near the sea, about a mile from its haven Penpont, which is accessible to small vessels. It is the see of a bishop, and has a cathedral and other churches, 1005 houses, and 6150 inhabitants, who make linen goods, and some pottery ware. Long. 3. 53. 26. W. Lat. 48. 40. 55. N.

POLE, Reginald, cardinal, and archbishop of Canterbury, a younger son of Sir Richard Pole, Lord Montague, was born at Stoverton Castle, in Staffordshire, in the year 1500. At seven years of age he was sent to a Carthusian monastery at Shene, near Richmond, in Surrey; and thence, when he was about twelve years old, removed to Magdalen College, in Oxford, where, by the instruction of the celebrated Linacre and Latimer, he made considerable progress in learning. In 1515 he took the degree of bachelor of arts, and was admitted to deacon's orders some time afterwards; in 1517, he was made prebendary of Salisbury, and in 1519 dean of Wimborne and dean of Exeter. We are not surprised at this young nobleman's early preferments, when we consider him as the kinsman of Henry VIII. and that he was bred to the church by the king's special command.

Being now about the age of nineteen, he was sent, according to the fashion of the times, to finish his studies at Padua, in Italy, where he resided some time in great splendour, having a handsome pension from the king. In 1525 he returned to England, where he was most graciously received at court, and universally admired for his talents and address; but preferring study and sequestration to the pleasures of a court, he retired to the Carthusian convent at Shene, where he had continued about two years, when the pious king began to divulge his scruples of conscience concerning his marriage with Catharine of Spain. Pole foresaw that this affair would necessarily involve him in difficulties; he therefore determined to quit the kingdom, and accordingly obtained leave to visit Paris. Having thus avoided the storm for the present, he returned once more to his convent at Shene; but his tranquillity was again interrupted by the king's resolution to shake off the pope's supremacy, of which Pole's approbation was thought indispensably necessary. How he managed in this affair is not very clear. However, he obtained leave to revisit Italy, and his pension was continued for some time.

The king, having now divorced Queen Catharine, married Anne Boleyn; and being resolved to throw off the papal yoke, ordered Dr Richard Sampson to write a book in justification of his proceedings, which he sent to Pole for his opinion. To this Pole, secure in the pope's protection, wrote a vehement answer, entitled *Pro Unitate Ecclesiasica*, and sent it to the king, who was so much offended with the contents, that he withdrew his pension, stripped him of all his preferments, and procured an act of attainder to be passed against him. In the mean time, Pole was created a cardinal, and sent in quality of nuncio to different parts of Europe. Henry made several attempts to have him secured and brought to England, but all of them proved abortive. At length the pope fixed him as legate at Viterbo, where he continued till the year 1543, when he was appointed legate at the council of Trent, and was afterwards employed by the pope as his chief counsellor.

Pope Paul III. having died in 1540, Pole was twice elected his successor, and, we are told, twice refused the papal dignity; the first time, because the election was made in too great haste; and the second, because it was done in the night. Cardinal Maria de Monte obtained the triple crown; and Pole, having kissed his slipper, retired to the convent of Magazune, near Verona, where he continued till the death of Edward VI. in the year 1553. On the accession of Queen Mary, Pole was sent as legate to England, where he was received by her majesty with great veneration, and conducted to the archbishop's palace at Lambeth, Thomas Cranmer being at that time prisoner in the Tower. He immediately appeared in the House of Lords, where he made a long speech; and this being reported to the Commons by their speaker, both these houses concurred in an humble supplication to be reconciled to the see of Rome. They presented it on their knees to her majesty, who interceded with the cardinal, and he graciously condescended to give them absolution. This business being ended, the legate made his public entry into London, and immediately set about the extirpation of heresy. The day after the execution of Cranmer, which he is falsely said to have advised, he was consecrated archbishop of Canterbury. In the same year, 1556, he was elected chancellor of the university of Oxford, and soon afterwards of Cambridge; both which he visited, by his commissioners. He died of a double quartan ague, in the year 1558, about sixteen hours after the death of the queen, and was buried in the cathedral of Canterbury.

As to his character, the Catholic writers ascribe to him every virtue under heaven; and even Bishop Burnet is lavish in his praise, attributing the cruelties of Mary's reign to the advice of Gardiner. In this Mr Hume agrees with the bishop, and represents Pole as the advocate of toleration. By every impartial account, he seems to have been a man of mild manners and of real worth, though undoubtedly a zealous member of the church of Rome. He wrote, *Pro Unitate Ecclesiastica, De Ejusdem Potestate*, a Treatise on Justification, and various other tracts.

Pole, in *Astronomy*, that point in the heavens round which the whole sphere seems to turn. It is also used for a point directly perpendicular to the centre of the plane of any circle, and distant from it by the length of a radius.

Pole-Axe, a sort of hatchet, nearly resembling a battle-axe, and which is principally employed in sea-fights, to cut away and destroy the rigging of any adversary who endeavours to board.

POLEIN, in English antiquity, is a sort of shoe, sharp or piked at the point. This fashion took its rise in the time of William Rufus; and the pikes were so long that they were tied up to the knees with silver or golden chains. But they were forbidden by statute 4, Edward IV. cap. 7.

POLEMARCHUS, a magistrate at Athens, who had under his care all the strangers and sojourners in the city, over whom he had the same authority as the archon had over the citizens.

POLEMICAL, in matters of literature or theology, an appellation given to books of controversy.

POLEMO, who succeeded Xenocrates in the direction of the academy, was an Athenian of distinguished birth, but in the earlier part of his life a man of loose morals. The manner in which he was reclaimed from the pursuit of infamous pleasures, and brought under the discipline of philosophy, affords a memorable example of the power of eloquence employed in the cause of virtue. As he was, one morning about sunrise, returning home from the revels of the night, he passed by the school of Xenocrates, and saw him surrounded with his disciples. Unable to resist so fortunate an opportunity of indulging his sportive humour, he rushed without ceremony into the school, and took his place amongst the philosophers. The whole assembly was astonished at this intrusion, and all but Xenocrates discovered signs of resentment. Xenocrates, however, preserved perfect command of his temper, and turning his discourse from the subject on which he was treating to the topics of temperance and modesty, he recommended them with such strength of argument and energy of language, that Polemo was constrained to yield to the force of conviction. Instead of turning the philosopher and his doctrine to ridicule, as he at first intended, he became sensible of the folly of his former conduct; was heartily ashamed of the contemptible figure which he had made in so respectable an assembly; assumed a sedate and thoughtful aspect; and resolved from that hour to relinquish his licentious pleasures, and devote himself to the pursuit of wisdom.

POLESINA, a delegation of Austrian Italy, in the province of Milan. It is bounded on the north by Padua, on the east by Venice, on the south by the papal states, and on the west by Mantua and Verona. It is 434 square miles in extent, and contains 135,200 inhabitants. It is a level district, without woods; but abounding in lakes and morasses, which render it unhealthy. The district is enclosed by the rivers Po and Etsch; and the interior is drained by the Adigetto, Tartaro, Castognaro, and many canals. The soil is very fruitful, and yields abundantly of maize, oats, wheat, and rice; and also much fruit, hemp, flax, wine, and good silk. The soil likewise furnishes abundance of nitre, the preparation of which affords much employment. The only other manufactures are those of leather, bricks, and tiles. The capital is Rovigio. In the time of the Romans this district was a marsh, known as *Paludes Padusæ*. It is now divided into seven districts, which are subdivided into fifty-six communes.

POLETÆ were ten magistrates of Athens, who, with three that had the management of the money allowed for public shows, were empowered to let out the tribute-money and other public revenues, and to sell confiscated estates; all which transactions were ratified by their president, or in his name.

POLIANTHES, the Tuberose, a genus of plants belonging to the hexandria class; and in the natural method ranking under the tenth order, *Coronariæ*.

POLICE.

The word *Police* has two meanings. According to the first, it is the science of regulating whatever belongs to the internal economy of a state; according to the second, or limited meaning, it is merely a system of preventive justice.

General definition.

The first definition may appear so extensive, as to make it possible to confound the idea of the science of police with that of politics, or government, as defined by Aristotle to consist of the ordering of all things in the state towards the ultimate end, namely, the common happiness. But the distinction may be understood, by comparing the operation of police regulations in society, to that of a system of domestic order in a family. The members of a commonwealth, like those of a family, must conform their conduct to certain conventional rules, which the chief authority enforces amongst them, for their mutual advantage, in addition to the moral duties which belong to them in common with all men. A breach of an economical law of this description, is an offence against police. Thus, whilst an assault, or a theft, is an offence against the person, or property, of a citizen; treason, one against the sovereign power; or perjury, one against the administration of justice; vagrancy, gaming, bigamy, and the like, are understood to be offences against the public police, upon the ground that the tendency of such acts, without reference to the question of their immorality, is injurious to the economy of society.[1]

But it is the office of police, taken in a large sense, to go farther than forbidding certain injurious acts. It may employ indirect means to prevent the commission of crimes. It may seek to avert the will of the citizen from a breach of the law, by turning his inclinations into a direction conformable to the public interests. Thus, it may avoid the use of any punishment containing ingredients which might make it an object of desire; it may take all possible care that punishment shall be certain; it may cultivate religious sentiments in the people; it may instruct them in their moral and social duties, and provide them with the means of agreeable recreation.[2] The object of such precautions is the same with that of punishment, namely, the prevention of crime; inasmuch as they tend to impress the citizens with a sense of right, acting educationally upon them, like the virtuous principles which a good father instils into the minds of his children. Hence the science of police has been described by a contemporary authority, as "the moral education of a people towards self-government."[3]

It is pretty clear, that police, in this extended sense of internal polity, comprehends the protection of society against not only physical, but also moral evils. The regulation of the highways, and internal navigation; the care of the public health; poor laws or corn laws, may be classed under it with no less propriety than public instruction, or religious establishments. The true ground on which an established church is defensible, is, its value as an instrument of police in this elevated sense; and the same test is applicable to national education, and other institutions, affecting the moral welfare of society.

The present state of moral and political science is not such as to enable us to define police with anything like precision. But if what has been said, does not convey an accurate notion of that which it is, it may point more plainly at that which it is not. No one, for instance, will expect to hear of police in relation to the external defence, or foreign policy, of a state. Few will confound its objects with those of the dispensations of justice which are directed to the maintenance of private rights, or to the security of the state itself, as a social existence.

Limited definitio

The second, or limited definition, of police, considers it as that branch of the administration of justice, which operates directly for the prevention and detection of crime. It is the judicial function to hear and determine between right and wrong, and to sentence the offender to the punishment which the law has awarded him. But the judge cannot be brought into action, without an auxiliary power for securing the persons of offenders for justice; for checking crimes in the act of commission; and for watching the observance, or breach, of the laws. This is the *preventive* branch of justice; and the system of operations destined for the performance of these services, goes, in ordinary language, under the name of police. The object of such operations is of course included within those of the term police, in a larger sense, and preventive justice is therefore their more appropriate name. Under a good system of law, the powers, means, and ends, of preventive justice, would be carefully defined; so that they should, in no case, be confounded with those of penal or executive justice, nor the same individuals be employed in the performance of duties essentially different. But this important distinction has rarely been attended to as it ought, and the efficiency of police establishments has been thereby not unfrequently impaired. At the present time there is, we believe, no instance of the police of a large city which, as a whole, can be said to be merely a preventive system; but a variety of functions are associated under the name of police, contributing to the preservation of the public peace, health, and convenience, but the classification of which is, for the most part, defective. There are, therefore, few perfect systems of police, either in the wide or the limited sense which, it has been seen, properly belongs to that word.

Before we proceed to point out the essential requisites of a good police system, it will be useful to take a review of some existing institutions of this nature.

Ancient police re gulation

From the earliest times, all nations which have established regular laws, have had amongst them police regulations. They form a prominent part of the institutions of the ancient Egyptians and Greeks, and also of the Mosaic law. A special branch of the Roman law was applied to police. The Emperor Augustus, as is well known, introduced important changes into the police of the city of Rome, by withdrawing the powers previously exercised by the Prætors and Ediles, and constituting a magistrate under the title of *Præfectus urbis*, under whom were the *magistratus minores*, or *curatores urbis*, assigned for the protection of the several quarters into which the city was divided. In the reigns of Constantine, Theodosius, and Justinian, very severe laws were enacted against female prostitution. The capitularies of Charlemagne are remarkable for the heavy penalties they inflict upon the same offence, which seems also to have been a favourite subject of regulation with Saint Louis, and

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[1] See an enumeration of offences treated by the English law as "against the public police or economy," in Blackstone's *Commentaries*, book 4, chap. 13; and Stephen's *Summary of the Criminal Law*, chap. 11.

[2] See, on the indirect means of preventing crimes, Bentham, *Principles of Legislation*, penal code, part 4.

[3] *Conversations-Lexicon*, vol. viii. 1835, art. *Polizei*.

Charles VI. of France. In 1502, we find police regulations established at Nuremburg, relating principally to the censorship of books; and there are extant, ordinances of police of the German empire, of the dates of 1548 and 1577, containing distinct ordinances for the empire, the circles, the counties, and the towns. Towards the end of the seventeenth century, the science of police acquired a new development, by the introduction into France of the system of secret police, to which we shall presently refer. There does not appear any particular advantage in detailing at length the police legislation of antiquity, or of the middle ages. It will, we think, be more instructive to confine our statements to modern times.

ld law of ngland.

The provision made for preventive justice by the old law of England, consisted in the powers which it vested in justices of the peace and constables, as also in individuals, when present at the commission of crime, or summoned by the hue and cry. The office of constable existed in the time of the Saxons, and the statute of Winchester (13th Edward I.) expressly directed that two constables should be chosen in every hundred; that suspicious night-walkers should be arrested and detained by the watch; and that in walled towns the gates should be closed from sun-setting to sun-rising. These are called high constables; in addition to whom petty constables were instituted for every town and parish in the reign of Edward III. and especially empowered by the statute 5th Edward III. cap. 44, "to arrest persons suspected of manslaughter, felonies, and robberies, and to deliver them to the sheriff, to be kept in prison till the coming of the justices." The hue and cry is the raising an alarm, and making continuous pursuit through the country, upon the commission of a felony, and was used as far back as the reign of Edward I., when it was comparatively easy by such means to discover a criminal flying from the law. At the present day, when the hue and cry is raised, every person, by command of the constable, is legally obliged, on pain of fine and imprisonment, to join in pursuit of the felon from county to county, or until they come to the sea; but it is now so rarely put in practice, that it may be considered as having almost fallen into desuetude. It is further an old rule of law, that every person present when a felony is committed, is authorized and required to arrest the offender. In early times, it seems to have been the custom for the freeholders of each county to elect "*de probioribus et potentioribus comitatus*," to be keepers of the peace; but the statute 1st Edward III., cap. 16, gave such appointments to the crown, by whom they still continue to be made. When the keepers of the peace became authorized by the statute 34th Edward III. to try felonies and misdemeanours, they acquired the title of justices; and their judicial functions have been so vastly extended by modern statutes, that the mere conservation of the peace is now by no means the most important part of their duties. Such were the ordinary courses available, under the law of England, for the prevention of crime, and for bringing offenders to justice.

As population and property increased, it was found that the ordinary magisterial and constabulary force became more and more inadequate for the public protection. It is not necessary to refer to the Newgate Calendar, or the life of Jonathan Wild, to prove the total absence of any effectual security to individuals, in the last century, against outrage and depredation. It is within the remembrance of persons now living, that a journey could not be undertaken from one part of England to another without risk of highway-robbery. The extent of crime in the metropolis at the close of the last century would be incredible, if it were not recorded upon respectable authority. Colquhoun, writing in the year 1800,[1] estimated the value of the property purloined and pilfered in various ways, in and about the metropolis, at two millions sterling in one year. Some of the instances given would now appear very curious.[2] The same writer furnishes a statement of the number of prisoners discharged from the metropolitan gaols and hulks in the eight years, 1792 to 1799, the total of which is 21,893, being, on an average, 2734 yearly; a very considerable number in proportion to the then population. The almost innumerable ramifications of crime in London, as detailed by Colquhoun, may excite surprise at the little effort that was made in any quarter before he wrote to repress it.

Police of London.

The public office in Bow Street was for some time the only place in the metropolis where a police magistrate sat regularly, without the jurisdiction of the city of London. Seven additional police offices were established in 1792, by the act 32d Geo. III. cap. 53, and the Thames police-office in 1798. Previously to their establishment, the magistrates of the county of Middlesex, and city of Westminster, acted as occasion required, in the same way as the magistrates ordinarily act in other parts of the country.

The constabulary force of the metropolis, comprising that of the cities of London and Westminster, the borough of Southwark, and parts adjacent, is stated by Colquhoun at 883; that consisting of the constables attached to the police offices and the Thames establishment, at 157; and, adding to these 2044 beadles, watchmen, and patroles, employed by the city, and by the numerous parishes and trusts, the civil force of the metropolis, available for purposes of police, amounted, in the aggregate, to 3084 men.

The Parliamentary Finance Committee of 1798, in their Twenty-eighth Report, took a general view of the Police Establishment, in reference principally to its expense; but although that committee recommended several important reforms, and, in the same year, the Government had under its consideration a proposition of Mr. Colquhoun for the establishment of a central police board, and other remedial measures, no result followed. The progress of crime and demoralization, however, began gradually to attract the attention of the Legislature, and Parliamentary Committees inquired into the subject of police in the years 1812, 1816, 1817, 1822, and 1828. At the latter date the necessity for a new system had become very urgent. The metropolis was subdivided into a number of petty jurisdictions, each acting independently, and frustrating the efforts of the other; the local functionaries were miserably inefficient; the absence of union in the constabulary power offered facilities to crime and disorder; and in the event of any real or anticipated tumult, it was necessary to preserve the peace of the town by a military force. In 1829, the act 10th Geo. IV. cap. 44, was passed, "for improving the police in and near the metropolis;" and pursuant to that act, a central office was established in London, and two commissioners appointed for the administration of a system of centralization, in lieu of the local functionaries. The metropolitan police district, according to that act, consists of about ninety parishes, and ultra-parochial places, in and surrounding the metropolis, comprising a population at present amounting to 1,515,592, but exclusive of the city of London and the river Thames. The active force employed under the commissioners at the close of the year 1837, was as follows:—

17 Superintendents at L.200 per annum each.
70 Inspectors at L.1, 10s. 6d. per week each.
342 Sergeants at L.1, 2s. 6d. per week each.
2992 Constables at 19s. per week each.

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[1] *Treatise on the Police of the Metropolis*, by P. Colquhoun, LL.D., magistrate, &c. London, 1806, seventh edition.

[2] The following is one:—"The wife of a well-known sharper, lately upon the town, is said to have appeared at court, dressed in a style of peculiar elegance; while the sharper himself is supposed to have gone in the dress of a clergyman. According to the information of a noted receiver, they pilfered to the value of L.1700 on the king's birthday (1795), without discovery or suspicion."

Horse patrol.

The horse patrol, formerly attached to Bow Street, and recently[1] placed under the commissioners, consists of seventy-six men, mounted and armed.

Offices.

There are at present in London nine police-offices, to each of which three magistrates are attached. These are, Bow Street, Queen Square, Marlborough Street, Marylebone, Hatton Garden, Worship Street, Whitechapel, Union Hall, and the Thames Police. Constables are specially attached to each office, sixty-three altogether, besides twenty-two surveyors, and seventy river constables, belonging to the Thames police.

Expense.

The total expense of these establishments appears by the latest returns to be as follows:—

Metropolitan Police Establishment, exclusive of Commissioners' salaries, year 1837	L.209,754 [2]
Horse Patrol, do.	10,289
Salaries of two commissioners	1,600
Police-offices, including the River Force, (1835)	51,724 [3]
Total	L.272,367

The expenses of the metropolitan force are defrayed principally by a rate levied with the poor rate, upon the inhabitants. A certain proportion, however, is paid out of the consolidated fund; but the advances by the treasury are limited to L.60,000 per annum. The expenses of the nine offices, including the Thames service, and also the commissioners' salaries, are wholly defrayed out of the consolidated fund.

City police

The city of London is not included within the metropolitan district, but retains its separate police, acting under the municipal authorities. Upwards of 1000 persons are employed as marshalmen, watchmen, and constables, and the total annual cost is returned at L.43,862, of which L.34,924 was levied by rates upon the inhabitants, and the residue paid out of the city revenue.[4]

Functions of the metropolitan police.

The functions of the metropolitan police force are exercised under the control partly of the commissioners, and partly of the magistrates. They are distributed throughout the district in seventeen divisions, distinguished by the letters A to V. In each division there are one or more station houses, in which prisoners are lodged in the first instance, on their being given in charge, or taken into custody, until they can be brought before the magistrates at the police offices. Prisoners consequently remain in the station-houses during the night, and also during Sundays. When the case comes on before the magistrate, he deals with it as the law requires, either by discharging the offender, committing him for trial or further examination, convicting him summarily, or holding him to bail.

When a complaint is made to a police magistrate, he issues his warrant as he sees occasion, either to a constable attached to his office, or to one of the metropolitan force. The commissioners of police, although as magistrates they have the legal power to do so, are not in the habit of granting warrants; and the policemen cannot arrest without warrant, unless a charge is made, or an offence is committed in their presence. They have in fact little power beyond that of an ordinary constable, except that the police acts contain more express authority for the apprehension of suspected persons, than the laws which apply to the kingdom in general.

The means of detecting crime have been greatly augmented by the action of the central police establishment, but it may be doubted whether its operation is as efficient as it might be made towards the hindrance of crime, or the preventing its commission. Numerous receivers of stolen goods continue to carry on their business with impunity, and flash-houses still exist in the metropolis, where thieves are known to congregate to concert their plans. There are no authorised informers belonging to the police force.

The subjoined table, compiled from official returns, will shew the extent to which the central police force is brought into action in the course of the year.

Years.	Number of persons taken into custody by Police.	Number discharged by the Magistrates.	Number summarily convicted or held to bail	Number committed for trial.
1834	64,269	34,499	26,302	3,468
1835	63,474	32,544	27,817	3,113
1836	63,384	29,776	30,453	3,175
1837	64,416	33,043	28,345	3,028
Total	255,543	129,862	112,897	12,783
Average of the last four years.	63,885	32,915	28,228	3,196

The circumstance of more than half of the persons taken into custody, having been discharged without punishment, cannot fail to be remarked as indicating unnecessary detention to a serious extent. The remedy for this lies in an improved system of bail and recognizances.

Number of offenders apprehended.

Of the 64,416 persons apprehended in the year 1837, it appears that 5643 were charged with offences against the person, 180 with violent offences against property, 15,289 with larcenies and other offences against property committed without violence, 1727 with malicious offences against property, 884 with forgery and offences against the currency, and 40,684 with offences of a miscellaneous character. Of this latter class, it is worthy of remark, that 21,426 were charged with drunkenness, 3103 as disorderly prostitutes, and 6842 as reputed thieves, suspicious characters, and vagrants. It should be borne in mind that these offenders are exclusive of those apprehended by the city police, and the constables attached to the offices.

The police magistrates are occupied not only in the disposal of the offenders brought before them, but in some matters not of a criminal character, such as the administration of the poor-laws, and other duties conferred by particular statutes. A reference to Burn's Justice will shew the wide range of a magistrate's duty. They have some few, but very limited, powers, in civil cases. They act, in some measure, ministerially, in planning the detection of offenders, and shaping the evidence towards their conviction. There are, however, good reasons for desiring that the magistrates should be entirely confined to their judicial functions.

Vagrants.

The law of England has never entrusted the constabulary, nor has it armed the central police, with any general power of personal *surveillance* over the people. The law which is the most stringent against disorderly or suspicious persons, is the vagrant act,[5] which in fact authorises the magistrate to punish, without any direct proof of the commission of a crime; and the metropolitan police acts[6] have somewhat extended the description of persons who may be apprehended and dealt with as rogues and vagabonds, according to the first mentioned act. In so populous and wealthy a city as London, it is indispensable that summary powers should be vested in the magistracy for the protection of the public against those who live by depredation, and who have neither "a local habitation nor a name," as securities for their good behaviour. It is officially recorded that in the year 1837, the number of depredators, offenders, and suspected persons, within the *cognizance* of the central police, was 19,919, being in the ratio of 1 to each 83 of the population; and as the average length of the career of each offender is estimated at about four years, the danger to property from the existence of such a floating mass of crime is sufficiently apparent. Far from the apprehension of peril to the liberty of the subject, from a further extension of the summary powers of the magistrates, the better opinion seems at present to be, that they might be extended with advantage even to all cases of larceny.

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[1] Under Act 6th and 7th, Will. IV. cap. 50.

[2] See *Parliamentary Return*, 16th Feb. 1838.

[3] *Ibid*, 13th June 1836.

[4] See *Parliamentary Return*, 13th June 1836.

[5] 5th Geo. IV. cap. 83.

[6] 10th Geo. IV. cap. 44, and 3d Will. IV. cap. 19.

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There are in London at present about thirty common gambling-houses known to the police, and the average number of persons daily resorting to each is about twenty. The police has not, however, any summary control over them, but they are subject to indictment by any common informer. Colquhoun reckoned forty-three gambling-houses, including seven subscription-houses of the first class, and supposed the yearly aggregate of money won and lost in them to be L.7,225,000. There are no means of knowing what may be the amount of play in the club-houses of the present day, but we entertain no doubt whatever that Colquhoun's estimate was altogether an exaggeration. The number of persons charged with gambling in London in the year 1837 was 366.

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There exists no medical police in this country of the kind which we find specially established in some parts of the continent. The exercise of the medical profession is subject to conditions imposed by law. We have quarantine laws, under the superintendence of the officers of the customs revenue; and the laws which prohibit the sale of unwholesome food are rather enforced by the officers of markets, than by any branch of the police service. A Board of Health was appointed for a special purpose, during the late visitation of the cholera, but there has never been any permanent establishment of this nature. The inquiry, how far such an establishment would be expedient, suggests itself chiefly as regards female prostitution. The existing law only subjects prostitutes to punishment as in case of disorderly conduct, and houses of ill-fame are only liable to indictment, not to summary visitation. The consideration of protecting the public against the spread of diseases, has not hitherto entered into the policy of our legislation, so as to subject prostitutes to any medical visitation; nor are they restricted from walking the streets, or frequenting places of public amusement. We shall presently notice the very different way in which this matter is treated in France. In the mean time, it is satisfactory to mention, that the extent of prostitution in London is, in truth, nothing like that which the notions of some writers have formed of it. Instead of there being 50,000 prostitutes in the metropolis, as estimated by Colquhoun, the actual number known to the police in 1837 was as follows:—

Prostitutes,	well-dressed, living in brothels,.......	895
Ditto,	well-dressed, walking the streets,.....	1612
Ditto,	low, infesting low neighbourhoods,...	3864
	Total,.........	6371

The number of brothels, in which prostitutes are kept, was 933, having an average number of four in each; the number of houses of ill-fame to which they resort, 848; and that of houses in which they lodge, 1554. Such appears from the best authority to be the real state of the case.[1]

A daily police report of the proceedings, and of the informations received at the several police-offices, is printed for the use of the magistrates and officers; and an official newspaper, called the *Hue and Cry* or *Police Gazette*, is also circulated amongst the authorities, throughout the kingdom.

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During the sessions of 1837 and 1838, a select committee of the House of Commons, appointed on the motion of Mr. Hawes, inquired into the state of the metropolis police, and recommended various important improvements in its management. Amongst these are the consolidation of the several constabulary forces of the metropolis and the river Thames, including those of the city of London, under one authority; the confinement of the magistrates to judicial duties; the extension of their summary jurisdiction to all cases of larceny, and also to many civil cases; the augmentation of the officer's power to arrest; the improvement of the bail system; and the better regulation of the police-offices, with a view to the public accommodation. Our limits do not permit us to discuss the advantages of these reforms. Suffice it to say, that they are of the utmost importance to the efficiency of the police service; and that until they are effected, the metropolis will not be adequately protected against crime and disorder.[2]

Rural police.

The English rural police is of two kinds; that established in the principal cities and towns, and that of the rural districts properly so called. In the former case, it is exercised by the municipal magistracies, and the constabularies acting under them; in the latter, it is vested in the justices of the peace, and constables acting under the old law to which we have adverted.

The cities and towns in which a police has been established upon the same system as that of the metropolis, are, Liverpool, Bristol, Bath, Hull, and Newcastle-upon-Tyne. Other towns have their police, more or less efficient, but regulated upon plans of their own, either prescribed by the municipalities, or by local Acts of Parliament.

The only instance that we are aware of, in which a special rural police has been established in England, is in Cheshire, by an act passed in 1829,[3] entitled "An Act to enable the magistrates of the county palatine of Chester to appoint special high constables for the several hundreds or divisions, and assistant petty constables for the several townships of that county." This act has provided the county with a comparatively efficient constabulary, whose duties and conduct are prescribed and superintended with more accuracy and vigilance than in any other part of the country.

But, however efficient, within an isolated district, may be this or that police establishment, it will have little effect towards the prevention or hindrance of crime in the aggregate, unless a regular chain of communication be maintained throughout the country; unless vigilance be made to circulate; unless, in short, there be centralization. This consideration induced the Government to issue a commission, dated the 20th of October 1836, the commissioners under which were directed to inquire into the best means of establishing a constabulary force in the English counties, with an especial view to the prevention of offences, and with regard to any proceedings before trial by which the detention and apprehension of offenders might be rendered more certain; also to inquire into the public services which might be obtained from such a force, either in the preservation of peace, and due protection of property, or enforcing the more regular observance of law; and into the manner in which such force should be appointed and paid. At the time we write, the commissioners have not made their report, but there is reason to believe that a very valuable one will soon be produced.

Advantages of organization.

That it is perfectly practicable to organize a constabulary force for the whole kingdom, acting under a central authority in the metropolis, and governed by a gradation of superior and responsible officers, cannot be doubted. Nor is it much less clear, that the public morality, and the interests of property would be greatly promoted by such a measure. It especially deserves notice, that, in the rural districts, the delinquents are almost entirely of the vagrant class, being either habitual depredators, or vagrants asking alms. Now, the only law for the constant control of these habitual delinquents, is the vagrant act before cited, which experience has shewn to be by no means sufficient. Few offences are committed within the view of a constable; therefore the constabulary seldom acts but upon information, and as there is no special obligation upon any one to communicate information, the enforcement of the law is so far dependent upon chance. Then, the ancient practice of pursuit by hue and cry having fallen into disuse, the vagrant depredators referred to, go from county to county, taking up their temporary abode in common lodging-houses, the number of which has much increased of late years, and so pursue their career with impunity. Of the habitual depredators within the cognizance of the metropolitan police in 1837, 2712 were known to be vagrant; in Bristol 605 were so known; in Hull 303; and in Newcastle 454. From 18,000 to 20,000 vagrants are annually committed to prison throughout the country. They assume different names as occasion requires, and to identify them, or ascertain their real history, is usually a matter of great difficulty.

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[1] The statistics throughout this paper are quoted on the authority of official documents.

[2] See the valuable Report of this Committee (Session 1838); also the *Edinburgh Review*, No. 134, Art. "Police of the Metropolis."

[3] 11th Geo. IV. cap. 97.

Expediency of placing discharged criminals under police control

One of the indirect means enumerated by Bentham for the prevention of crime, was a system of proper names, by which an appellation should be assigned to each individual, indicative of his family and birth-place, and distinguishing him from all other persons whatsoever. Bentham also recommended, in certain cases, the affixing marks on the skin, such as are imprinted by sailors on their bodies, with gunpowder, at the present day. The old law of England branded all laymen who had once been admitted to the benefit of clergy, by burning them with a hot iron in the brawn of the left thumb, in order to distinguish their persons for the future. Now, it is worthy of consideration, whether the rationale of branding is not still applicable to the cases of all offenders once convicted of crime? It is very desirable that all persons of suspicious character should, for a limited period after their liberation, be so distinguished from others, as to enable the police to have a knowledge of their movements. It is also desirable, for their own sake, as well as that of the public, that such individuals should, as far as possible, be kept away from immediate incentives to crime. To whatever perfection prison-discipline may eventually be brought, it is vain to expect that its reformatory influence can invariably be such as to subdue the frailty of human nature, and the seductions of present opportunities. The law of France has, therefore, as we shall presently show, placed the criminal, for a limited period after his discharge, under a certain *surveillance* of the *Haute police*, as a part of his punishment. The expediency of introducing such a system into the English law to any, and to what extent, is a point deserving of serious reflection.

Such a proposal must of course be understood as applicable only to persons actually convicted of offences. Any thing resembling a passport system for the whole population, innocent as well as guilty, would not only be incompatible with free institutions, but invincibly repugnant to the spirit and feelings of the British people. The question therefore resolves itself into one of punishment, the problem being to find that punishment, which having regard to the habits of the criminal, shall contain within it the maximum of prevention, combining the direct with the indirect method of hindering crime. Now, assuming, as the fact is, that imprisonment, according to the present system of secondary punishments, has not the qualities required, but is often neither deterring, nor reformatory, might not police-supervision be substituted, in some cases partially, in others entirely, for such imprisonment? Would not such police supervision be a peculiarly appropriate punishment for vagrants and other petty offenders, the terms of whose imprisonment are very short? and might it not be advantageous, even in the cases of graver offenders, to permit the commutation, under certain regulations, of a portion of the imprisonment, into police-supervision? We think that the principle of such alterations might be demonstrated to be beneficial, but then it would remain to be considered of what the proposed supervision ought to consist.

The liberated convict, who might be thus placed under police control, might properly be required to inform the police from time to time of his place of residence; to present himself to an officer periodically; to avoid all disorderly or tumultuous assemblies, and all places of public resort of a vicious character, to be specified to him by the police; not to enter any towns or districts, specially prohibited by the police, such as in many cases the metropolis, or other populous towns, or the localities of large fairs, or races, would be; and, above all, not to associate with other liberated convicts. Any breach of these conditions should subject the offender to summary imprisonment.

Such regulations might be objected to upon the one hand as too irksome, and, on the other, as not sufficiently stringent. It might be suggested to add to their severity, by prescribing absolutely the place of residence of the delinquent, by prohibiting him from all places whatever of public amusement, and the like. Care, however, must be taken not to draw the restraining cord so tight as to debar the convict from that which is harmless in itself, and may by possibility have a beneficial influence upon his character. But we acknowledge the difficulty of fixing the limits of restriction, a difficulty which occurs in every branch of police, and, until our knowledge of the science shall be advanced by experience, will continue to meet us at every step in legislation.

Whilst the formation of a general rural police in England is under consideration, it will answer little purpose to describe the nature of the constabulary, which now serves as a substitute for it. Its inefficiency is notorious. The fatal riot which took place at Canterbury[1] is a flagrant instance of the mischiefs which a single individual may bring upon society, when society has not taken measures of ordinary prudence for its own protection.

Scotland.

The constabulary of Scotland is under the control of the magistrates of the municipalities and counties, in the same way as in those parts of England where the principle of the central police has not been introduced. It is consequently wanting in almost all the requisites of an efficient system.

Ireland.

A regular police force was first established throughout Ireland under an act passed in 1814,[2] "to provide for the better regulation of the laws in Ireland, by appointing superintending magistrates and additional constables in certain cases." Several other acts followed, which were consolidated by the act of 1836,[3] and by this latter the constabulary is at present regulated. The lord-lieutenant appoints stipendiary magistrates and constables in the several towns, counties, and baronies in the proportions prescribed by the act, with an inspector-general and sub-inspectors for their superintendence. The following qualification for the constables is illustrative of the state of society in Ireland. They are required to be "of a sound constitution, able-bodied, and under the age of forty years, able to read and write, of a good character for honesty, fidelity, and activity, not a gamekeeper, wood-ranger, *tithe-proctor*, *viewer of tithes*, *bailiff*, *or parish clerk*, or a hired servant, or keeping any house for the sale of beer, wine, or spirituous liquors by retail." The stipendiary magistrates are fifty in number, with salaries varying from L.400 to L.1000 per annum. The office of inspector-general is considered as a highly responsible one; his salary is L.1500 per annum. The following is a summary of the total amount of police force employed on the 1st of January 1838; distinguishing the proportion of expenses borne respectively by the consolidated fund, and by the counties, cities, and towns, pursuant to the provisions of the act:[1]

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[1] We refer to the proceedings of Courtenay, otherwise Thom, in May 1838.

[2] 54 Geo. III. c. 131.

[3] 6 Will. IV. c. 13.

1	Inspector-general		
2	Deputy inspectors-general		
4	County inspectors		
35	Sub-inspectors		
109	Chief constables		
105	Do. 2d rate		
35	Head constables	Consolidated fund	L.227,606
216	Do. 2d class	Counties and towns	152,661
1037	Constables		
5211	Sub-constables	Total expense	L.380,268
1439	Do. 2d class		
50	Magistrates		
18	Paymasters		
1	Receiver		
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It will be observed that the above force contains a variety of gradations of officers; and this is a principle of great importance in the organization of police establishments. It both regulates responsibility, and holds out the prospect of promotion as the reward of merit.

The lord-lieutenant is empowered to establish an additional special police force in any county or district declared to be in a state of disturbance. The peculiar condition of Ireland has rendered this provision requisite; but it is well known that it has not hitherto superseded the necessity of the large military force which, as an instrument of mere police, continues to be stationed in that country.

Dlin.

The City of Dublin has a special police force, with an office and two magistrates, acting for that metropolis and a certain surrounding district. Its powers and duties are analogous to those of the London central police; and it acts under the immediate authority of the chief secretary to the Lord-Lieutenant. It was established by act of Parliament in the year 1836.[2]

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There are, in various parts of the United Kingdom, officers possessing limited powers of police for special purposes, such as the police of docks, railways, &c. whose authority is defined by the particular statutes under which they act.

Fnce.

The nation, in whose history the operations of the police have been the most conspicuous, is modern France. A knowledge of the extent and effects of the police agency for the last century and a half is indispensable to a right understanding of French history, and there are ample materials for an elaborate work upon the subject.[3] Our present limits do not permit us to do more than trace superficially the origin of existing institutions.

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From the commencement of the feudal *regime*, the provost of Paris was the highest municipal authority. He not only carried the sword at the head of a military force, but presided in the robe of a judge at the Châtelet, that ancient and venerable building to which the administration of justice was so long wholly confined. One of the ten chambers, or courts, of the Châtelet, was that of police, to which reports were made of all infractions of the police regulations of the city. The provost had under him two officers of the second rank, called the *lieutenant-civil*, and the *lieutenant-criminel*, besides the judicial and ministerial staff of the Châtelet. There was also an independent police authority, called the *bureau de ville*, which took cognizance of all that related to the water, the quays, the ramparts, and the public festivals of Paris, and whose principal officer was styled the provost of merchants. For a long period, the parliament of Paris moderated these conflicting jurisdictions, and in 1667, their recommendations gave rise to the edict made by Louis XIV. in that year, whereby the functions of police were withdrawn from the civil and criminal lieutenants, and conferred on a new magistrate, who, under the name of *lieutenant de police*, became the representative of that jurisdiction which had previously been exercised by the authorities of the Châtelet. The *bureau de ville*, however, continued its functions as before. In 1674, the title of the new magistrate was declared by the king to be that of *Lieutenant-General de Police*, which continued to the Revolution.

The first of these officers was De la Reynie, famous for being charged with the execution of the edict which revoked that of Nantes in 1685. To him succeeded the Marquis D'Argenson in 1697, the creator of the system of secret police, which has ever since been more or less acted upon in France. D'Argenson employed *espionage* largely. He is described by Fontenelle, as having unparalleled powers of divination, and was undoubtedly a man of unusual sagacity. He had the merit of refusing to execute in Paris, the measures of persecution against the Protestants, which were being carried on in the provinces. The succeeding lieutenants-general were, Machault d'Arnouville (1718), Count d'Argenson (1720), Taschereau de Baudry (1720), Ravot d'Ombreval (1724), René Hérault (1725), De Marville (1739), Berryer (1747), Bertin (1754), De Sartine (1759). The activity of the last mentioned officer was very remarkable. He chose his inferior agents with judgment, and some curious proofs are on record, how accurately he knew all that was passing in Paris.[4] He was in the habit of furnishing to Louis XV. reports of a licentious character, describing the most scandalous indecencies committed in the capital, and a collection of them was found in the Bastille at the capture of that fortress-prison, in July 1789. The secret police was brought to great perfection by De Sartine, and he had his emissaries in every European state. He seems to have been both feared and hated by the people. The French police about this time excited the attention of other governments; and both the Empress Catherine II. of Russia, and Maria Theresa of Austria, having applied to the French government for information on the subject, De Sartine made for their use a collection of the ordinances and regulations then subsisting, which is still extant. An unfortunate event is recorded to have happened during De Sartine's administration, which is illustrative of the evils of conflicting jurisdictions in matters of police. A fête, with fire-works and illuminations, was held in the Place Louis XV. on 30th of May 1770, in celebration of the marriage of the Dauphin with Marie Antoinette. The responsibility of the arrangements was divided between De Sartine and the provost of Merchants, and the consequence was, that a scene of confusion ensued, in which 132 persons were killed, and as many wounded. The parliament reprimanded both functionaries, and additional powers were soon afterwards conferrred on the lieutenant-general. To De Sartine, succeeded Le Noir (1774), D' Albert (1775), Le Noir, (second administration 1776), and De Crosne (1785), who closed with the Revolution the list of lieutenants of police. Their office, and that of the provost of Merchants, merged in the *comité permanent*, who re-organized the municipality of Paris, and laid the foundation of the existing institutions, which take their origin principally from the legislation of the revolutionary period. The secret or *haute police*, was acted on, as is well known, by the General Directory, and afterwards, with terrible effect, under the Emperor Napoleon. The unfortunate Duc d'Enghien was one of its victims. The life of the celebrated Fouché, is full of interest and instruction under this head. Not the least remarkable circumstance in Fouché's career, is the fact of Napoleon having been in the habit of employing several branches of *contre-police*, to watch the proceedings of his own police-minister.[1] Thus, he had a distinct police of the palace under the grand-marshall, of the city of Paris under the military governor, and of all France under the inspector-general of *gendarmerie*. The *gendarmes* throughout France had to transmit daily bulletins of all that took place, for the information of the Emperor. The general police under Fouché was evidently considered by Napoleon as a sort of rival of the Imperial power.

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[1] See *Parliamentary Return*, 11th May 1838.

[2] See act 6 and 7 Will. 4, cap. 29.

[3] See especially the following works: De la Marre, *Traité de la Police*. Dessessart's *Dictionnaire Universel de Police de* 1786 *à* 1791. Peuchet, *Archives de Police*, 6 vols. *Nouveau Dictionnaire de Police*, par Elouin. Trebuchet, et Labat, Paris 1835; an interesting and valuable account of the whole of the internal arrangements of society in France. *De la Prostitution dans la Ville de Paris*, par A. J. B. Parent-Duchatelet. Paris 1836.

[4] See two anecdotes cited by Colquhoun, chapter 17.

Description of French system.

The law of France declares the police to be instituted "to maintain order and public tranquillity, liberty, property, and individual security." Its principal characteristic is declared to be "vigilance;" the objects of its solicitude are society *en masse*.[2]

It is divided into *administrative* and *judicial* police. The administrative has for its object, the maintenance of public order everywhere, and in every part of the general administration. Its tendency is to the prevention of crime, and it causes to be executed all public laws, ordinances and regulations. It is exercised throughout France by the minister of the interior, in cases of general measures. In the departments, and in the communes, it is under the direction of the *préfets*, *sous-préfets*, and *maires*, and in Paris, under that of the *préfet de police*. These magistrates may prescribe such measures as are not contrary to the existing law, and make such orders, in respect of local police, as circumstances may require, any infraction of which is punishable according to the penal code.

The *administrative* is subdivided into *general* and *municipal* police. The latter term includes also the *rural* police. The general administrative police, comprises the regulation of passports, mendicity and vagrancy, prisons and public institutions, the press, religious worship, seditious language, public provocation to crimes, defamation of authorities, desertion, &c.[3] To this head belongs the *haute police*, to which we shall presently advert. The objects of municipal police are the preservation of the public security, health, and tranquillity, in the public streets and passages, in regard to fires, inundations, the exchange, markets, theatres, and public places, the public edifices and monuments, the course of commerce, and collection of taxes.[4] It seems to comprise, with some additions, the functions of the ancient *bureau de ville*.

The *judicial* branch of police is engaged in detecting the perpetrators of the crimes and offences, the commission of which has not been prevented by the administrative branch. It collects evidence, arrests offenders, and delivers them to the tribunals authorised to try and punish them. It is exercised under the authority of the *cours royales*.[5] Although this branch is termed judicial, it would seem more correct to describe it, as that which secures offenders for justice, in contradistinction to the operations by which the act of crime itself is hindered from commission.

A special police service is established in the French ports, under the name of *police maritime*. All offences committed in ports or naval arsenals, whether committed by persons in the naval service or otherwise, are cognizable by the maritime tribunals established for the purpose. The crews of all ships of war in port, are amenable to these tribunals for all offences against naval discipline. Offences against maritime police are described to be; first, all such as are committed against public order, and the service of the arsenals, or in the contravention of the special rules made for the port; and, second, simple thefts below the value of six francs, committed in the arsenals. The penalties which the tribunals of police are empowered to inflict, are, imprisonment not exceeding three months, compensation under 100 francs, loss of wages, and expulsion from the service of the arsenal.[6]

The rural police of France is exercised by the *juges de paix*, and the mayors, under the superintendence of the *préfets* and *sous-préfets*, by the aid of *gendarmerie*.[7] The *préfets* are the chief magistrates of the departments, and are appointed by the king. The duties of a prefect are so comprehensive, as to have been thus described by a legal writer, "Surveiller, reparer, feconder, voilà sa tache." He watches especially over the property of the state, and the public security; the roads, rivers, and other objects of common use; and is the agent of all the operations of government in his department.[8] He has the power of requiring the aid of the officers of the judicial police, for all purposes relating to the prevention of crime. The rural police punishes thefts or injuries to natural productions, regulates gleaning, the fixing of boundaries between lands, the interment of dead animals, and a variety of matters affecting the cultivation of land, and likely to give rise to disputes amongst a population of small proprietors. Offenders against rural police are punishable by imprisonment, and by the enforcement of compensation, as amends for injuries done.

The principle of centralization, it will be perceived, exists in the rural police of France to a considerable degree. The mayors and local magistrates, being under the immediate supervision of the prefects, who are controlled directly by the Minister of the Interior, there are the means of obtaining a certain unity of action in its proceedings. But the chain of communication throughout France, for purposes of police, would probably be improved if the machinery were less complicated, and the number of subordinate functionaries were smaller. Complaints are frequent, in cases where local improvements or changes are required, or where individuals have to petition for the redress of a grievance, or for permission from Government to do some act, of the great number of hands through which such applications must pass, in order to their being consulted, before the requisite authority can be obtained. The public thus suffers inconvenience and delay, from the want of simplicity in the arrangement of the system. It is not in the administration of rural police, properly so called, that the French system suggests much worthy of consideration, but rather in respect of the Haute Police, whereby convicted offenders are brought immediately under official surveillance in all parts of the country. In Paris, the "préfet de police" is charged with the whole administration of his department.[9] As regards the municipality, he exercises all the functions of the mayors in the communes, but is subject to no other control than that of the Minister of the Interior. The expenses of the prefecture are charged upon the city of Paris, but its jurisdiction extends throughout the Department of the Seine. The prefect is empowered to make such regulations as he deems expedient, consistently with the existing laws. A summary of his functions will perhaps be the best mode of conveying a notion of the extent of police interference in the French metropolis.

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[1] See *Memoires de Fouché*, Paris 1834. *Témoignages Historiques, ou quinze ans de Haute Police sous Napoléon*, par Desmarets, Paris 1833.

[2] *Code des Délits et des Peines, du 3me Brumaire, an* 4, livre i. art. 16 and 17.

[3] See *Arreté du 5 Brumaire, an.* 9, and *Decree* of 25th March 1811.

[4] See the *Arreté* and *Decree* above cited, and the Laws of August 1790, and July 1791.

[5] *Code d'Instruction Criminelle*, art 8 and 9; also *Code du 3 Brumaire, an.* 4, art. 29.

[6] See Law of 20th September 1792, and several Decrees and Ordonnances, especially those of 12th Nov. 1806, and 14th Oct. 1818.

[7] See Law 6th October 1791.

[8] See Law 28 Pluvoise, an. 8, (1800), art. 15.

[9] See Law of 28th Pluviose, an. 8, art. 16.

In respect of the general police, it is at the prefecture that passports are issued to travellers, and are *visa'd* on their arrival at Paris. Travellers remaining in Paris more than three days require permission for that purpose. All public establishments for the relief of the poor, or charitable purposes, are subject to police inspection. The prefecture may arrest all vagrants and mendicants. It superintends the police arrangements of the metropolitan prisons, and appoints certain of their officers. It carries into effect the regulations in force relating to hotels, lodging-houses, gaming-houses, and brothels. It prevents tumultuous assemblies, and coalitions of workmen. It puts in force the laws affecting the press, and restraining indecency and obscenity; superintends the construction of theatres, and keeps order within them; attends places of worship to prevent disorders there; takes cognisance of the distribution of gunpowder, and the use of arms; arrests deserters, and makes the arrangements at public *fêtes.*

The duties of the préfet and his officers in regard to the *municipal* police, are still more multifarious than those of the *general.* The care of all roads and passages, not being the great roads of the kingdom, *(la petite voirie)* and of the shops and stalls; the construction of scaffoldings, and the demolition of ruinous buildings; are committed wholly to the prefecture of police. Thus the police causes the streets and gutters to be cleaned; seizes dangerous animals; regulates the speed of carriages; and prevents their stopping the way. It preserves health, as far as possible, by removing all filthy or noxious accumulations; takes measures to prevent fire; and secures the requisite supply of water to the city. It verifies weights and measures; enforces the regulations of the markets, baths, hackney coaches, pawnbrokers, and the numerous other places and things in Paris which are subject to special rules; guards from injury the public buildings, monuments, fountains, &c., and requires their repair, when needful, by the proper authorities. In short, there is scarcely any part of the *matériel* of society, which is not subjected to the supervision of the prefecture of police.

The establishment of the prefect consists of a numerous body of *commissaires*, inspectors, and peace-officers, in due gradation; and the gendarmerie are at his absolute disposal, who answer the best to the description of the constables of the London central police. It will be observed that the functions of the prefect of Paris and his officers are principally administrative; but they also act judicially, as the French law terms it, to a certain extent, in securing and collecting evidence against such offenders as are amenable to the jurisdiction of the tribunals of correctional police.

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The French executive government has long exercised, and still seems to possess the right of exercising what is called the *haute police administrative,* in all cases where an individual has done an act considered by the executive as dangerous to the public safety, although not contrary to the existing law. This is the undefined power that has instituted the odious system of secret police, and has been made the instrument of so much tyranny and injustice. It is, in truth, no part of the established police system, but rather an arbitrary power of *ex post facto* legislation committed to the Government, for supposed cases of danger which the law may not have foreseen. The "haute police administrative" is usually exercised by the Minister of the Interior, through the préfet de police, and occasionally by the Council of State.

The law has, however, clearly defined that department of the Haute Police, which takes under its control offenders discharged from prison, and watches over their conduct for a specified time. This constitutes a part of the punishment to which certain offenders may be sentenced, pursuant to the penal code.[1] It extends to both the higher and lower classes of delinquents. The effect of it is to give to the Government the right to determine certain places in which the offender is forbidden to appear after his discharge from prison. He is, besides, required to declare, before he is set at liberty, in what place he intends to reside; and thereupon he receives an order regulating his route to such place. On his arrival he must present himself within twenty-four hours, before the mayor of the commune, and cannot change his residence without informing the mayor three days beforehand, of the place to which he desires to remove, and receiving from him a new order prescribing his route thither. In case of breach of these regulations, the offender is liable to imprisonment not exceeding five years. The terms of surveillance vary according to the crime; but vagrants and mendicants are specially subjected to a surveillance of not less than five, nor more than ten years.

The provisions of the penal code of France have lately been modified, by dispensing with those enactments which required prisoners, on their discharge, to find security for their good behaviour, and in default assigned them a fixed place of residence. It was found, in practice, that very few indeed were able to find the security, and the restriction of the convict to a particular locality rendered him so notorious as to make it impracticable for him to obtain a livelihood. Some were actually reduced to such destitution as to be under the necessity of begging a temporary admission into prison. We have seen that, at present, the government only reserves the right of prohibiting certain places; and the list of such places comprises, Paris and its suburbs, Lyons, Marseilles, Bordeaux, Lisle, Strasbourg, Nantes, Brest, Toulon, Rochfort, L'Orient, and Cherbourg. Even to these places the convict is allowed access for any special reasons approved by the police. The number of discharged convicts thus under the surveillance of the Haute Police throughout France, was in 1833, about 40,000.[2]

It has has been already suggested, whether a system of police-supervision might not be introduced into the English criminal law with good effect, and, in particular, as a valuable instrument of rural police. The working of the French Haute Police would afford, without doubt, some useful lessons towards fixing the proper limit of restriction. It demonstrates, especially, the wisdom of interfering as little as possible with the market for the labour of the discharged convict; and this is of the more importance in England in proportion to the greater density of population. In the United States, where the demand for labour is boundless, the emancipated convict transports himself to a distance from the seat of his crime, and obtains immediate employment without a stigma on his character. But in England and France the difficulty of earning a livelihood is comparatively so great, that caution is requisite, lest the tendency of any system of police surveillance to be established, should be to abridge the means of subsistence of the criminal population. The difficulty, however, is by no means one against which it seems impracticable to guard successfully.

Prostitution

The French medical police consists of the restrictions imposed by law upon the exercise of the medical profession, and the vending of secret remedies, which are liable to examination before they can be sold. The subject of prostitution belongs also principally to this head.

The law of France visits with punishment "every person who shall have committed a public outrage on modesty."[1] But the law being silent in all such cases of prostitution as do not thus constitute a *public* violation of decency, the administration is placed in the delicate position of having to determine what may amount to such a violation. The police, therefore, whilst it prohibits the open scandal of prostitution; not allowing immodest women to appear in the street, or in public places, or any indecency to be openly committed; acts upon the principle of tolerating houses of debauchery, and preventing by its *surveillance*, as much as possible of the injury arising to the public from such establishments. These houses are therefore licensed, and the number of them in Paris is about 220. Every female living in habitual prostitution is required to be registered by the police. Such as reside at their own houses are obliged to present themselves regularly, at stated periods, at the public dispensary for medical examination; and those inhabiting the *maisons de tolérance*, are also regularly visited by the medical authorities. Every female carries with her a ticket, upon which the medical inspections are noted from time to time. All females known to the police as prostitutes, but unregistered *(insoumises)*, are liable to arrest, and are brought to the dispensary for examination.

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[1] Code Pénal, art. 11.

[2] *Circulaire du Ministre de l'Intérieur du* 18 *Juillet* 1833, *sur la Surveillance Légale des Condamnés Libérés;* a document well worthy of reference.

The number of *registered* prostitutes in Paris appears to have gradually increased, from a monthly average of 1293, in the year 1812, to an average of 2902 in the year 1822, and of 3558 in 1832.[2] In the year 1834, the monthly average was 3786.[3] It does not of course follow, that the actual number of prostitutes has increased commensurately with the numbers registered; on the contrary, there is reason to believe it has diminished. But to determine this point accurately, we should have before us the comparative numbers, both registered and unregistered, for a series of years back; which, it would seem, there are no means of ascertaining.

There can be no doubt that the effect of these regulations has operated very beneficially upon the health of the registered prostitutes. It appears that the monthly average of disease amongst the registered women, wherever resident, upon a series of years, from 1812 to 1832, has varied from one in seventeen to one in thirty-four,[4] and that in 1834, it did not exceed one in 43;[5] whilst the proportion of the total number of the unregistered, or *insoumises*, arrested by the police from 1816 to 1828, who were found diseased, was as high as one in four,[4] and upon a monthly average of the year 1834, it was even higher.[5] The police regulations, therefore, confine the existence of disease in a great degree to the class of prostitutes who receive their visitors privately, without any official cognizance. There are no means of knowing the actual extent of licentiousness amongst the female population of Paris; but the police is, of course, not responsible for the disease resulting from it; and although it might be objected that the removal of disease, as a result of prostitution, is a sort of encouragement to immorality, still it must be remembered, that prostitution is, in large towns, an inevitable evil; that it is, to a large class of persons, an industry, and a resource against want; and that, it being wholly out of the power of police regulations to prevent it, the more it can be divested of its power of injuring society physically and morally, the lighter will be the evil of its existence.

Belgium.

In Belgium there is no centralized police, but it is subject to the local authorities. A recent law has placed discharged convicts under the temporary supervision of the police, in the same way as in France.[6]

Police. Prussia.

The police of Prussia is also a matter belonging to separate jurisdictions throughout the kingdom. The *landraths* in the rural districts exercise powers resembling those of our justices of the peace. In the cities special boards are appointed, under the direction of which the regulation of buildings, sewers, and supplies of water and of food are placed.[7] The police superintends the examination of medical practitioners; the insurance offices; and the fire-engines. It exercises the usual functions for the prevention of crimes, and keeps a certain degree of surveillance over vagrants and mendicants. Brothels are subject to visitation, and prostitutes to medical examination. There is no secret system of police in Prussia, analogous to that of France which we have described; nor does it, we believe, now exist, in any part of Germany.

The length at which we have described the police institutions of England and France, will render the less necessary a particular reference to those of the other European states, because little is to be learned from them; and in all countries, the institutions of which are in arrear of civilization, the distinction between police, and other branches of administration, is marked less and less strongly, until we descend to the point of barbarism, at which there is a confusion of all the functions of government, internal and external, civil and military, legislative, judicial, and ministerial, in one absolute sway; with comparatively inadequate security against foreign aggression, and none whatever for domestic peace. A good police system is, on the contrary, a distinguishing mark of the supremacy of organized law in the country where it is in force.

Having thus endeavoured to present such a sketch of existing institutions as our space will admit, it only remains to point out what we consider as the indispensable requisites of a good police system. These are,—

Requisites of a good police system.

1st, Centralization, under one superintending authority, which may keep up a regular and certain channel of communication, throughout every part of the country, may secure uniformity of administration, and enforce vigilance and activity in the officers employed.

2d, The powers and duties of the police force should be so correctly defined, as to leave no room for doubt, when action is required. The whole charge, both of preventing the perpetration of crime, and securing offenders for justice, should be committed to it, with such miscellaneous functions as the legislature may properly entrust to it in addition. No person ought ever to act both ministerially in aid of police, and also judicially as a magistrate.

3d, The utmost care and caution are needful in fixing the extent of police interference, so that the amount of public advantage derivable from it, shall exceed that of the inconvenience sustained. This task is a delicate and difficult one; for police interference has, in some instances, been so wrongly applied as to defeat its own end.

4th, A good system of secondary punishments is essential to the efficiency of a police establishment. If the tendency of imprisonment is such as to excite to crime, it counteracts the most important object of police, namely, its prevention.

Other matters will probably have suggested themselves to the reader; but our limits do not permit us to discuss them at length. The requisites above stated may be considered as cardinal points, which cannot be disregarded without impairing the efficiency of any system of police to which they are wanting.

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[1] Code Pénal, art. 330.

[2] Parent-Duchatelet, *de la Prostitution*, &c.

[3] *Nouveau-Dictionnaire de Police.*

[4] Parent-Duchatelet.

[5] *Nouveau Dictionnaire.*

[6] *Loi sur la surveillance des condamnés libérés, du* 31 *Decembre* 1836.

[7] Several German works on medical police may be consulted, especially, Franks, *System einer vollstundigen Medicinischen Policei*, 6 vols. 1784 to 1825. Niemann's *Medicinische Policei Wissenchaft*, Leipsig, 1829. Consbruch and Ebromaier's *Allgemeine Encyclopæd. fur Arzte*. bd. 10. *Conversations-Lexicon*, vol. viii. art. *Medicinische-Policei.*

POLICY of Insurance, or Assurance, of ships, is a contract or convention, by which a person takes upon himself the risks of a sea-voyage; obliging himself to make good in part or in whole the losses and damages that may befall the vessel, its equipage, tackle, victualling, lading, &c. either from tempests, shipwrecks, pirates, fire, war, reprisals, in consideration of a certain sum, more or less, according to the risk; which sum is paid down to the assurer by the assuree upon his signing the policy.

POLIGNA, Melchior de, a French cardinal, was born of an ancient and noble family at Puy, the capital of Velay, in 1662. He was sent by Louis XIV. as ambassador extraordinary to Poland, where, on the death of Sobieski, he formed a project of procuring the election of the prince of Conti; but failing in this, he returned home under some disgrace. When restored to favour, he was sent to Rome as auditor of the Rota. He acted as plenipotentiary during the congress at Utrecht, at which time Clement I. created him cardinal; and upon the accession of Louis XV. he was appointed to reside as minister of France at Rome, where he remained till the year 1732, and died in the year 1741. He left behind him a manuscript poem, entitled *Anti-Lucretius, seu De Deo et Natura*, the plan of which he is said to have formed in Holland in a conversation with Bayle.

POLIGNY, an arrondissement of the department of the Jura, in France, extending over 496 square miles. It comprehends seven cantons, divided into 161 communes, and contains 72,650 inhabitants. The capital is a city of the same name, situated on the river Elantine. It is well built, and in a fertile district, in which some good red wine is produced. It contains 1150 houses, with 5620 inhabitants, who make porcelain, tan leather, and refine much saltpetre.

POLISHER, or Burnisher, amongst mechanics, an instrument for polishing and burnishing things proper to take a polish.

POLITENESS means elegance of manners, or good breeding. Lord Chesterfield denominates it the art of pleasing. It has also been called an artificial good nature; and indeed good nature is the foundation of true politeness, for without it art will make but a very indifferent figure, and generally defeat its own ends. Where compliance and assent, caution and candour, arise from a natural tenderness of disposition and softness of nature, as they sometimes do, they are almost always amiable, and certainly excusable; but as the effects of artifice, they must be despised. The persons who possess them are often indeed themselves dupes of their own deceit, when they imagine others are deluded by it; for excessive art always betrays itself.

A variety of excellent rules for acquiring politeness, with strictures on particular kinds of impoliteness, may be found in the Spectator, Rambler, Idler, Lounger, Mirror, and other periodical works of that kind; in Knox's Essays, and among Swift's works. Chesterfield's Art of Pleasing, and his Letters, are also worthy of perusal, provided the reader be on his guard against the insincerity and the false maxims which these books are calculated to infuse.

POLITIAN, Angelo, was born at Monte Pulciano in Tuscany, in the year 1454. He studied the Greek language, of which he became a complete master, under Andronicus of Thessalonica. He is said to have written verses both in Greek and in Latin when he was not more than twelve years of age. He also studied the Platonic philosophy under Marsilius Ficinus, and that of Aristotle under Argyropylus. Politian was one of the most learned and polite writers of his time. The first work which gained him a reputation was a poem on the tournament of Julian de' Medicis. The account he wrote, some time afterwards, of the conspiracy of the Pazzi, was also very much esteemed. He composed many other pieces which merit approbation; and had he lived longer, he would have enriched the republic of letters with many excellent works. He died at the age of forty. His morals answered the homeliness of his face rather than the beauty of his genius; for Paul Jovius informs us, that he was a man of singularly awkward and perverse manners, of a countenance by no means open and liberal, a nose remarkably large, and squinting eyes. "He was crafty, satirical, and full of inward malice; for his constant way was to sneer and ridicule the productions of other men, and never to allow any criticism, however just, upon his own."

Nevertheless, Politian was a man of consummate erudition; and not only so, but a very polite and elegant writer. Erasmus, in his *Ciceronianus*, calls him a rare miracle of nature, on account of his excelling in every kind of writing. "Fateor angelum prorsus angelica fuisse mente, rarum naturæ miraculum, ad quodcunque scripti genus applicaret animum." Some of his poems were so much admired, that several learned men have made it their business to comment on them. It has often been reported that he spoke of the Bible with contempt; and that, having read it but once, he complained that he had never spent his time so ill. But this is not probable; for it must be remembered that he was a priest and canon of Florence, and we learn from one of his epistles that he preached during a whole Lent. It does not indeed follow from this that he did not think contemptuously of the Bible, because many of his church, especially amongst the better sort, have not been very orthodox believers, and he might be one of these; but it is not likely he would speak out so freely. "I could much more easily believe," says Bayle, "the judgment he is said to have pronounced on the Psalms of David and the Odes of Pindar. He did not deny that there are many good and fine things in the Psalms; but he pretended that the same things appear in Pindar with more brightness and sweetness." The two Scaligers have spoken highly of Politian. The elder has preferred a consolatory elegy of his to that which Ovid sent to Livia upon the death of Drusus, and says he would rather have been the author of it; the younger calls him an excellent poet, but thinks the style of his epistles too inflated and declamatory.

The first edition of the works of Politian is that of Aldus, Venice, 1498, in folio, which was followed by those of Paris, Badius, 1512 and 1519, in the same form, and Lyons, Gryphes, 1528, 1533, and 1545, in two volumes 8vo. But the most complete edition is that which appeared at Basil in 1553, and is the only one that contains the history of the Conspiracy of the Pazzi, which had been published separately in 1472, in 4to, probably at Florence, and which J. Adimari reprinted at Naples in 1769, 4to. The original edition of the *Miscellanea*, Florence, 1489, in folio, is in greater request than those of Brescia, 1496, Venice, 1508, and Basil, 1522, all in folio. The *Stanze* were reprinted at Bologna with the *Orfeo*, 1494, in 4to; and many other editions followed, till 1820, when they were inserted in the *Bibliotheca Poetica Italiana.*

POLITICAL, from πολις, a city, signifies any thing that relates to policy or civil government.

POLITICAL ARITHMETIC is the art of reasoning by figures upon matters relating to government; such as the revenues, number of people, extent and value of land, taxes, trade, &c. in any nation. These calculations are generally made with a view to ascertain the comparative strength, prosperity, and resources of any two or more nations. With this view, Sir William Petty, in his Political Arithmetic, entered into a variety of calculations concerning the different countries of Europe. With these calculations Dr Davenant was dissatisfied; and, therefore, from the observations of Mr Gregory King, he advanced others of his own. (See his Essay on Trade.) The advancement of society has entirely superseded the calculations of these writers; but their works are deserving of notice, as marking the progress of knowledge in this branch of political science. See the articles Insurance, Mortality, and Statistics.

POLITICAL ECONOMY.

Political Economy.

THE subordinate parts of the science of political economy have been treated in separate articles of this work, with the fulness which their importance seemed to require. The present article, therefore, will be principally confined to an attempt to define the objects and limits of the science—to trace its progress—to exhibit and establish the fundamental principles on which it is founded—and to point out the relation and dependence of its different parts. In doing this, we shall have occasion to examine some of the more prominent theories advanced in this field of inquiry; our object being, not merely to lay before the reader what we conceive to be a true theory of the science, but also to present him with as full an exposition as our limits will allow of the doctrines advocated by the more celebrated of its professors.

PART I.

DEFINITION AND HISTORY.

Definition of the Science.—Causes of its being neglected in Greece and Rome, and in the Middle Ages.—Species of Evidence on which its Conclusions are founded.—Rise of the Science in Modern Europe.—Mercantile System.—Progress of Commercial Philosophy in England in the Seventeenth and Eighteenth Centuries.—System of Quesnay and the French Economists.—Publication of the "Wealth of Nations."—Distinction between Politics and Statistics, and Political Economy.

Definition of the science.

Political economy[1] is *the science of the laws which regulate the production, distribution, and consumption of the products necessary, useful, or agreeable to man, which it requires some portion of voluntary labour to produce, procure, or preserve.*

This definition has been framed so as to exclude all reference to articles existing independently of man, and which may be obtained in unlimited quantities without any laborious exertion. Had such been the case with all the articles required to satisfy our wants and desires, this science would either not have existed, or would have been cultivated only as a source of amusement, without any view to utility. Political economy is exclusively conversant with objects which come under the observation of every man, and are continually modified by human interference. It is, in fact, the *science of values;* and nothing destitute of exchangeable value, or which will not be accepted as an equivalent for something else that is either wholly or partially the produce of labour, can come within the scope of its inquiries. It is obvious, however, that an article may be possessed of the highest degree of *utility*, or, as it is sometimes termed, of intrinsic worth, and yet be wholly destitute of value in exchange. Without utility nothing will ever be an object of demand; but how necessary soever any article may be to our comfort, or even existence, and however great the demand for it, still, if it be a spontaneous production of nature, if it exist independently of human agency, and if every individual have an indefinite command over it, it can never become the subject of an exchange, or afford any basis for the reasonings of the economist. It cannot justly be said, that the food with which we appease the cravings of hunger, or the clothes by which we are defended from the inclemency of the weather, are more useful than atmospheric air; and yet they are possessed of that value of which it is totally destitute. The reason is, that food and clothes are not, like air, gratuitous products; they cannot be had at all times without any exertion; they are *obtainable only by labour;* and as none will voluntarily sacrifice the fruits of their industry without an equivalent, they are truly said to possess exchangeable value.

Definitio

Distinc- between value in exchang and utili

The word *value* has, we are aware, been very generally employed to express, not only the exchangeable worth of a commodity, or its capacity to exchange for or buy other commodities, but also to express its *utility*, or its capacity of satisfying our wants, and of contributing to our comforts and enjoyments. But it is obvious that the utility of commodities—that the capacity of bread to appease hunger, or of water to quench thirst—is a totally different and distinct quality from their capacity to exchange for or buy other commodities. Dr Smith perceived this difference, and showed the importance of carefully distinguishing between the utility, or, as he expressed it, the "value in use," of commodities, and their value in exchange. But he did not always keep this distinction in view, and it has been frequently lost sight of by later writers. We have no doubt, indeed, that the confounding of these opposite qualities has been one of the principal causes of the confusion and obscurity in which many branches of the science, not in themselves difficult, are still involved. When it is said that water is highly valuable, the phrase has a very different meaning from what is attached to it when it is said that gold is valuable. Water is indispensable to existence, and has, therefore, a high degree of utility, or of "value in use;" but being generally obtainable in large quantities, without much labour or exertion, it has, in most places, but a very low value in exchange. Gold, on the other hand, is of comparatively little utility; but as it exists only in limited quantities, and as a great deal of labour is necessary to procure it in small supplies, it has a high value in exchange, and will be readily accepted as an equivalent for a large quantity of most other things. To confound these different sorts of value would evidently lead to the most erroneous conclusions. And, therefore, to avoid all chance of error from mistaking the sense of so important a word as *value*, we shall not use it except to signify exchangeable worth, or value in exchange; and shall employ the word *utility* to express the power or capacity of an article to satisfy our wants and desires.

A few words will suffice to show the necessity and importance of distinguishing between utility and value. Were they identical, or were they regulated by the same laws, it would necessarily follow, that whatever increased the utility of any article would also increase its value, and *vice versa.* But the fact is distinctly and completely the reverse. The utility of a commodity is never increased by merely raising its value. A deficient harvest increases the exchangeable value of corn, but most certainly it does not increase its utility. Were such an improvement made in the manufacture of hats as should enable them to be produced for half the expense it now takes to bring them to market, their value, and consequently their price, would very soon be also reduced a half. Each individual would be able to buy two hats for the same sum it formerly required to buy one; and while the utility of no single hat would be impaired by this fall of value, it is plain that the sphere of their utility inition.

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[1] *Economy*, from οἰκος, *a house*, or *family*, and νομος, *a law—the government of a family.* Hence political economy may be said to be to the state what domestic economy is to a family.

would be greatly extended, and that they would be brought within the reach of a large proportion of those whose poverty might previously have hindered their obtaining them. The grand object, in fact, of this science is to discover the means by which the value of commodities may be reduced to the lowest possible limits. For, the more their value is reduced, the more obtainable they become, and the greater, consequently, is the amount of necessaries, conveniencies, and luxuries at the disposal of every individual.

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Political economy has frequently been defined to be "the science which treats of the production, distribution, and consumption of *wealth*;" and if by wealth be meant those material products which possess exchangeable value, and are necessary, useful, or agreeable to man, the definition is quite unexceptionable. But those who have adopted this definition have attached a different, and a much too extensive, meaning to the term wealth. They have sometimes, for example, considered wealth as synonymous with "*all that man desires as useful and agreeable.*" But if political economy were to embrace a discussion of the production and distribution of all that is useful and agreeable, it would include within itself every other science; and the best Encyclopædia would really be the best treatise on political economy. Good health is useful and delightful, and therefore, on this hypothesis, the science of wealth should comprehend the science of medicine; civil and religious liberty are highly useful, and therefore the science of wealth should comprehend the science of politics; good acting is agreeable, and therefore, to be complete, the science of wealth should embrace a discussion of the principles of the histrionic art, and so on. Such definitions are obviously worse than useless. Their only effect is to generate confused and perplexed notions respecting the objects and limits of the science, and to prevent the student ever acquiring a distinct idea of the nature of the inquiries in which he is engaged.

Mr Malthus defined wealth to consist of "those material objects which are necessary, useful, and agreeable to man." (*Principles of Political Economy*, p. 28.) But waiving the objections that may justly be made to the introduction of the word "material," it is still too comprehensive to be made use of. Atmospheric air, and the heat of the sun, are both material products, and are highly useful and agreeable. But their independent existence, and incapacity of appropriation, exclude them, as has been already seen, from the investigations of this science.

Dr Smith has not explicitly stated the precise meaning he attached to the term wealth; but he most commonly describes it to be "the annual produce of land and labour." It has, however, been justly objected to this definition, that it refers to the sources of wealth before it is known what wealth is, and that it includes all the useless products of the earth, as well as those appropriated and enjoyed by man.

The above definition is not liable to any of these objections. By confining the science to a discussion of the laws regulating "the production, distribution, and consumption of those products which have exchangeable value, and are necessary, useful, or agreeable," we give it a distinct and definite object. When thus properly restricted, the researches of the economist occupy a field which is exclusively his own. He runs no risk of wasting his time in inquiries which belong to other sciences, or in unprofitable investigations respecting the production and consumption of articles which cannot be appropriated, and exist independently of human industry.

Capacity of appropriation is indispensably necessary to constitute wealth. And we shall invariably employ this term to distinguish those products obtainable only by the intervention of human labour, and which consequently may be appropriated by one individual, and consumed exclusively by him. A man is not said to be wealthy because he has an indefinite command over atmospheric air, this being a privilege he enjoys in common with every one else, and which can form no ground of distinction; but he is said to be wealthy, according to the degree in which he can afford to command those necessaries, conveniencies, and luxuries which are not the gifts of nature, but the products of human industry. It must, however, be carefully observed, that although the possession of value be necessary to the existence of wealth, they cannot be confounded without leading to the most erroneous conclusions. Wealth and value are as widely different as utility and value. It is plain that every man will command a much greater quantity of those necessaries and gratifications of which wealth consists, when their value declines, than when it increases. *Wealth and value vary inversely*,—the one increasing as the other diminishes, and diminishing as the other increases. Wealth is greatest where the facility of production is greatest, and value is greatest where the difficulty of production is greatest.

Definition.

Importance of the science.

The science of political economy is exclusively conversant with that class of phenomena which the exertion of human industry exhibits. Its object is to ascertain the means by which this industry may be rendered most productive of the necessaries, luxuries, and enjoyments which form wealth; the laws which determine its distribution among the different classes of society; and how it may be most profitably consumed. To enter into lengthened arguments to prove the importance of a science having such objects in view, would be worse than useless. The consumption of wealth is indispensable to existence; but the eternal law of Providence has decreed that it can only be procured through the intervention of industry—that man must earn his bread in the sweat of his brow. This twofold necessity renders the production of wealth a constant and principal object of the exertions of the vast majority of the human race. It has subdued the natural aversion of man from labour, given activity to indolence, and armed the patient hand of industry with zeal to undertake, and perseverance to overcome, the most difficult and disagreeable tasks. But when wealth is thus necessary, when the desire to acquire it is sufficient to make us submit to the greatest privations, it is plainly impossible to doubt the utility and importance of the science which teaches the modes by which its acquisition may be facilitated, and by which the greatest amount of wealth may be obtained with the least difficulty. There is no class of persons to whom a knowledge of this science can be considered as extrinsic or superfluous. There are some, doubtless, to whom it may be of more advantage than to others; but it is of the utmost consequence to all. The prosperity of individuals, and consequently of nations, does not depend nearly so much on salubrity of climate, or fertility of soil, as on their power to apply labour with perseverance, skill, and judgment. Industry can balance almost every other deficiency. It can render regions naturally inhospitable and unproductive, the comfortable abodes of an intelligent and refined, a crowded and wealthy population; but where it is wanting, the choicest gifts of nature are of no value; and countries possessed of the greatest capabilities of improvement, with difficulty furnish a miserable subsistence to the scanty population of hordes distinguished only by their barbarism and wretchedness.

Causes of the neglect of this science in antiquity and the middle ages.

The possession of wealth being thus necessary to individual existence and comfort, and to the advancement of nations in the career of civilization, it may well excite astonishment that so few efforts should have been made to discover its sources and facilitate its acquisition, and that the study of political economy was not early considered as forming a principal part in a comprehensive system of educa-

Causes of the neglect of Political Economy.

tion. Two circumstances, to which we shall now briefly advert, seem to have been principally instrumental in occasioning the neglect of this science—the institution of domestic slavery in the ancient world, and the darkness of the period when the plan of education in the universities of modern Europe was first organized.

The citizens of Greece and Rome considered it degrading to employ themselves in those occupations which form the principal business of the inhabitants of modern Europe. In some of the Grecian states they were prohibited from engaging in any species of manufacturing or commercial industry; and in Athens and Rome, where this prohibition did not exist, these employments were universally regarded as mean, mercenary, and unworthy of freemen, and were in consequence carried on exclusively by slaves, or the very dregs of the people.[1] Agriculture was treated with more respect. Some of the most distinguished characters in the earlier ages of Roman history had been actively engaged in rural affairs; but notwithstanding their example, in the flourishing period of the republic, and under the emperors, the cultivation of the soil was usually carried on by slaves, belonging to the landlord, and employed on his account. The mass of Roman citizens were either engaged in the military service,[2] or derived a precarious and dependent subsistence from the supplies of corn furnished by the conquered provinces. In such a state of society the relations subsisting in modern Europe between landlords and tenants, and masters and servants, were unknown; and the ancients were in consequence entire strangers to all those interesting and important questions arising out of the rise and fall of rents and wages, which form so important a branch of economical science. The philosophy of the ancient world was also extremely unfavourable to the cultivation of political economy. The luxurious or more refined mode of living of the rich, was regarded by the ancient moralists as an evil of the first magnitude. They considered it as subversive of those warlike virtues, which were the principal objects of their admiration, and in consequence they denounced the passion for accumulation as fraught with the most injurious consequences. It was impossible that this science should become an object of attention to men imbued with such prejudices; or that it should be studied by those who held the objects about which it is conversant in contempt, and spurned the labour by which wealth is produced.

At the establishment of our universities, the clergy being almost the exclusive possessors of the little knowledge then in existence, their peculiar feelings and pursuits naturally exercised a marked influence over the plans of education they were employed to frame. Grammar, rhetoric, logic, school divinity, and civil law, comprised the whole course of study. To have appointed professors to explain the principles of commerce, and the means by which labour might be rendered most effective, would have been considered as equally superfluous and degrading to the dignity of science. The prejudices against commerce, manufactures, and luxury, generated in antiquity, had a powerful influence in the middle ages. None were possessed of any clear ideas concerning the true sources of wealth, happiness, and prosperity. The intercourse between different countries was extremely limited, and was rather confined to marauding excursions, and a piratical scramble for the precious metals, than to a commerce founded on the gratification of real or reciprocal wants.

Causes of the neglect of Political Economy.

These circumstances sufficiently account for the slow progress of this science, and the little attention paid to it, down to a very recent date. And since it became an object of more general attention and liberal inquiry, the opposition between the theories and opinions that have been espoused by the most eminent of its professors—a necessary and inevitable result of its recent cultivation—has proved exceedingly unfavourable to its progress, and generated a disposition to distrust its best established conclusions. This prejudice is, however, extremely ill founded; and notwithstanding the diversity of the theories that have been formed to explain its various phenomena, it undoubtedly admits of as much certainty in its conclusions as any science not exclusively dependent on mere relation. A brief exposition of the principles on which it is founded, and of the mode in which its investigations should be conducted, will evince the correctness of this statement.

Principles of the science. Nature of the evidence on which its conclusions are founded.

Political economy is not a science of speculation, but of fact and experiment. The principles on which the production and accumulation of wealth and the progress of civilization depend, are not the offspring of legislative enactments. Man's existence depends on his exerting himself to produce wealth; and the desire implanted in his breast, of rising in the world and improving his condition, impels him to save and accumulate. The principles which form the basis of this science make, therefore, a part of the constitution of man and of the physical world, and their operations, like those of the mechanical principles, may be traced by the aid of observation and analysis. There is, however, a material distinction between the physical and the moral and political sciences. The conclusions of the former apply in *every* case, while those of the latter apply only in the *majority* of cases. The principles on which the production and accumulation of wealth depend are inherent in our nature, but they do not exercise the same influence over every individual; and the theorist must satisfy himself with framing his rules so as to explain their operation in the majority of instances, leaving it to the sagacity of the observer to modify them so as to suit individual cases. Thus it is an admitted principle in morals, as well as in political economy, that by far the largest proportion of the human race have a much clearer view of what is conducive to their own interests, than it is possible for any other man, or select number of men, to have, and consequently that it is sound policy to allow individuals to follow the bent of their inclination, and to engage in any branch of industry they think proper. This is the general theorem; and it is one which is established on the most comprehensive expe-

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[1] The force of the prejudices on this head may be learned from the following quotations: "Illiberales autem et sordidi," Cicero says, "questus mercenariorum, omniumque quorum operæ, non quorum artes emuntur. Est enim illis ipsa merces auctoramentum servitutis. Sordidi etiam putandi, qui mercantur a mercatoribus quod statim vendant, *nihil enim proficiunt, nisi admodum mentiantur!* Opificesque omnes in sordida arte versantur, *nec enim quidquam ingenuum potest habere officina*......Mercatura autem, si tenuis est, sordida putanda est; sin autem magna et copiosa, multa undique apportans, multisque sine vanitate impertiens, non est admodum vituperanda." (*De Officiis*, lib. i. sect. 42.)

"Vulgaris opificum, quæ manu constant, et ad instruendam vitam occupatæ sunt; in quibus nulla decoris, nulla honesti simulatio est." (Senecæ *Epistolæ*, ep. 89.)

A hundred similar quotations might be produced; but the one from Cicero is sufficient to establish the accuracy of what has been advanced. The strength of the prejudice against commerce and the arts is proved by its exerting so powerful an influence over so cultivated a mind. For a further discussion of the opinions of the Romans on this subject, see the *Dissertazione del Commercio de Romani* of Mengotti, which received a prize from the Academy of Paris in 1787, and the *Memoria Apolegetica del Commercio de Romani* of Torres, published at Venice in 1788.

[2] "Rei militaris virtus præstat cæteris omnibus; hæc populo Romano, hæc huic urbi æternam gloriam peperit." (Cicero *pro Murena*.)

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rience. It is not, however, like the laws which regulate the motions of the planetary system, universally applicable; it will hold good in nineteen out of twenty instances, but the twentieth may be an exception. But it is not required of the economist that his theories should quadrate with the peculiar bias of a particular person. His conclusions are drawn from contemplating the principles found to determine the condition of mankind, as presented on the large scale of nations and empires. His business is with man in the aggregate, with states, and not with families, with the passions and propensities which actuate the great bulk of the human race, and not with those which are occasionally found to influence a solitary individual.

This distinction should be kept constantly in view. Nothing is more common than to hear it objected to some of the best established truths in political and economical science, that they are at variance with certain facts, and that therefore they should be rejected. But these objections very often originate in an entire misapprehension of the nature of the science. It would be easy to produce a thousand instances of individuals who have been enriched by monopolies and restrictions, and even by robbery and plunder; though it would certainly be rather rash thence to conclude that society may be enriched by such means! This, however, is the single consideration to which the economist has to attend; and, until it can be shown that monopolies and restrictions are not destructive of national wealth, and that what is gained by the monopolist is not lost by the public, he is justified in considering them injurious. To arrive at a well-founded conclusion in this science, it is not enough to observe results in particular cases, or as they affect a few individuals; we must further inquire whether these results be constant and universally applicable,—whether the same circumstances which have given rise to them in one instance, would in every instance, and in every state of society, be productive of the same or similar results. A theory inconsistent with a uniform and constant fact, must be erroneous; but the observance of a particular result at variance with customary experience, and when we may not have the means of discriminating the circumstances attending it, should not make us hastily modify or reject a principle which accounts satisfactorily for the greater number of appearances.

The example of the few arbitrary princes, distinguished by their equity, humanity, and generosity, is not enough to overthrow the principle which teaches that it is of the essence of irresponsible power to debauch and vitiate its possessors, to render them haughty, cruel, and suspicious; nor is the example of those who, attentive only to present enjoyment and careless of the future, lavish their fortune in boisterous dissipation or vain expense, sufficient to invalidate the general conclusion, that the passion for accumulation is stronger and more powerful than the passion for expense. Had this not been the case, mankind could never have emerged from the condition of savages. The stupendous improvements made in different ages and nations, the forests that have been cut down, the marshes and lakes that have been drained and cultivated, the harbours, roads, and bridges that have been constructed, the cities and edifices that have been raised, are *all* the fruit of a saving of income, and establish, in despite of a thousand instances of prodigality, the ascendency and superior force of the accumulating principle.

The want of attention to these considerations has occasioned much of the error and misapprehension with which this science has been and still is infected. Almost all the absurd theories and opinions which have successively appeared have been supported by an appeal to facts. But a knowledge of facts, without a knowledge of their mutual relation, without being able to show why the one is a cause and the other an effect, is, to use the illustration of M. Say, no better than the indigested erudition of an almanac maker, and affords no means of judging of the truth or falsehood of a general principle.

Rise of the
Science in
Modern
Europe.

But, though we are not to reject a received principle because of the apparent opposition of a few results, with the circumstances of which we are unacquainted, we should have no confidence in its solidity, unless it be deduced from a very comprehensive and careful induction. He who would arrive at a true knowledge of the laws regulating the production, distribution, and consumption of wealth, must draw his materials from a very wide surface; he should study man in every different situation—should have recourse to the history of society, arts, commerce, and civilization, to the works of philosophers and travellers, to everything, in short, that can throw light on the causes which accelerate or retard the progress of civilization. He should observe the changes which have taken place in the fortunes and condition of the human race in different regions and ages of the world; should trace the rise, progress, and decline of industry; and, above all, he should carefully discriminate the effect of different political measures, and the various circumstances wherein an advancing and declining society differ from each other. Such investigations, by disclosing the real causes of national opulence and refinement, and of poverty and degradation, furnish the means of satisfactorily solving almost all the important problems in the science of wealth, and of devising a scheme of public administration calculated to insure the continued advancement of society in the career of improvement.

It should be kept in mind, that it is no part of the business of the economist to inquire into the means by which individual fortunes may be increased or diminished, except to ascertain their general operation and effect. The *public interests* should always form the exclusive objects of his attention. He is not to frame systems, and devise schemes, for increasing the wealth and enjoyments of particular classes; but to apply himself to discover the sources of national wealth, and universal prosperity, and the means by which they may be rendered most productive.

Those who reflect on the variety and extent of the previous knowledge required for the construction of a sound theory of political economy, will cease to feel any surprise at the errors into which economists have been betrayed, or at the discrepancy of the opinions still entertained on some important points. This science is of very recent origin. Though various treatises of considerable merit had previously appeared on some of its separate parts, it was not treated as a whole, or in a scientific manner, until about the middle of last century. This circumstance is of itself enough to account for the number of erroneous systems that have since appeared. Instead of deducing their general conclusions from a comparison of particular facts, and a careful examination of the phenomena attending the operation of different principles, and of the same principles under different circumstances, the first cultivators of almost every branch of science begin by framing their theories on a very narrow and insecure basis. Nor is it really in their power to go to work differently. Observations are scarcely ever made or particulars noted for their own sakes. It is not till they begin to be in request as furnishing the only test by which to ascertain the truth of some popular theory, that they are made in sufficient numbers and with sufficient accuracy. It is, in the peculiar phraseology of this science, the *effectual demand* of the theorist that occasions the production of the facts or raw materials he is afterwards to work into a system. The history of political economy strikingly exemplifies the truth of this remark. Being, as already observed, entirely unknown to the ancients, and but little attended to by our ancestors down to a comparatively late period, those circumstances which would have enabled us to judge with the greatest precision, of the wealth and civilization of the more celebrated states of antiquity, and of Europe during the middle ages, have either been thought unworthy of notice by the historian, or have been very imperfectly and carelessly detailed. Those, therefore, who first began to trace the principles of the science had but a comparatively scanty experience on which to build their conclusions. Nor did they even avail themselves of the few historical facts with which they might easily have become acquainted, but almost exclusively confined their attention to those which happened to fall within the sphere of their own observation.

Mercantile system.

Agreeably to what has now been stated, we find that the theories advanced by the early economical writers were formed on the most contracted basis, and were only fitted to explain a few of the most obvious and striking phenomena. The *mercantile theory*, for example, was entirely bottomed on the popular and prevalent opinions respecting money. The precious metals having been long used, both as standards by which to ascertain the comparative value of different commodities, and as the equivalents for which they were most frequently exchanged, acquired a fictitious importance, not merely in the estimation of the vulgar, but in that of persons of the greatest discernment. The simple consideration, that all buying and selling is really nothing more than the bartering of one commodity for another—of a certain quantity of corn or wool, for example, for a certain quantity of gold or silver, and *vice versa*, was entirely overlooked. The attention was gradually transferred from the money's worth to the money itself; and the wealth of individuals and of states came to be measured, not by the abundance of their disposable products,—by the quantity or value of the commodities with which they could afford to purchase the precious metals,—but by the quantity of these metals actually in their possession. It is on this flimsy and fallacious hypothesis that the theories of almost every writer on economical subjects antecedent to the appearance of the works of Child, North, and Locke, in England, and of Gournay and Quesnay in France, are founded; and, what is of infinitely greater moment, it is on this same hypothesis that the different civilized countries have proceeded to regulate their intercourse with each other. Their grand object has not been to facilitate the production of necessaries, comforts, and luxuries, but to monopolize the largest possible supply of gold and silver. And, as these could not be obtained in countries destitute of mines, except in exchange for exported commodities, various schemes were resorted to for encouraging exportation, and for preventing the importation of most products other than the precious metals. In consequence, the excess of the value of the exports over that of the imports was long considered as the most infallible test of the progress of a country in the career of wealth. This excess, it was believed, could not be balanced otherwise than by an equivalent importation of gold or silver, that is, of the only real wealth it was then supposed a country could possess.

These principles and conclusions, though absolutely false and erroneous, afford a tolerable explanation of a few very obvious phenomena, and are in perfect unison with the popular prejudices on the subject. It was natural, therefore, that they should be espoused by the merchants or practical men, who were the earliest writers on this science. They did not consider it necessary to subject the principles they assumed to any refined analysis or examination. But, reckoning them as sufficiently established by the common consent and agreement of mankind, they applied themselves exclusively to the discussion of the practical measures calculated to give them the greatest efficacy.

Balance of trade.

"Although a kingdom," says one of the earliest and ablest writers in defence of the mercantile system, "may be enriched by gifts received, or by purchase taken, from some other nations, yet these are things uncertain, and of small consideration when they happen. The ordinary means, therefore, to increase our wealth and treasure, is by foreign trade, wherein we must ever observe this rule,—to sell more to strangers yearly than we consume of theirs in value. For, suppose, that when this kingdom is plentifully served with cloth, lead, tin, iron, fish, and other native commodities, we do yearly export the overplus to foreign countries to the value of L.2,200,000, by which means we are enabled, beyond the seas, to buy and bring in foreign wares for our use and consumption to the value of L.2,000,000: By this order duly kept in our trading, we may rest assured that the kingdom shall be enriched yearly L.200,000, which must be brought to us as so much treasure; because that part of our stock which is not returned to us in wares, must necessarily be brought home in treasure." (Mun's *Treasure by Foreign Trade*, orig. ed. p. 11.)

The gain on our foreign commerce is here supposed to consist exclusively of the gold and silver which, it is taken for granted, must necessarily be brought home in payment of the excess of exported commodities. Mun lays no stress whatever on the circumstance of foreign commerce enabling us to obtain an infinite variety of useful and agreeable products, which it would either be impossible to produce at all, or to produce so cheaply, at home. We are desired to consider all this accession of wealth,—all the vast addition made by commerce to the motives which stimulate, and to the comforts and enjoyments which reward, the labour of the industrious, as *nothing*, and to fix our attention exclusively on the balance of L.200,000 of gold and silver! This is much the same as if we were desired to estimate the comfort and advantage derived from a suit of clothes, by the number and glare of the metal buttons by which they are fastened! And yet this rule for estimating the advantageousness of foreign commerce was long regarded by the generality of merchants and practical statesmen as infallible; and, until very recently, we were annually congratulated on the excess of our exports over our imports!

Manufa turing tem.

But there were other circumstances, besides the erroneous notions respecting the precious metals, which led to the establishment of the mercantile system, and to the enacting of regulations restrictive of the freedom of industry. The feudal governments established in the countries that had formed the western division of the Roman empire, early degenerated into a system of anarchy and lawless oppression. The princes, unable of themselves to restrain the usurpations of the greater barons, or to control their violence, endeavoured to strengthen their influence and consolidate their power by attaching the inhabitants of cities and towns to their interests. For this purpose, they granted them charters, enfranchising the citizens, abolishing every existing mark of servitude, and forming them into corporations, or bodies politic, to be governed by councils and magistrates of their own selection. The order and good government that were thus established in the cities, and the security enjoyed by their inhabitants, when the rest of the country was a prey to rapine and disorder, stimulated their industry, and gave them a vast ascendency over the cultivators of the soil. It was from them that the princes derived the greater part of their supplies of money; and it was by means of their co-operation that they were enabled to control and subdue the pride and independence of the barons. But the citizens did not render this assistance to their sovereigns merely by way of compensation for the original gift of their charters. They were continually soliciting and obtaining new privileges. And it was not to be expected that princes, whom they had laid under essential obligations, and who must have regarded them as forming by far the most industrious and deserving portion of their subjects, should be at all disinclined to gratify their wishes.

To enable them to obtain their provisions cheap, and to carry on their industry to the best advantage, the exportation of corn, and of the raw materials of their manufactures, was strictly prohibited; at the same time that heavy duties and absolute prohibitions were interposed to prevent the importation of manufactured articles from abroad, and to secure the monopoly of the home market to the native manufacturers. These, together with the privilege granted to the citizens of corporate towns, of preventing any individual from exercising any branch of business without leave from them, and a variety of subordinate regulations intended to force the importation of the raw materials required in manufactures, and the exportation of the manufactured goods, form the principal features of the system of public economy adopted, in the view of encouraging manufacturing industry, in every country of Europe, in the fourteenth, fifteenth, sixteenth, and seventeenth centuries. The freedom of industry recognised by their ancient laws was almost totally destroyed. It would be easy to mention a thousand instances of the excess to which this artificial system was carried in England and other countries; but as many of these must be familiar to the reader, we shall only observe, as illustrative of its spirit, that by an act passed in 1678, for the encouragement of the English woollen manufacture, it was ordered that all *dead bodies* should be wrapped in woollen shrouds!

But the exclusion of foreign competition, and the monopoly of the home-market, did not satisfy the manufacturers and merchants. Having obtained all the advantage they could from the public, they attempted to prey on each other. Those possessed of most influence, procured the privilege of carrying on particular branches of industry, to the exclusion of every one else. This abuse was carried to a most oppressive height in the reign of Elizabeth, who granted an infinite number of new patents. At length the grievance became so intolerable as to make all classes join in petitioning for its abolition; and this, after much opposition on the part of government, who regarded the power of erecting monopolies as a very valuable branch of the prerogative, was effected by an act passed in the 21st of James I. But this act did not touch any of the fundamental principles of the mercantile or manufacturing system; and the exclusive privileges of all bodies corporate were exempted from its operation.

In France the interests of the manufacturers were warmly espoused by Colbert, the justly celebrated minister of finance during the most splendid period of the reign of Louis XIV.; and the year 1664, when the tariff, compiled under Colbert's direction, was promulgated, has been sometimes considered, though improperly, as the æra of the manufacturing system.

These restrictions were zealously supported by the writers in defence of the mercantile system and the balance of trade. The facilities given to the exportation of manufactured goods, and the obstacles thrown in the way of their importation, seemed to them to be particularly well fitted for making the exports exceed the imports, and procuring a favourable balance. Instead, therefore, of regarding these regulations as the offspring of a selfish monopolizing spirit, they looked on them as having been dictated by the soundest policy. The manufacturing and mercantile systems were thus naturally blended together. The acquisition of a favourable balance of payments was the grand object to be accomplished; and heavy duties and restrictions on importation from abroad, and bounties and premiums on exportation from home, were the means by which it was to be attained! It cannot excite surprise that a system having so many popular prejudices in its favour, and which afforded a plausible and convenient apology for the exclusive privileges enjoyed by the manufacturing and commercial classes, should have early attained, or that it should still preserve, notwithstanding the overthrow of its principles, a powerful practical influence. Melon and Forbonnais in France—Genovesi in Italy—Mun, Sir Josiah Child, Dr Davenant, the authors of the British Merchant, and Sir James Steuart, in England—are the ablest writers who have espoused, some with more and some with fewer exceptions, the leading principles of the mercantile system.

"It is no exaggeration to affirm, that there are but few political errors which have produced more mischief than the mercantile system. Armed with power, it commanded and forbid where it should only have *protected.* The regulating mania which it inspired tormented industry in a thousand ways, to force it from its natural channels. It made each nation regard the welfare of its neighbours as incompatible with its own; hence the reciprocal desire of injuring and impoverishing each other; and hence that spirit of commercial rivalry which has been the immediate or remote cause of the greater number of modern wars. This system stimulated nations to employ force or cunning to extort commercial treaties, productive of no real advantage to themselves, from the weakness or ignorance of others. It formed colonies that the mother country might enjoy the monopoly of their trade, and force them to resort exclusively to her markets. In short, where it has been productive of the least injury, it has retarded the progress of national prosperity; everywhere else it has deluged the earth with blood, and has depopulated and ruined some of those countries whose power and opulence it was supposed it would carry to the highest pitch." (Storch, *Traité d'Economie Politique*, tome i. p. 122.)

Progress of commercial science in England.

The greater attention which began to be paid, in the seventeenth, and in the earlier part of the last century, to subjects connected with finance, commerce, and agriculture, gradually prepared the way for the downfall of the mercantile system. The English writers preceded those of every other country, in pointing out its defects, and in discovering the real nature and functions of money, and the true principles of commerce. The establishment of a direct intercourse with India did much to accelerate the progress of sound opinions. Until very recently the precious metals have always been one of the most advantageous articles of export to the East.[1] And when the East India Company was established in 1600, power was given them annually to export *foreign* gold coins or bullion, of the value of L.30,000; the Company being bound to import, within six months after the termination of every voyage, except the first, as much gold and silver as should together be equal to the value of the silver they exported. But the Company's enemies contended that these regulations were not complied with, and that it was contrary to all principle, and highly injurious to the public interests, to permit the exportation of any quantity of bullion. The merchants and others interested in the India trade, among whom we have to reckon Sir Dudley Digges, whose defence of the Company was published in 1615, Mr Mun, who published a very able pamphlet in defence of the Company in 1621,[2] Mr Misselden, and more recently Sir Josiah Child, could not controvert the reasoning of their opponents, without openly impugning some of the commonly received opinions regarding money. In such circumstances it is easy to see that prejudice would be forced to give way to interest. At first, however, the advocates of the Company did not contend, nor is there, indeed, any good reason for thinking that they were of opinion, that the exportation of gold or silver to the East Indies was beneficial, on the ground that the commodities brought back were of greater value. They contended that the Company did not export a greater quantity of bullion than their charter authorized; and they further contended that this exportation was advantageous, because the commodities imported from India were chiefly re-exported to other countries, whence a greater quantity of bullion was obtained in exchange for them.[1] But even this was an immense advance in the progress to a sounder theory. *C'est toujours le premier pas qui coute.* The advocates of the Company began gradually to assume a higher tone; and at length boldly contended that bullion was *nothing but a commodity*, and that its exportation should be as free as that of anything else. Nor were these opinions confined to the partners of the East India Company. They were gradually communicated to others; and many eminent merchants were taught to look with suspicion on several received maxims, and were in consequence led to acquire more correct and comprehensive views regarding commercial intercourse. The new ideas ultimately made their way into the House of Commons; and in 1663 the statutes prohibiting the exportation of foreign coin and bullion were repealed, and full liberty given to the East India Company and to private traders to export them in unlimited quantities.

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[1] Pliny, when enumerating the spices, silks, and other eastern products imported into Italy, says, "Minimaque computatione millies centena millia sestertium annis omnibus, India et Seres, peninsulaque illa (Arabia) imperia nostro demunt." (*Hist. Nat.* lib. xii. cap. 18.)

Charles V. used to say that the Portuguese, who then engrossed almost the whole commerce of the East, were the common enemies of Christendom, inasmuch as they drained it of its treasure to export it to infidels! (Misselden on *Free Trade*, p. 24.)

[2] This pamphlet, which is now become extremely rare, is printed in Purchas's Pilgrims, vol. i. p. 732.

In addition to the controversies respecting the East India trade, the foundation of the colonies in America and the West Indies, the establishment of a compulsory provision for the support of the poor, and the acts prohibiting the exportation of wool and the non-importation of Irish cattle, &c. drew an extraordinary portion of the public attention to questions connected with the domestic policy of the country. In the course of the seventeenth century, a more than usual number of tracts were published on commercial and economical subjects. And although the doctrines of the greater number are strongly tinctured with the prevailing spirit of the age, it cannot be denied that several of their authors rose far above the prejudices of their contemporaries, and have an unquestionable right to be regarded as the founders of the modern theory of commerce; as the earliest teachers of those sound and liberal doctrines, by which it has been shown that the prosperity of states can never be promoted by restrictive regulations, or by the depression of their neighbours—that the genuine spirit of commerce is inconsistent with the selfish and shallow policy of monopoly—and that the *self-interest* of mankind, not less than their duty, requires them to live in peace, and to cultivate friendship with each other.

Mr Mun.

We have already referred to Mun's treatise entitled England's Treasure by Foreign Trade. This treatise was first published in 1664; but there is good reason to suppose that it had been written many years previously. Mr Mun's son, in the dedication to Lord Southampton, prefixed by him to the work, says that his father "was, *in his time*, famous among merchants," a mode of expression which he would hardly have used had not a considerable period elapsed since his father's death; and Misselden, in his Circle of Commerce, published in 1623 (p. 36), refers to Mun's tract on the East India trade, and speaks of its author as being an accomplished and experienced merchant. Perhaps, therefore, we shall not be far wrong if we assume that the treatise on Foreign Trade was written so early as 1635 or 1640. At all events, it is certain that the doctrines which it contains do not differ much from those which he had previously maintained in his pamphlet in defence of the East India Company, and some of the expressions are literally the same with those of the petition presented by that body to parliament in 1628, which is known to have been written by Mr Mun.[2] The extract we have previously given shows, that Mun's opinions, in so far as regards the question respecting the balance of trade, were identical with those of his contemporaries. But we believe he was the first who endeavoured to show, and who, in point of fact, successfully showed, that a favourable balance could not be procured by restrictive regulations; that the exportation and importation of bullion, coin, and every other commodity, should be freely permitted; and that violent measures will never bring gold or silver into a kingdom, or retain them in it. (Pp. 27, 92, &c. original ed.) Mun also distinctly lays it down, "that those who have wares cannot want money," and that "it is not the keeping of our money in the kingdom, but the necessity and use of our wares in foreign countries, and our want of other commodities, that causeth the vent and consumption on all sides, which causeth a quick and ample trade." (P. 43.)[3] Nor are these detached and incidental passages thrown out at random. They breathe the same spirit which pervades the rest of Mun's book, and constitute and form a part of his system. His observations in answer to Malyne's, on some rather difficult questions connected with exchange, are both accurate and ingenious.

Sir Jos Child.

The first edition of Sir Josiah Child's celebrated work on trade (A New Discourse of Trade, &c.) was published in 1668; but it was very greatly enlarged in the next edition, published in 1690. There are many sound and liberal doctrines advanced in this book. The argument to show that colonies do not depopulate the mother country, is as conclusive as if it had proceeded from the pen of Mr Malthus; and the just and forcible reasoning in defence of the naturalization of the Jews is highly creditable to the liberality and good sense of the writer, and discovers a mind greatly superior to existing prejudices. Sir Josiah has also many judicious observations on the bad effects of the laws against *forestalling* and *regrating*, on those limiting the number of apprentices, and on corporation privileges.

When treating of the laws relating to the exportation of wool, Sir Josiah lays it down as an axiom, "that they that can give the best price for a commodity shall never fail to have it by one means or other, notwithstanding the opposition of any laws, or interposition of any power by sea or land; of such force, subtilty, and violence, is the general course of trade."

The radical defect of Sir Josiah Child's treatise consists in its being chiefly written to illustrate the advantages which he labours to show would result from reducing the legal rate of interest to four per cent.; an error into which he was led by mistaking the low interest of Holland for the principal cause of her wealth, when it was in truth the effect of her comparatively heavy taxation.

It is, however, worthy of remark, that this error was very soon detected. In the same year (1668) that Sir Josiah's treatise first appeared, a tract was published, entitled Interest of Money mistaken, or a treatise proving that the Abatement of Interest is the Effect, and not the Cause, of the Riches of a Nation. The author of this tract maintains the opinion afterwards held by Locke and Montesquieu, that the interest of money does not depend on statutory regulations, but that it varies according to the comparative opulence of a country; or rather according to the scarcity and abundance of money, increasing when the supply of money diminishes, and diminishing when it increases.[1] Having endeavoured to establish this principle, the author successfully contends that Sir Josiah Child had totally mistaken the cause of the wealth of the Dutch, of which he shows the lowness of interest was merely a consequence.

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[1] Those who have not the original pamphlets may consult Macpherson's History of Commerce, vol. ii. pp. 297, 315, 511; Macpherson's Account of the European Commerce with India, pp. 94, 104; and Mr Robert Grant's Sketch of the History of the Company, p. 44; where they will find an ample confirmation of what is stated above.

[2] This petition, and the reasons on which it is founded, were so well esteemed as to occasion its being reprinted in 1641.

[3] These expressions are in the petition of the Company, presented to parliament in 1628.

Si William
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In 1672 Sir William Petty published his celebrated tract entitled the Political Anatomy of Ireland. In this work, the absurdity of the act passed in 1664, prohibiting the importation of cattle, beef, &c. from Ireland into Britain, is ably exposed, and the advantage of an unconstrained internal commerce clearly set forth. "If it be good for England," says Sir William, "to keep Ireland a distinct kingdom, why do not the predominant party in parliament, suppose the western members, make England beyond Trent another kingdom, and take tolls and customs upon the borders? Or why was there ever any union between England and Wales? And why may not the entire kingdom of England be further cantonised for the advantage of all parties?" (P. 34, ed. 1719.)

The great defect in the writings of Mun, Misselden, Child, and others, does not consist so much in their notions about the superior importance of the precious metals, or the balance of trade, as in those respecting the advantages they supposed were derivable from importing durable rather than rapidly perishable commodities and luxuries. This, however, was an extremely natural opinion; and we need not be surprised that the early writers on commerce fell into an error, from which neither the profound sagacity of Locke, nor the strong sense of Mr Harris, has been able to preserve them. But even so early as 1677, the fallacy of this opinion was perceived. In that year there appeared a small tract, entitled England's Great Happiness; or, a Dialogue between Content and Complaint; in which the author contends, that if there be a demand for wine, fruit, and such like articles, their importation in exchange for money is advantageous; and, on this ground, he defends the French trade, which was loudly declaimed against by the practical men of that day. We shall make a short extract from this remarkable tract:

"*Complaint.*—You speak plain; but what think you of the French trade, which draws away our money by wholesale? Mr Fortrey,[2] whom I have heard you speak well of, gives an account that they get L.1,600,000 a year from us.

"*Content.*—'Tis a great sum; but, perhaps, were it put to a vote in a *wise council*, whether for that reason the trade should be left off, 'twould go *in the negative*. For paper, wine, linen, Castile soap, brandy, olives, capers, prunes, kid-skins, taffaties, and such like, we cannot be without; and for the rest, which you are pleased to style *Apes* and *Peacocks* (although wise Solomon ranked them with gold and ivory), they set us all agog, and have increased among us many considerable trades......I must confess, I had rather they'd use our goods than money; but if not, I would not lose the getting of ten pound because I can't get an hundred; and I don't question but when the French get more foreign trade, they'll give more liberty to the bringing in foreign goods. I'll suppose John-a-Nokes to be a butcher, Dick-a-Styles to be an exchange man, yourself a lawyer; will you buy no meat or ribbands, or your wife a fine Indian gown or fan, because they will not truck with you for indentures which they have need of? I suppose no; but if you get money enough of others, you care not though you give it away in specie for these things. I think 'tis the same case."

The spirit of this tract may perhaps be better inferred from the titles of some of the dialogues. Among others, we have "To export money our great advantage;"—"The French trade a profitable trade;"—"Variety of wares for all markets, a great advantage;"—"High living, a great improvement to the arts;"—"Invitation of foreign arts, a great advantage;"—"Multitudes of traders, a great advantage," &c. &c. But its influence was far too feeble to arrest the current of popular prejudice. In the year after its publication (1678) the importation of French commodities was prohibited for three years. This prohibition was made perpetual in the reign of William III. when the French trade was declared to be a nuisance!—a principle, if we may so call it, which has been acted upon down almost to this very hour.

In 1681 a pamphlet was published in defence of the East India Company, under the signature of "Philopatris," but evidently the production of Sir Josiah Child. In the introduction to this pamphlet the following principles are laid down:—

"That all close monopolies (Sir Josiah contends that the East India Company does not come under this description), of what nature or kind soever, are destructive to trade, and consequently obstructive to the increase of the value of our lands."

"That silver or gold, coined or uncoined, though they are used for a measure of all other things, are no less a commodity than wine, oil, tobacco, cloth, or stuffs; and may, in many cases, be exported as much to the national advantage as any other commodity."

"That no nation ever was, or will be, considerable in trade, that prohibits the exportation of bullion." (P. 3.)

Sir William Petty's *Quantulumcunque.*

In Sir William Petty's *Quantulumcunque*, published in 1682, the subject of money is treated with great ability, and the idea of draining England of her cash, by an unfavourable balance, successfully combated. "If some English merchants," it is said, "should be so improvident as to carry out money only, then the foreign merchants would buy up such English commodities as they wanted with money brought into England from their respective countries, or with such commodities as England likes better than money; for the vending of English commodities doth not depend on anything else but the use and need which foreigners have of them." Sir W. denies that "a country is the poorer for having less money;" and concludes by strongly condemning the laws regulating the rate of interest; observing, that there may as well be laws to regulate the rate of exchange and of insurance. (See pp. 3, 6, 8, original edition.)

Sir Dudley North.

But a tract entitled Discourses on Trade, principally directed to the Cases of Interest, Coinage, Clipping, and Increase of Money, written by Sir Dudley North, and published in 1691, unquestionably contains a far more able statement of the true principles of commerce than any that had then appeared.

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[1] It has been generally supposed that Hume was the first who showed (in his Essay on Interest) the fallacy of this opinion, and who proved that the rate of interest does not depend on the abundance or scarcity of money, but on the abundance or scarcity of disposable capital compared with the demands of the borrowers, and the rate of profit. This, however, is a mistake, the doctrine in question having been fully demonstrated in a pamphlet written by Mr Massie, entitled Essay on the Governing Cause of the Natural Rate of Interest, published two years before Mr Hume's Essay appeared.

[2] Mr Fortrey's pamphlet has been much referred to. It was published in 1663, and reprinted in 1673. It contains a very good argument in favour of enclosures. The reference in the text sufficiently explains the opinions of the writer in regard to commerce.

We regret that our limits will not permit our giving so full an account as we could have wished of this extraordinary tract. The author is a most intelligent and consistent advocate of the great principles of commercial freedom. He is not, like the most eminent of his predecessors, well informed on one subject, and erroneous on another. He is throughout sound and liberal. His system is consentaneous in its parts, and complete. He shows, that in commercial matters, nations have the same interests as individuals; and exposes the absurdity of supposing that any trade advantageous to the merchant can be injurious to the public. His opinions respecting the imposition of a seignorage on the coinage of money, and the expediency of sumptuary laws, then in great favour, are equally enlightened.

We subjoin from the preface to this tract an abstract of the general propositions maintained in it:

"That the whole world as to trade is but as one nation or people, and therein nations are as persons.

"That the loss of a trade with one nation is not that only, separately considered, but so much of the trade of the world rescinded and lost; for all is combined together.

"That there can be no trade unprofitable to the public; for if any prove so, men leave it off; and wherever the traders thrive, the public, of which they are a part, thrive also.

"That to force men to deal in any prescribed manner, may profit such as happen to serve them; but the public gains not, because it is taking from one subject to give to another.

"That no laws can set prices in trade, the rates of which must and will make themselves. But when such laws do happen to lay any hold, it is so much impediment to trade, and therefore prejudicial.

"That money is a merchandise, whereof there may be a glut, as well as a scarcity, and that even to an inconvenience.

"That a people cannot want money to serve the ordinary dealing, and more than enough they will not have.

"That no man will be the richer for the making much money, nor have any part of it, but as he buys it for an equivalent price.

"That the free coynage is a perpetual motion found out, whereby to melt and coyn without ceasing, and so to feed goldsmiths and coyners at the public charge.

"That debasing the coyn is defrauding one another, and to the public there is no sort of advantage from it; for that admits no character or value but intrinsick.

"That the sinking by alloy or weight is all one.

"That exchange and ready money are the same, nothing but carriage and re-carriage being saved.

"That money exported in trade is an increase to the wealth of the nation; but spent in war, and payments abroad, is so much impoverishment.

"In short, that all favour to one trade or interest is an abuse, and cuts so much of profit from the public."

Unluckily this admirable tract never obtained any considerable circulation. There is good reason, indeed, to suppose that it was designedly suppressed.[1] At all events, it speedily became excessively scarce; and we are not aware that it has ever been referred to by any subsequent writer on commerce.

The disordered state of the coin, and the proceedings relative to the great recoinage, in the reign of William III., led to a great deal of discussion both in and out of parliament, and contributed, in no ordinary degree, to diffuse juster notions respecting money and commerce. It was then that Mr Locke published his well-known tracts on Money.[2] They immediately obtained a very extensive circulation; and though infected with some very grave errors, had a powerful influence in preventing the success of Mr Lowndes's proposal for degrading the standard of the coin, and in contributing to establish the true theory of money. The restoration of the currency was not, however, effected without great opposition. A large minority in parliament supported Lowndes's views; and they were also supported by a number of writers. Of these, Mr Nicholas Barbon seems to have been one of the ablest. In his tract entitled A Discourse concerning Coining the New Money Lighter, published in 1696, he detected several of the errors into which Locke had fallen; and he had the further merit of ably demonstrating the fallacy of the popular opinions respecting the balance of trade; and of showing that no bullion could ever be sent abroad in payment of an unfavourable balance, unless it were at the time the cheapest and most profitable article of export.

Mr Barbon.

The inferences deduced by Barbon from his investigations into the balance of trade and foreign exchange are:

"That a trading nation is made rich by traffic and the industry of the inhabitants—and that the native stock of a nation can never be wasted.

"That no sort of commodities ought to be totally prohibited—and that the freer trade is, the better the nation will thrive.

"That the poverty and riches of a nation does not depend on a lesser or greater consumption of foreign trade, nor on the difference of the value of those goods that are consumed.

"That the balance of trade is a notion that serves rather to puzzle all debates of trade, than to discover any particular advantages a nation may get by regulating of trade.

"That the balance of trade (if there be one) is not the cause of sending away the money out of a nation: But that proceeds from the difference of the value of bullion in several countries, and from the profit that the merchant makes by sending it away more than by bills of exchange.

"That there is no occasion to send away money or bullion to pay bills of exchange, or balance accounts.

"That all sorts of goods, of the value of the bill of exchange, or the balance of the account, will answer the bill, and balance the account as well as money." (P. 59.)

It is singular, that a writer possessed of such sound and enlarged opinions respecting the principles of commercial intercourse, and who had shown that bullion differed in no respect from other commodities, should have maintained that the value of coined money depended on the stamp affixed to it by government. This gross and unaccountable error destroyed the effect of Barbon's tract; and was, most probably, the cause of the oblivion into which it very soon fell, and of its never having attracted that attention to which, on other accounts, it was justly entitled.

Dr Davenant.

The commercial writings of Dr Davenant, inspector-general of imports and exports, were published in the interval between 1695 and 1711. Though a partisan of the mercantile system, Dr Davenant had emancipated himself from many of the prejudices of its more indiscriminate and zealous supporters. He considered a watchful attention to the balance of trade, and its "right government," as of the highest importance; but he did not consider wealth as consisting exclusively of gold or silver; or that prohibitions and restrictions should be rashly imposed, even on the intercourse with those countries with which the balance was supposed to be unfavourable. But we are far from thinking that his commercial writings deserve the eulogies that rogress of Commer- al Science n England.

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[1] See the Honourable Roger North's Life of his brother, the Honourable Sir Dudley North, p. 179.

[2] Considerations on the Lowering of Interest and Raising the Value of Money, 1691. Further Considerations concerning Raising the Value of Money, 1695.

have been bestowed on them, or that they had any material effect in accelerating the progress of sound commercial science. They do not, in fact, contain a single principle not to be found in the work of Sir Josiah Child. Some of Dr Davenant's paragraphs are exceedingly good; but the treatises of which they form a part are remarkably inconclusive, and are for the most part pervaded by narrow and contracted views. There is no evidence to show that he was at all aware of the influence of commerce in facilitating the production of wealth, by giving rise to the territorial division of labour, and enabling each people to devote itself, in preference, to those employments for the successful prosecution of which they have some natural advantage.[1]

acob Van- erlint.

In 1734, Jacob Vanderlint, who describes himself as a tradesman, published his tract entitled Money answers all Things. Dugald Stewart has referred to it in the Appendix to his Life of Dr Smith, and has quoted some passages illustrative of the advantages of commercial freedom, which, he truly says, "will bear a comparison, both in point of good sense and of liberality, with what was so ably urged by Mr Hume twenty years afterwards, in his Essay on the Jealousy of Trade." Vanderlint closes his pamphlet with an argument in favour of the substitution of a territorial tax in place of every other; an idea borrowed from Locke, and subsequently adopted by the French economists.

ir Mat- hew ecker.

In 1744,[2] Sir Matthew Decker, an extensive merchant, published an Essay on the Causes of the Decline of Foreign Trade. This essay has been frequently referred to by Dr Smith, and it deserved his notice. Sir Matthew is a most intelligent and decided enemy of restrictions, monopolies, and prohibitions. To give full freedom to industry—he proposed that corporation privileges should be abolished; and that the existing taxes should be repealed, and replaced by a *single tax* laid on the consumers of luxuries, proportionally to their incomes. The following extracts will give an idea of the spirit and ability which pervades Sir Matthew's work:—

"In the Memoirs of De Witt, it is said, 'that restraint is always hurtful to trade;' the reason whereof is plain; for nature has given various products to various countries, and thereby knit mankind in an intercourse to supply each other's wants. To attempt to sell our products, but to buy little or none from foreigners, is attempting an impossibility, acting contrary to the intent of nature, cynically, and absurdly, and, as ours is a populous manufacturing country, might be prejudicial to our interests; for, could we raise all necessaries and vanities within ourselves, this intercourse designed by nature would be destroyed; and then, how is our navy, our only bulwark, to be maintained?" (P. 147.)

"Trade cannot, will not, be forced; let other nations prohibit, by what severity they please, interest will prevail; they may embarrass their own trade, but *cannot hurt a nation whose trade is free, so much as themselves.* Spain has prohibited our woollens; but had a reduction of our taxes brought them to their natural value only, they would be the cheapest in Europe of their goodness, consequently must be more demanded by the Spaniards, be smuggled into their country in spite of their government, and sold at better prices; their people would be dearer clothed, with duties and prohibitions, than without, consequently must sell their oil, wine, and other commodities dearer; whereby other nations, raising the like growths, would gain ground upon them, and their balance of trade grow less and less. But should we, for that reason, prohibit their commodities? By no means; for the dearer they grow, no more than what are just necessary will be used; their prohibition does their own business; some may be necessary for us; what are so, we should not make dearer to our own people; some may be proper to assort cargoes for other countries, and why should we prohibit our people that advantage? *Why hurt ourselves to hurt the Spaniards?* If we would retaliate effectually upon them for their ill intent, handsome premiums given to our plantations to raise the same growths as Spain might enable them to supply us cheaper than the Spaniards could do, and establish a trade they could never recover. Premiums may gain trade, but prohibitions will destroy it." (P. 163.)

Progress of Commercial Science in England.

Sir Matthew applies the same argument to expose the absurdity and injurious effect of the restraints on the trade with France. "I allow," he says, "that Britain should be always vigilant over the designs of France, but need not be afraid of her power; her wise regulations in trade should be the objects we should keep our eyes upon, and out-do her if possible; or else, as she rises, we must sink. But it is our comfort, that our remedy is always in our own hands; nor can there be any solid reason for the nation's paying dearer to other countries for goods we could buy cheaper in France. Would any wise dealer in London buy goods of a Dutch shopkeeper for 15d. or 18d. when he could have the same from a French shopkeeper for 1s.? Would he not consider, that, by so doing, he would empty his own pockets the sooner, and that, in the end, he would greatly injure his own family by such whims? And shall this nation commit an absurdity that stares every private man in the face?......The certain way to be secure is to be more powerful, that is, to extend our trade as far as it is capable of; and as restraints have proved its ruin, to reject them, and depend on freedom for our security; bidding defiance to the French, or any nation in Europe, that took umbrage at our exerting our natural advantages." (P. 184.)

We do not know that the impolicy of restrictions on the importation of foreign corn has ever been more ably and triumphantly exposed than in the following passage: "Every home commodity, in a free trade, will find its natural value; for, though that fluctuates, as of necessity it must, according to the plentifulness or scarcity of seasons, yet, for the home consumption, every home commodity must have great advantage over the foreign, as being upon the spot, and free from freight, insurance, commission, and charges, which on the produce of lands, being all bulky commodities, must in general be about 15 per cent., and a greater advantage cannot be given without prejudice; for 15 per cent. makes a great difference in the price of necessaries between the nation selling and the nation buying, and is a great difficulty on the latter, but, arising from the natural course of things, cannot be helped; though it is a sufficient security to the landholder, that foreigners can never import more necessaries than are absolutely required; and I presume, in such cases, they have more charity than to starve the people merely for an imaginary profit, which yet would prove their ruin in the end; for it is a fallacy and an absurdity to think to raise the value of lands by oppressions on the people that cramp their trade; for if trade declines, the common people must either come upon the parish, or fly for business to our neighbours: in the first case, they

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[1] The progress of enlarged and liberal opinions with regard to commerce seems to have been in no small degree counteracted by the publication of the British Merchant. This work was written by some of the first merchants of their time, to expose the alleged defects in the commercial treaty with France, negotiated by Queen Anne's Tory administration in 1713. It consists of a series of papers published weekly, and afterwards collected in three volumes. Public opinion being very much against the treaty, the British Merchant enjoyed a large share of popularity. Its authors appear to have been thoroughly imbued with all the prejudices of the mercantile sect; and the work is now only deserving of notice as containing the fullest exposition of their peculiar doctrines.

[2] We quote from the edition of the Essay published at Edinburgh in 1756. It appears from the work itself (p. 4), that it had been written in 1740; the first edition was in 4to.

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become a heavy tax on the rich, and, instead of buying the produce of their lands, must have it given them; and in the second case, when the consumers are gone, what price will the produce of land bear?" (P. 56.)

Mr Hume.

Mr Harris.

Of a work so well known as Mr Hume's Political Essays (published in 1752) it is almost superfluous to speak. The ability with which he has combated the prejudice against the French trade, and ridiculed the fear of being deprived of a sufficiency of bullion; the liberality and expansion of his views respecting commerce; and the beauty of his illustrations, cannot be too highly praised. It did not, however, enter into his plan to give a systematic view of the influence of commerce, nor has he instituted any analysis of the sources of wealth. Mr Harris endeavoured to supply the latter deficiency; and his Essay on Money and Coins, published in 1757, is, perhaps, on the whole, the best economical treatise that appeared previously to the publication of the Wealth of Nations. We have already noticed Harris's mistake of supposing that it was more profitable to import durable rather than rapidly consumable commodities; and, as a writer on commerce, he is undoubtedly very inferior to Sir Dudley North and Sir Matthew Decker. But the comprehensive and able manner in which he has treated the subject of money, the skill with which he has illustrated the effects of the division of labour in facilitating production and increasing wealth, and the near approach he has made to some of the fundamental doctrines of Dr Smith, if they do not give him a pre-eminence, certainly place him in the first rank among his precursors.

Early Italian writers on commerce.

We have been induced to treat of the progress of commercial science in England at considerable length, partly on account of the interest and importance of the subject, and partly because we are not acquainted with any work in which it has been investigated. Say and other continental writers contend that the Italians and French were the first who discovered and established the just principles of commercial intercourse. But the details now given prove the indisputable priority of the English. The economical works of Davanzati, Serra, Turbolo, and Scaruffi, are almost wholly occupied with a discussion of the effects of a forced reduction of the standard of money. They deserve credit for having opposed all tampering with the currency; but the arguments they employ to show its injustice and impolicy are stated with much greater brevity and force in Sir Robert Cotton's speech in the Privy Council in 1626. The *Discurso Economico* of Bandini, the earliest writer on commerce whose works have been thought worthy of a place in the voluminous collection of Italian works on Political Economy,[1] was published so late as 1737. Belloni and Algarotti's Essays on Commerce, both very inferior to the works of Sir Josiah Child or Sir Dudley North, were published, the former in 1750, and the latter in 1763.

Early French Writers o Commer

The French have still less claim than the Italians to be considered the discoverers of the true principles of commerce. There are many just and striking observations on the injury France sustained from the want of a free internal traffic, and the oppressiveness of taxation, in the *Dixme Royale* of Marshal Vauban, written in 1698. But Vincent de Gournay, whom the French state to be one of the earliest of their authors who entertained comprehensive and liberal notions regarding commerce, was born so late as 1712.[2] Gournay published translations of the treatise of Sir Josiah Child, and of a tract of Sir Thomas Culpepper, at Paris, in 1752. So slow was the progress of economical science in France, that even Montesquieu has a chapter entitled "*A quelles nations il est désavantageux de faire le commerce.*"[3]

System o the Frenc economists.

M. Quesnay.

But neither the efforts of the English nor French writers in favour of the freedom of commerce and industry had any considerable influence on the mercantile system. Their opinions respecting the nature of wealth, and the causes of national opulence, being confused and contradictory, their arguments in favour of a liberal system of commerce had somewhat of an empirical appearance, and failed of making that impression which is always made by arguments founded on well-established principles, and shown to be consistent with experience. Locke, as will be afterwards seen, entertained correct opinions respecting the paramount influence of labour in the production of wealth; but he did not prosecute his investigations in the view of elucidating the principles of this science, and made no reference to them in his subsequent writings. Harris adopted Locke's views, and deduced from them some practical inferences of great importance; but his general reasonings are merely introductory to his Treatise on Money, and are not illustrated with that fulness of detail, or in that comprehensive and systematic manner, necessary in scientific works. The celebrated M. Quesnay, a physician attached to the court of Louis XV., was the first who attempted to investigate and analyse the sources of wealth, with the intention of ascertaining the fundamental principles of political economy, and who, consequently, gave it a systematic form, and raised it to the rank of a science. Quesnay's father was a small proprietor, and having been educated in the country, he was naturally inclined to regard agriculture with more than ordinary partiality. At an early period of his life, being struck with its depressed state in France, he set himself to discover the causes which had prevented its making that progress which the industry of the inhabitants, the fertility of the soil, and the excellence of the climate, seemed to insure. In the course of this inquiry, he speedily discovered that the prohibition of exporting corn to foreign countries, and the preference given by the system of Colbert to the manufacturing and commercial classes over the agriculturists, had formed the most powerful obstacle to the progress and improvement of agriculture. But Quesnay did not satisfy himself with exposing the injustice of this preference, and its pernicious consequences. His zeal for the interests of agriculture led him, ystem of e French Economists.

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[1] *Scrittori Classici Italiani di Economia Politica.* The publication of this collection of the works of her economical writers does honour to Italy, or rather to Napoleon, by whom it was liberally patronised. It was begun in 1803 and finished in 1805, in 50 volumes 8vo.

[2] See Dupont's edition *Des Œuvres de M. Turgot*, tom. iii. p. 311.

[3] Maupertuis, in his Eloge of Montesquieu, candidly admits that France is indebted for the science of commerce, finance, and population, to England. The passage is curious: "Comme le plan de Montesquieu," he observes, "renfermoit tout ce qui peut être utile au genre humain, il n'a pas oublié cette partie essentielle qui regarde le commerce, les finances, la population; science *si nouvelle parmi nous*, qu'elle n'y a encore point de nom. C'est *chez nos voisins qu'elle est née; et elle y demeura jusque à ce que M. Melon lui fit passer le mer.*"

Melon's work, *Essai Politique sur le Commerce*, was published in 1734. It is entirely founded on the principles of the mercantile system. Mr Bindon translated it into English, and published it, along with some rather valuable annotations and remarks, at Dublin, in 1739.

Melon had advocated the ruinous policy of raising the denomination of the coin. This gave occasion to the publication of an acute work by Dutot, entitled *Réflexions Politiques sur les Finances et le Commerce*, 2 tomes 12mo, 1738. Dutot's work was in its turn very ably criticised by Duverney, in his *Examen des Réflexions Politiques sur les Finances*, &c. 2 tomes 12mo, 1740. These works contain a great deal of curious and interesting information respecting French finance. Duverney's account of the *Mississippi Scheme* is particularly good.

not merely to place it on the same level with manufactures and commerce, but to raise it above them, by endeavouring to show that it was the only species of industry which really increased the riches of a nation. Founding on the fact, that everything which either ministers to our wants, or gratifies our desires, must be originally derived from the earth, Quesnay assumed as a self-evident truth, that the earth is the only source of wealth, and held that industry is altogether incapable of producing any new value, except when employed in agriculture, including therein fisheries and mines.[1] His observation of the striking effects of the vegetative powers of nature, and his inability to explain the real origin and causes of rent, confirmed him in his opinion. The fact, that of all who engage in laborious undertakings, none but the cultivators of the soil pay rent for the use of natural agents, appeared to him an incontrovertible proof that agriculture is the only species of industry which yields a nett surplus (*produit net*) over and above the expenses of production. Quesnay allowed that manufacturers and merchants are highly useful; but as they realize no nett surplus in the shape of rent, he contended they did not add any greater value to the raw material of the commodities they manufacture or carry from place to place, than the mere equivalent of the capital or stock consumed in these operations. These principles once established, it followed that landlords, farmers, and labourers employed in agriculture, were the only *productive* classes in a state; and that the labour of manufacturers and traders being *unproductive*, their means of subsistence and wealth were wholly derived from the agriculturists. It further followed, that the expenses of government, and the various public burdens, however imposed, must be defrayed out of the *produit net*, or rent of the landlords; and, consistently with this principle, Quesnay proposed that all the existing taxes should be repealed, and that a single tax (*l'impôt unique*), levied directly from the produce of the land, should be imposed in their stead.

The *economical table* of M. Quesnay—" Cette formule étonnante," says Dupont, " qui peint la naissance, la distribution, et la reproduction des richesses, et qui sert à calculer avec tant de sureté, de promptitude, et de précision, l'effet de toutes les opérations relatives aux richesses"—was published at Versailles in 1758.

But, however much impressed with the importance of agriculture over every other species of industry, Quesnay did not solicit for it any exclusive favour or protection. He successfully contended, that the interests of the agriculturists, as of all other classes, would be best promoted by establishing a system of perfect freedom. He showed that it could never be the interest of the proprietors and cultivators of the soil to fetter or discourage the industry of merchants, artificers, and manufacturers; for the greater the liberty they enjoyed, the greater would be their competition, and their products would, in consequence, be sold so much the cheaper. Neither, on the other hand, could it ever be the interest of the unproductive classes to harass and oppress the agriculturists, either by preventing the free exportation of their products, or by imposing on them any restrictive regulations. When the cultivators enjoy the greatest degree of freedom, their industry, and consequently their *surplus produce*—the only fund from which any accession of national wealth can be derived—will be carried to the greatest possible extent. According to this " liberal and generous system" (*Wealth of Nations*, p. 303[2]), the establishment of perfect liberty, perfect security, and perfect justice, is the only, as it is the infallible, means of securing the highest degree of prosperity to all classes of society.

System of the French Economists.

" On a vu," says the commentator of this system, M. Mercier de la Rivière, " qu'il est de l'essence de l'ordre que l'intérêt particulier d'un seul ne puisse jamais être séparée de l'intérêt commun de tous; nous en trouvons une preuve bien convaincante dans les effets que produit naturellement et nécessairement la plénitude de la liberté qui doit regner dans le commerce, pour ne point blesser la propriété. L'intérêt personnel, encouragée par cette grande liberté, presse vivement et perpétuellement chaque homme en particulier, de perfectionner, de multiplier les choses dont il est vendeur, de grossir ainsi la masse des jouissances qu'il peut procurer aux autres hommes, afin de grossir, par ce moyen, la masse des jouissances que les autres hommes peuvent lui procurer en échange. *Le monde* alors *va de lui-même;* le désir de jouir, et la liberté de jouir, ne cessant de provoquer la multiplication des productions et l'accroissement de l'industrie, ils impriment à toute la société un mouvement qui devient une tendance perpétuelle vers son meilleur état possible." (Tome ii. p. 444.)[3]

We shall have other opportunities of fully examining the principles of this theory. At present, it is sufficient to remark, that, in assuming agriculture to be the only source of wealth, because the matter of which commodities are composed is originally derived from the earth, Quesnay and his followers mistake altogether the nature of production, and really suppose wealth to consist of matter. But, in its natural state, matter is very rarely possessed of utility, and is

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[1] " Cherchant d'où vient les richesses des nations. Quesnay trouva qu'elles ne naissent que des travaux dans lequels la *Nature et la Puissance Divine* concourent avec les efforts pour produire ou faire recueillir des productions nouvelles : de sorte qu'on ne peut attendre l'augmentation des ces richesses que de la cultivation, de la pêche, et de l'exploitation des mines, et des carriers." (See the *Notice sur les Economistes*, by one of the most zealous of the sect, *Dupont de Némours*, in the *Œuvres de Turgot*, tom. iii. p. 312.)

[2] M'Culloch's edition, 1 vol. 8vo.

[3] That Quesnay is entitled to the merit of originality cannot, we think, be disputed. He had certainly, however, been anticipated in several of his peculiar doctrines by some English writers of the previous century. The fundamental principles of the economical system are distinctly and clearly stated in a tract entitled Reasons for a Limited Exportation of Wool, published in 1677. " That it is of the greatest concern and interest of the nation," says the author of the tract, " to preserve the nobility, gentry, and those to whom the land of the country belongs, at least, much greater than a few artificers employed in working the superfluity of our wool, or the merchants who gain by the exportation of our manufactures, is manifest—1. Because they are the masters and proprietaries of the foundation of all the wealth in this nation, all profit arising out of the ground, which is theirs : 2. Because they bear all taxes and public burdens; which, in truth, are only borne by those who buy, and sell not; all sellers raising the price of their commodities, or abating of their goodness, according to their taxes." (Not being able to procure the pamphlet itself, we quote from the extract given in Mr Smith's Memoirs of Wool, vol. i. p. 254.)

In 1696, Mr Asgill published a treatise entitled Several Assertions Proved, in order to Create Another Species of Money than Gold, in support of Dr Chamberlayne's proposition for a Land Bank. We extract from this treatise the following passage, breathing, as Dugald Stewart has justly observed, the very spirit of Quesnay's philosophy.

" What we call commodities is nothing but land severed from the soil. Man deals in nothing but earth. The merchants are the factors of the world, to exchange one part of the earth for another. The king himself is fed by the labour of the ox; and the clothing of the army and the victualling of the navy must all be paid for to the owner of the soil, as the ultimate receiver. All things in the world are originally the produce of the ground, and there must all things be raised." (This passage has been quoted in Lord Lauderdale's Inquiry into the Nature and Origin of Public Wealth, 2d ed. p. 109.)

These passages are interesting, as exhibiting the first germs of the theory of the Economists. But there is no reason whatever to suppose that Quesnay was aware of the existence of either of the tracts referred to. The subjects treated in them were of too local a description to excite the attention of foreigners; and Quesnay was too candid to conceal his obligations, had he really owed always destitute of value. It is only by means of the labour bestowed in the appropriation of matter, and in fitting and preparing it for use, that it acquires exchangeable value, and becomes wealth. Human industry does not produce wealth by making any additions to the matter of our globe, this being a quantity susceptible neither of augmentation nor diminution. Its real effect is simply to produce wealth by giving utility to matter already in existence; and it will be hereafter seen, that the labour employed in manufactures and commerce is as productive of utility, and consequently of wealth, as that employed in agriculture. Neither is the cultivation of the soil, as Quesnay supposed, the only species of industry which yields a surplus over the expenses of production. When none but the best soils are cultivated, and when, consequently, agriculture is most productive, no rent, or *produit net*, is obtained from the land; and it is only after recourse has been had to poorer soils, and when the productive powers of the labour and capital employed in cultivation begin to diminish, that rent begins to appear; so that, instead of its being any proof of the superior productiveness of agricultural industry, rent is a consequence of its becoming less productive! The opinion of Quesnay, that man derives no assistance from the productive powers of nature, unless when employed in agriculture, is totally destitute of foundation; and, in a subsequent part of this article, it will be shown that the manufacturer and merchant derive fully as much assistance from these powers as the agriculturist, fisher, or miner.

Though the theory of the French economists, considered in reference to the fundamental principles of the science, was equally erroneous with that to which it was opposed, its novelty and ingenuity, its systematical and consentaneous form, the liberal system of commercial intercourse which it recommended, and the benevolent and excellent character of its founder, speedily obtained for it a very high degree of reputation. The opinions of Quesnay were early communicated to, and zealously espoused by, his friends the Marquis de Mirabeau, Mercier de la Rivière, Dupont de Némours, and others; and were afterwards advocated by Turgot, one of the most distinguished statesmen of whom France has to boast;[1] and by Letrosne, Condorcet, Raynal, and most of the succeeding French writers on commerce and finance. Their practical influence on the legislation of the country has also been considerable. In 1763 the free transportation of corn from one province to another was permitted; and in 1764 liberty was given to export it to foreign countries whenever the home price did not exceed thirty livres the septier (48s. the quarter). This last edict, after being suspended in 1770, was again revived in 1778 during the administration of Turgot. But the facility given to the imposition of the *contribution foncière* should certainly be considered as the greatest practical achievement of the economists; and there is but too much reason to fear it will long continue to afford a palpable demonstration of the fallacy of their doctrines.[2]

Notwithstanding the defects of their theory, the labours of the French economists contributed powerfully to accelerate the progress of economical science. In reasoning on subjects connected with national wealth, it was now found to be necessary to subject its sources, and the laws which regulate its production and distribution, to a more accurate and searching analysis. In the course of this examination, it was speedily ascertained that the mercantile and economical theories were alike erroneous and defective; and that to establish the science on a firm foundation, it was necessary to take a much more extensive survey, and to seek for its principles, not in a few partial and distorted facts, or in metaphysical abstractions, but in the connection subsisting among the various phenomena manifested in the progress of civilization. The Count di Verri, whose Meditations on Political Economy were published in 1771, pointed out the fallacy of the opinions entertained by the French economists respecting the superior productiveness of agriculture; and showed that all the operations of industry really consist of modifications of matter already in existence.[3] But Verri did not trace the consequences of this important principle; and, possessing no clear and definite notions of what constituted wealth, he did not attempt to discover the means by which labour might be facilitated. He made several valuable additions to particular branches of the science, and had sufficient acuteness to detect the errors in the systems of others; but the task of constructing a better system in their stead required talents of a far higher order.

Wealth of Nations.

At length, in 1776, our illustrious countryman, Adam Smith, published the Wealth of Nations—a work which has done for political economy what the *Principia* of Newton did for physics, and the *Esprit des Loix* of Montesquieu for politics. In this work the science was, for the first time, treated in its fullest extent, and many of its fundamental

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them any. It is probable he may have seen Locke's treatise on Raising the Value of Money, where the idea is thrown out that all taxes fall ultimately on the land. But there is an immeasurable difference between the suggestion of Locke and the well-digested system of Quesnay.

[1] Turgot's *Réflexions sur la Formation et la Distribution des Richesses*, published in 1771, is certainly the best of all the works founded on the principles of the Economists, and is, in some respects, the best work on Political Economy published previously to the Wealth of Nations.

[2] Exclusive of the *Réflexions* of Turgot, the following are the principal works published by the French Economists:—

Tableau Economique, et Maximes Générales du Gouvernement Economique, par François Quesnay, 4to. Versailles, 1758.
Théorie de l'Impôt, par M. de Mirabeau, 4to, 1760.
L'Ami des Hommes, par M. de Mirabeau, seven tomes, 1760, &c.
Eléments de la Philosophie Rurale, par M. de Mirabeau, three tomes 12mo, 1763.
L'Ordre Naturel et Essentiel des Sociétés Politiques, par Mercier de la Rivière, 4to, and two tomes 12mo, 1767.
Sur l'Origine et Progrès d'une Nouvelle Science, par Dupont de Némours, 1767.
La Physiocratie, ou Constitution Naturelle du Gouvernement le plus avantageux aux genre humain, par Quesnay, two tomes, 1767.
Lettres d'un Citoyen à un Magistrat, sur les Vingtièmes et les autres Impôts, par l'Abbé Baudeau, 1768.

[3] "Alcuni benemeriti scrittori, rattristati dai gravi disordini, che soffrono i popoli per le gabelle, sono passati all'estremo de considerare ingiusto e mal collocato il tributo se non ripartito sui fondi di terra, e colla creazione di un linguaggio ascetico, hanno eretta la setta degli economisti, presso la quale ogni uomo che non adoperi l'aratro, e un essere sterile, e i manifattori si chiamano una *classe sterile.* Rispettando il molto di vero e di utile che da essi è stato scritto, io non saprei associarmi alla loro opinione ne sul tributo, ne su di questa pretesa classe sterile. La riproduzione e attribuibile alla manifattura ugualmente, quanto al laroro de campi. Tutti i fenomini dell' universo, sieno essi prodotti dalla mano dell'uomo o vero dalle universali leggi della fisica, non ci danno idea di attuale *creazione*, ma unicamente di una *modificazione* della materia. *Accostare e seperare* sono gli unici elementi che l'ingegno umano ritrova analizando l'idea della *riproduzione*; e tanto e riproduzione *di valore e di richezza* se la terra, l'aria, e l'aqua ne'campi si trasmutino in grano, come se colla mano dello uomo il glutine di un insetto si trasmuti in velluto, o vero alcuni pezzetti di metallo si organizzino a formare una ripetizione. Degli intieri citta, e degli stati intieri campano non d'altro che sul prodotto di questa fecondissima *classe sterile*, la di cui riproduzione comprende il valore della materia prima, la consumazione proporzionata delle mani impiegatevi, e di piu quella porzione che fa arrichire chi ha intrapresa la fabbrica e chi vi s'impiega con felice talento." (*Meditazioni sulla Economia Politica*, § 3.)

Wealth of Nations.

principles placed beyond the reach of cavil and dispute. In opposition to the French economists, Dr Smith showed that *labour* is the only source of wealth, and that the desire inherent in the breast of every individual to improve his fortune and rise in the world is the cause of its accumulation. He next traced the means by which the powers of labour may be rendered most effective, and showed that it is productive of wealth when employed in manufactures and commerce, as well as in the cultivation of the land. Having established these principles, Smith showed, in opposition to the commonly received opinions of the merchants and statesmen of his time, that wealth did not consist in the abundance of gold and silver, but in that of the various necessaries, conveniencies, and enjoyments of human life; he showed that individuals are always the best judges of what is for their own interest, and that in prosecuting branches of industry advantageous to themselves, they necessarily prosecute such as are advantageous to the public.[1] Thence Dr Smith drew his grand inference, that every regulation intended to force industry into particular channels, or to determine the commercial intercourse to be carried on between different parts of the same country, or between distant and independent countries, is impolitic and pernicious —injurious to the rights of individuals, and adverse to the progress of real opulence and lasting prosperity.

The fact that traces of most of these principles, and that the distinct statement of some of the more important, may be found in the works of previous writers, detracts but little from the merits of Dr Smith. In adopting the discoveries of others, he made them his own; he demonstrated the truth of principles on which his predecessors had, in most cases, stumbled by chance; separated them from the errors by which they were encumbered; traced their remote consequences; pointed out their limitations; showed their practical importance and real value,—their mutual dependence and relation; and reduced them into a consistent and well-compacted system. We do not mean to say that Smith produced a perfect work. Undoubtedly there are errors, and those, too, of no slight importance, in the Wealth of Nations. The principles to which we have just referred, and which form the basis of the work, are unimpeachable. Smith, however, has not always reasoned correctly from them, and he has occasionally introduced others, which a more careful observation and analysis has shown to be ill founded. But, after every allowance has been made for these defects, enough still remains to justify us in considering him as the real founder of the science. If he has not left a perfect work, he has at all events left one which contains a greater mass of useful and universally interesting truths than have ever been given to the world by any other individual; and he has pointed out and smoothed the route, by following which, subsequent philosophers have been enabled to perfect much that he had left incomplete, to rectify the mistakes into which he fell, and to make many new and important discoveries. Whether, indeed, we refer to the soundness of its leading doctrines, to the liberality and universal applicability of its practical conclusions, or to the powerful and beneficial influence it has had on the improvement and progress of economical science, and on the policy and destiny of nations, Smith's work must be placed in the foremost rank of those that have done most to liberalise, enlighten, and enrich mankind.

Distinction between Politics and Political Economy.

The practical part of the science of political economy was long confounded with that of politics; and it is undoubtedly true that they are very intimately connected, and that it is frequently impossible to treat those questions which strictly belong to the one without referring more or less to the principles and conclusions of the other. But, in their leading features, they are sufficiently distinct. The laws which regulate the production and distribution of wealth are the same in every country and stage of society. Those circumstances which are favourable or unfavourable to the increase of riches and population in a republic may equally exist, and will have exactly the same effects, in a monarchy. That security of property, without which there can be no steady and continued exertion,—that freedom of engaging in every different branch of industry, so necessary to call the various powers and resources of human talent and ingenuity into action,—and that economy in the public expenditure, so conducive to the accumulation of national wealth,—are not the exclusive attributes of any particular species of government. If free states have generally made the most rapid advances in wealth and population, it is an indirect rather than a direct consequence of their political constitution. It results more from the greater security which a popular government presents, that the right of property will be held sacred,—that the freedom of industry will be less fettered and restricted,—and that the public income will be more judiciously levied and expended, than from the circumstance of a greater proportion of the people being permitted to exercise political rights and privileges. Give the same securities to the subjects of an absolute monarch, and they will make the same advances. Industry does not require to be stimulated by extrinsic advantages. The additional comforts and enjoyments which it procures have always been found sufficient to insure the most persevering and successful exertions. And whatever may be the form of government, those countries always advance in the career of improvement, in which the public burdens are moderate, industry free, and every individual permitted peaceably to enjoy the fruits of his labour. It is not, therefore, so much on its political organization, as on the talents and spirit of its rulers, that the wealth of a country is principally dependent. Economy, intelligence, and liberality on the part of those in power, have frequently elevated absolute monarchies to a very high degree of opulence and prosperity; while all the advantages derived from a more liberal system of government have not been able to preserve free states from being impoverished and exhausted by the extravagance, intolerance, and short-sighted policy of their rulers.

Politics and political economy are, therefore, sufficiently distinct. The politician examines the principles on which government is founded, he endeavours to determine in whose hands the supreme authority may be most advantageously placed, and unfolds the reciprocal duties and obligations of the governing and governed portions of society. The political economist does not take so high a flight. It is not of the constitution of the government, but of its ACTS only, that he presumes to judge. Whatever measures affect the production or distribution of wealth, necessarily come within the scope of his observation, and are canvassed by him. He examines whether they are in unison with the principles of economical science. If they are, he pronounces them to be advantageous, and shows the nature and extent

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[1] It is of importance to observe, that Dr Smith does not say that, in prosecuting such branches of industry as are most advantageous to themselves, individuals necessarily prosecute such as are at the same time *most* advantageous to the public. His leaning to the system of the Economists—a leaning perceptible in every part of his work—made him so far swerve from the principles of his own system, as to admit, that individual advantage is not always a true test of the public advantageousness of different employments. He considered that agriculture, though not the only productive employment, is the most productive of any; that the home trade is more productive than a direct foreign trade; and the latter than the carrying trade. It will be hereafter seen that there is no foundation for these distinctions.

Distinction between Politics and Political Economy.

of the benefits of which they will be productive; if they are not, he shows in what respect they are defective, and to what extent their operation will be injurious. But he does this without inquiring into the constitution of the government by which these measures have been adopted. The circumstance of their having emanated from the privy council of an arbitrary monarch, or the representative assembly of a free state, though in other respects of supreme importance, cannot affect the immutable principles by which he is to form his opinion upon them.

Distinction between statistics and political economy.

Besides being confounded with politics, the practical part of political economy has frequently been confounded with statistics; but they are still more easily separated and distinguished. The object of the statistician is to describe the condition of a particular country at a particular period; while the object of the political economist is to discover the causes which have brought it into that condition, and the means by which its wealth and riches may be indefinitely increased. He is to the statistician what the physical astronomer is to the mere observer. He takes the facts furnished by the statistician, and after comparing them with those furnished by historians and travellers, he applies himself to discover their relation. By a patient induction,—by carefully observing the circumstances attending the operation of particular principles,—he discovers the effects of which they are really productive, and how far they are liable to be modified by the operation of other principles. It is thus that the relation between rent and profit,—between profit and wages, and the various general laws which regulate and connect the apparently conflicting, but really harmonious interests of every different order of society, have been discovered and established with all the certainty of demonstrative evidence.

PART II.

PRODUCTION OF WEALTH.

SECT. I.—*Definition of Production.—Labour the only Source of Wealth.*

Definition of production.

All the operations of nature and of art are reducible to, and really consist of, transmutations,—of changes of form and of place. By production in this science, we are not to understand the production of matter, for that is exclusively the attribute of Omnipotence, but the production of utility, and consequently of exchangeable value, by appropriating and modifying matter already in existence, so as to make it satisfy our wants, and contribute to our enjoyments. The labour which is thus employed is the only source of wealth.[1] Nature spontaneously furnishes the matter of which commodities are made; but, independently of labour, matter is rarely of any use, and is never of any value. Place us on the banks of a river, or in an orchard, and we shall infallibly perish of thirst or hunger, unless, by an effort of industry, we raise the water to our lips, or pluck the fruit from its parent tree. It is seldom, however, that the mere appropriation of matter is sufficient. In the infinite majority of cases, labour is required not only to appropriate it, but to convey it from place to place, and to give it that peculiar shape, without which it may be totally useless, and incapable of either ministering to our necessities or our comforts. The coal used in our fires is buried deep in the bowels of the earth, and is absolutely worthless until the miner has extracted it from the mine, and brought it into a situation where it may be used. The stones and mortar of which our houses are built, and the rugged and shapeless materials from which the various articles of convenience and ornament with which they are furnished have been prepared, were, in their original state, alike destitute of value and utility. And of the innumerable variety of animal, vegetable, and mineral products which form the materials of our food and clothes, none were originally serviceable, while many were extremely noxious to man. His *labour* has given them utility, has subdued their bad qualities, and made them satisfy his wants, and minister to his comforts and enjoyments. "Labour was the first price, the original purchase-money, that was paid for all things. It was not by gold or by silver, but by labour, that all the wealth of the world was originally purchased." (*Wealth of Nations*, p. 14.)

Labour th only Sour of Wealt

Those who observe the progress and trace the history of the human race in different countries and states of society, will find their comfort and happiness always pretty nearly proportioned to their expertness in appropriating the raw products of nature, and in fitting and adapting them to their use. The savage, whose labour is confined to the gathering of wild fruits, or to the picking up of the shell-fish on the sea coast, is placed at the very bottom of the scale of civilization, and is, in point of comfort, decidedly inferior to many of the lower animals. The *first* step in the progress of society is made when man learns to hunt wild animals, to feed himself with their flesh, and clothe himself with their skins. But labour, when confined to the chase, is extremely barren and unproductive. Tribes of hunters, like beasts of prey, whom they closely resemble in their habits and modes of subsistence, are but thinly scattered over the surface of the countries which they occupy; and, notwithstanding the fewness of their numbers, any unusual deficiency in the supply of game never fails to reduce them to the extremity of want. The *second* step in the progress of society is made when the tribes of hunters and fishers apply their labour, like the ancient Scythians and modern Tartars, to the domestication of wild animals and the rearing of flocks. Their subsistence is much less precarious than that of hunters; but they are almost entirely destitute of the comforts and elegancies which give to civilized life its chief value. The *third* and most decisive step in the progress of civilization —in the great art of producing the necessaries and conveniencies of life—is made when the wandering tribes of hunters and shepherds renounce their migratory habits, and become agriculturists and manufacturers. It is then, properly speaking, that man begins fully to avail himself of his productive powers. He then becomes laborious, and, by a necessary consequence, his wants are then, for the first time, fully supplied, and he acquires an extensive command over the articles necessary to his comfort as well as his subsistence.

The earth not a sourc of wealth.

However paradoxical the assertion may at first sight appear, it is notwithstanding true that the earth does not gratuitously supply a single atom of wealth. It is a powerful machine given by Providence to man; but without his abour the ly Source Wealth.

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[1] This point has been well stated by M. Destutt Tracy. "Non seulement," says he, "nous ne créons jamais rien, mais il nous est même impossible de concevoir ce que c'est que créer ou anéantir, si nous entendons rigoureusement par ces mots, faire quelque chose de rien, ou reduire quelque chose à rien; car nous n'avons jamais vu un être quelconque sortir du néant ni y rentrer. De là cet axiome admis par toute l'antiquité: rien ne vient de rien, et ne peut rédévenir rien. Que faisons-nous donc par notre travail, par notre action sur tous les êtres qui nous entourent? Jamais rien qu'opérer dans ces êtres des changements de forme ou de lieu qui les approprient à notre usage, qui les rendent utiles à la satisfaction de nos besoins. Voilà ce que nous devons entendre par produire; c'est donner aux choses une utilité qu'elles n'avoient pas. Quel que soit notre travail, s'il n'en resulte point d'utilité, il est infructeux; s'il en resulte, il est productif." (*Elémens d'Idéologie*, tome iii. p. 162.)

labour it would be altogether useless, and would for ever stand idle and unemployed. It is through the intervention of labour that the products of the earth become valuable and useful. Its surface is, in its natural state, covered with fruits and game; its bowels contain an infinite variety of mineral products; its seas and rivers are stored with fish; and it is endowed with inexhaustible vegetative and productive powers; but all these powers and products are plainly of no use, and have no value, until the labour of man renders the former subservient to his purpose, and appropriates the latter, and gives them the peculiar form required to fit them to support his existence and increase his enjoyments.

pinion of obbes.

The importance of labour in the production of wealth was very clearly perceived both by Hobbes and Locke. At the commencement of the 24th chapter (entitled Of the Nutrition and Procreation of a Commonwealth) of the Leviathan, published in 1651, Hobbes says, "The nutrition of a commonwealth consisteth in the plenty and distribution of materials conducing to life.

"As for the plenty of matter, it is a thing limited by nature to those commodities which, from (the two breasts of our common mother) land and sea, God usually either freely giveth, or for labour selleth to mankind.

"For the matter of this nutriment, consisting in animals, vegetables, minerals, God hath freely laid them before us, in or near to the face of the earth; so as there needeth no more but the labour and industry of receiving them: insomuch that plenty dependeth (next to God's favour) on the labour and industry of man."

pinion of ocke.

But Locke had a much clearer apprehension of this doctrine. In his Essay on Civil Government, published in 1689, he has entered into a lengthened and able analysis to show that the products of the earth owe almost all their value to labour. "Let any one consider," says he, "what the difference is between an acre of land planted with tobacco or sugar, sown with wheat or barley, and an acre of the same land lying in common, without any husbandry upon it, and he will find that the improvement of labour makes the far greater part of the value. I think it will be but a very modest computation to say, that of the products of the earth useful to the life of man, *nine tenths* are the effects of labour; nay, if we will rightly consider things as they come to our use, and cast up the several expenses about them, what in them is purely owing to nature, and what to labour, we shall find, that in most of them *ninety-nine hundredths* are wholly to be put on the account of labour.

"There cannot be a clearer demonstration of anything, than several nations of the Americans are of this, who are rich in land, and poor in all the comforts of life; whom nature having furnished as liberally as any other people with the materials of plenty, *i. e.* a fruitful soil apt to produce in abundance what might serve for food, raiment, and delight, yet, for want of improving it by labour, have not one hundredth part of the conveniencies we enjoy; and the king of a large and fruitful territory there feeds, lodges, and is worse clad than a day-labourer in England.

"To make this a little clear, let us but trace some of the ordinary provisions of life through their several progresses, before they come to our use, and see how much of their value they receive from human industry. Bread, wine, and cloth, are things of daily use, and great plenty; yet, notwithstanding, acorns, water, and leaves or skins, must be our bread, drink, and clothing, did not labour furnish us with these more useful commodities; for whatever bread is more worth than acorns, wine than water, and cloth or silk than leaves, skins, or moss, that is solely owing to labour and industry; the one of these being the food and raiment which unassisted nature furnishes us with; the other, provisions which our industry and pains prepare for us; which how much they exceed the other in value, when any one hath computed, he will then see how much labour makes the far greatest part of the value of things we enjoy in this world; and the ground which produces the materials is scarce to be reckoned on as any, or, at most, but a very small part of it.

Labour the only Source of Wealth.

"An acre of land that bears here twenty bushels of wheat, and another in America which, with the same husbandry, would do the like, are, without doubt, of the same natural intrinsic value. But yet the benefit mankind receives from the one in a year is worth L.5, and from the other possibly not worth *one penny;* if all the profit an Indian received from it were to be valued and sold here, at least, I may truly say, not $\frac{1}{1000}$. 'Tis labour, then, which puts the greatest part of value upon land, *without which it would scarcely be worth anything:* 'tis to that we owe the greatest part of its useful products; for all that the straw, bran, bread, of that acre of wheat, is more worth than the product of an acre of good land, which lies waste, is all the effect of labour. For 'tis not merely the ploughman's pains, the reaper's and thrasher's toil, and the baker's sweat, is to be counted into the bread we eat; the labour of those who broke the oxen, who digged and wrought the iron and stones, who felled and framed the timber employed about the plough, mill, oven, or any other utensils, which are a vast number, requisite to this corn, from its being seed to be sown, to its being made bread, must all be charged on the account of *labour*, and received as an effect of that; Nature and the earth furnishing only the almost worthless materials as in themselves. 'Twould be a strange catalogue of things that industry provided and made use of about every loaf of bread, before it came to our use, if we could trace them: Iron, wood, leather, barks, timber, stone, brick, coals, lime, cloth, dyeing drugs, pitch, tar, masts, ropes, and all the materials made use of in the ship that brought away the commodities made use of by any of the workmen, to any part of the work; all which, it would be almost impossible, at least too long, to reckon up." (*Of Civil Government*, book ii. § 40, 41, 42, and 43.)[1]

Had Locke carried his analysis a little further, he could not have failed to perceive that neither water, leaves, skins, nor any of the spontaneous products of nature, have any value except what they owe to the labour required to appropriate them. The value of water to a man placed on the bank of a river depends on the labour necessary to raise it to his lips; and its value, when carried ten or twenty miles off, is equally dependent on the labour necessary to convey it there. All the rude products, productive powers, and capacities of nature, are gratuitously offered to man. Nature is not niggardly or parsimonious. She neither demands nor receives an equivalent for her favours. An object which it does not require any portion of labour to appropriate or to adapt to our use, may be of the very highest utility; but, as it is the free gift of nature, it is impossible it can have the smallest value.[2]

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[1] This is a very remarkable passage. It contains a far more distinct and comprehensive statement of the fundamental doctrine, that labour is the constituent principle of value, than is to be found in any other writer previous to Smith, or than is to be found even in the Wealth of Nations. But Locke does not seem to have been sufficiently aware of the value of the principle he had elucidated, and has not deduced from it any important practical conclusion. On the contrary, in his tract on the Raising of the Value of Money, published in 1691, he lays it down broadly that all taxes, however imposed, ultimately *fall on the land;* whereas it is plain he should, consistently with the above principle, have shown that they would fall, not exclusively on the produce of land, but generally on the produce of industry, or on all species of commodities.

[2] Bishop Berkeley entertained very just opinions respecting the source of wealth. In his Querist, published in 1735, he asks,—

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"Si je retranche," to use a striking illustration of this doctrine given by M. Canard, "de ma montre, par la pensée, tous les travaux qui lui ont été successivement appliquées, il ne resterai que quelques grains de minéral placées dans l'intérieur de la terre, d'où on les a tirés, et où ils n'ont aucune valeur. De même, si je décompose le pain que je mange, et que j'en retranche successivement tous les travaux successifs qu'il a reçus, il ne restera que quelques tiges d'herbes, graminées, éparses dans des désertes inculcates, et sans aucune valeur." (*Principes d'Economie Politique*, p. 6.)

It is to labour, therefore, that man owes everything possessed of exchangeable value. Labour is the talisman that has raised him from the condition of the savage—that has changed the desert and the forest into cultivated fields—that has covered the earth with cities and the ocean with ships—that has given us plenty, comfort, and elegance, instead of want, misery, and barbarism.

Having established this fundamental principle—having shown that labour alone gives value to commodities—it is plain that the great practical problem of this science must resolve itself into a discussion of the means by which labour may be rendered most efficient, that is, by which the greatest amount of necessary and desirable products may be obtained with the least outlay of labour. Wealth, as already seen, is always increased by every diminution of the labour required to produce the articles of which it consists. Every measure and invention that has any tendency to save labour, or to reduce the cost of producing commodities, adds proportionally to our power of obtaining wealth and riches; while every measure or regulation that has any tendency to waste labour, or to raise the cost of producing commodities, equally lessens this power. This is the simple and decisive test by which we are to judge of every measure affecting the wealth of the country, and of every invention. If they render labour more productive—if they tend to reduce the value of commodities, to render them more easily obtainable, and, consequently, to bring them within the command of a greater portion of society—they are advantageous; but if their tendency be different, they are as certainly disadvantageous. Considered in this point of view, that great branch of the science which treats of the production of wealth will be found to be abundantly simple, and easily understood.

Labour, according as it is applied to the raising of raw produce—to the fashioning of that raw produce, when raised, into articles of utility, convenience, or ornament—and to the conveyance of raw and wrought products from one country and place to another—is said to be agricultural, manufacturing, and commercial. An acquaintance with the particular processes, and most advantageous methods, of applying labour in each of these great departments of industry, forms the appropriate study of the agriculturist, manufacturer, and merchant. It is not consistent with his objects for the political economist to enter into the details of particular businesses and professions. He confines himself to an investigation of the means by which labour generally may be rendered most productive, and how its powers may be increased in *all* departments of industry.

SECT. II.—*Means by which the Productive Powers of Labour are increased.—Security of Property.—Division of Labour.—Accumulation and Employment of Capital.*

Means by which the Product Powers of Labour may be increased.

The most careless and inattentive observer of the progress of mankind from poverty to affluence must have early perceived, that there are *three* circumstances whose conjoint operation is necessary to stimulate and improve the productive powers of industry. The *first*, and most indispensable, is the *security of property*, or a strong conviction in the mind of every individual that he will be allowed to dispose at pleasure of the fruits of his labour. The *second* is the introduction of exchange or barter, and the consequent appropriation of particular individuals to particular employments. And the *third* is the accumulation and employment of the produce of previous labour, or, as it is more commonly termed, of capital, or stock. Every improvement that either has been or that may yet be made, in the great art of producing the necessaries, comforts, and conveniencies of human life, will be found to be resolvable into the more judicious and successful application of one or more of those means of stimulating labour, and adding to its power. To give a full exposition of the nature and influence of each would far exceed the limits of this article; and we must content ourselves with such observations as may suffice to give a general idea of their operation.

Security of property.

SECURITY OF PROPERTY is the first and most indispensable requisite to the production of wealth. Its utility in this respect is so obvious and striking, as to make it be more or less respected in every country, and in the earliest and rudest periods of society. All have been impressed with the reasonableness of the maxim which teaches that those who sow should be permitted to reap; that the labour of a man's body and the work of his hands should be considered as exclusively his own. No horde, how barbarous soever, has been discovered in which the principle of *meum* and *tuum* was not recognised. Nothing, it is plain, could ever tempt any one to engage in any laborious employment—he would neither domesticate wild animals, nor clear and cultivate the ground, if, after months and years of toil, when his flocks had become numerous, and his harvests were ripening for the sickle, a stranger were allowed to rob him of the produce of his industry. No wonder, therefore, that the utility of some general regulations, securing to every individual the peaceable enjoyment of the produce he had raised, and of the ground he had cultivated and improved, suggested itself to the first legislators. The author of the book of Job places those who removed their neighbours' landmarks at the head of his list of wicked men; and some of the earliest profane legislators subjected those guilty of this offence to a capital punishment. (Goguet, *De l'Origine des Loix*, &c. tom. i. p. 30, 4to ed.)

Dr Paley has said that the law of the land is the real foundation of the right of property. But the obvious utility of securing to each individual the property acquired by his industry, has undoubtedly formed the irresistible reason which has induced every people emerging from barbarism to establish this right. It is, in truth, the foundation on which all the institutions of society rest. Until property

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"Whether it were not wrong to suppose *land* itself to be wealth? And whether the *industry of the people* is not first to be considered as that which constitutes wealth, which makes even land and silver to be wealth, neither of which would have any value but as means and motives to industry?" "Whether, in the wastes of America, a man might not possess twenty miles square of land, and yet want his dinner, or a coat to his back." (*Querist*, Numbers 38 and 39.)

We shall afterwards notice Sir William Petty's opinion on this subject.

Say appears to think (*Discours Préliminaire*, p. 37), that Galiani was the first to show, in his treatise *Della Moneta*, published in 1750, that labour is the only source of wealth. But the passages we have now laid before the reader prove the erroneousness of this opinion. Galiani has entered into no analysis or argument to prove the correctness of his statement; and as it appears from other parts of his work that he was well acquainted with Locke's Tracts on Money, a suspicion naturally arises that he had seen the Essay on Civil Government, and that he was really indebted to it for a knowledge of this principle. This suspicion derives strength from the circumstance of Galiani being still less aware than Mr Locke of the value of the discovery. See *Trattato della Moneta*, p. 39, ediz. 1780.

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has been publicly guaranteed, men look on each other as enemies rather than as friends. The idle and improvident are always desirous of seizing on the earnings of the laborious and frugal; and were they not restrained by the strong arm of the law from prosecuting their attacks, they would, by generating a feeling of insecurity, effectually check both industry and accumulation, and sink all classes to the same level of hopeless misery as themselves. The security of property is quite as necessary to accumulation as to production. No man ever denies himself an immediate gratification when it is within his power, unless he think that by doing so he has a fair prospect of obtaining, at some future period, a greater accession of comforts and enjoyments, or of avoiding some considerable evil. Where the right of property is vigilantly protected, an industrious man, who produces as much by one day's labour as is sufficient to maintain him two days, instead of idling away the second day, accumulates the surplus which exceeds his wants as a capital; the increased consequence and enjoyments which the possession of capital brings along with it being, in the great majority of cases, more than sufficient to countervail the desire of immediate gratification. But wherever property is insecure, we look in vain for the operation of this principle. "It is plainly better for us," is then the invariable language of the people, "to enjoy while it is in our power, than to accumulate property we shall not be permitted to use, and which will either expose us to the extortion of a rapacious government, or to the depredations of those who exist only by the plunder of their more industrious neighbours."

The security of property is not violated merely when a man is deprived of the power of peaceably enjoying the fruits of his industry; it is also violated, and perhaps in a still more unjustifiable manner, when he is prevented from using his powers, in any way not injurious to others, that he considers most beneficial for himself. Of all the species of property a man can possess, the faculties of his mind and the powers of his body are most particularly his own. He should, therefore, be permitted to enjoy, that is, to use or exert these powers at discretion. And hence the right of property is as much, or more, infringed upon, when a man is interdicted from engaging in a particular branch of business, as it is when the property he has produced and accumulated is forcibly taken from him. Every monopoly which gives to a few individuals the exclusive power of carrying on certain branches of industry, is thus, in fact, established in direct violation of the right of property of every one else. It prevents them from using their natural capacities or powers in the way they might have considered best; and as every man who is not a slave is justly held to be the best, and, indeed, only judge of what is advantageous for himself, the principles of natural law and the right of property are both subverted when he is excluded from any employment. In like manner, the right of property is violated whenever any regulation is made to force an individual to employ his labour or capital in a particular way. The property of a landlord is violated when he is compelled to adopt any system of cultivation, even supposing it to be preferable to that which he would otherwise follow. The property of the capitalist is violated when he is obliged to accept a particular rate of interest for his stock; and the property of the labourer is violated whenever he is obliged to employ himself in any particular occupation.

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The finest soil, the finest climate, and the finest intellectual powers, can prevent no people from becoming barbarous, poor, and miserable, if they have the misfortune to be subjected to a government which does not respect the right of property. This is the greatest of all calamities. The ravages of civil war, of pestilence, and of famine, may be repaired; but nothing can enable a nation to contend against the deadly influence of an established system of violence and rapine. The want of security, of a lively and well-founded expectation of being permitted freely to dispose of the fruits of industry, is the principal cause of the wretched state of the Ottoman dominions in the present day, as it was of the decline of industry and arts in Europe during the middle ages. When the Turkish conquerors overran those fertile and beautiful countries in which, to the disgrace of the other European powers, they are still permitted to encamp, they parcelled them among their followers, on condition of their performing certain military services, on a plan corresponding, in many important particulars, to the feudal system of our ancestors. But these possessions are not hereditary. They do not descend to the children or legatees of the present possessors, but on their death revert to the sultan. Among the occupiers of land in Turkey there is, therefore, no thought of futurity. No one feels any interest about the prosperity of an unknown successor, and no one ever executes any improvement unless he expect to reap all the advantage during his own life. This is the cause why the Turks are so extremely careless about their houses. They never construct them of solid or durable materials. And it would be a gratification were they assured that they would fall to pieces the moment they have breathed their last. Under this miserable government the palaces have been changed into cottages, and the cities into villages. The long-continued want of security has extinguished the very spirit of industry, and destroyed not only the power, but even the desire, to emerge from barbarism.

Security of Property.

Had it been possible for arbitrary power to profit by the lessons of experience, it would long since have perceived that its own wealth, as well as that of its subjects, would be most effectually promoted by maintaining the inviolability of property. Were the Turkish government to establish a vigilant system of police, to give to each individual full power to dispose of the fruits of his labour, and to substitute a regular plan of taxation for the present odious system of extortion and tyranny, industry would revive, capital and population would be augmented, and moderate duties, imposed on a few articles in general demand, would bring a much larger sum into the coffers of the treasury than all that is now obtained by force and violence. The stated public burdens to which the Turks are subject, are light when compared with those imposed on the English, the Hollanders, or the French. But when the latter have paid the taxes due to government, they know they will be permitted peaceably to enjoy or accumulate the remainder of their earnings; whereas the Turk has no security but that the moment after he has paid his stated contribution, the pasha, or one of his satellites, may strip him of every additional farthing he possesses. Security is the foundation, the principal element, in every well-digested system of finance. When maintained inviolate, it enables a country to support, without much difficulty, a very heavy load of taxes; but where there is no security, where property is a prey to rapine and spoliation, to the attacks of the needy, the powerful, or the profligate, the smallest burdens are justly regarded as oppressive, and uniformly exceed the means of the impoverished and spiritless inhabitant.

Case of the Jews.

The Jews have been supposed to afford an instance of a people whose property has been long exposed to an almost uninterrupted series of attacks, and who have, notwithstanding, continued to be rich and industrious. But when rightly examined, it will be found that the case of the Jews forms no exception to the general rule. The absurd prejudices with which the Jews have been almost universally regarded, prevented their acquiring any property in land, and excluded them from participating in the charitable institutions of the different countries among which they are scattered. Having therefore no adventitious sup-

Security of Property.

port on which to depend, in the event of their becoming infirm or destitute, they had a powerful additional motive to save and accumulate; and being excluded from agriculture, they were of necessity compelled to addict themselves, in preference, to commerce. In an age when the profession of a merchant was generally looked upon as something mean and sordid, and when, of course, they had comparatively little competition, they must have made considerable profits; but these have been very greatly exaggerated. It was natural that those indebted to the Jews should represent their gains as enormous; for this inflamed the existing prejudices against them, and afforded a miserable pretext for defrauding them of their just claims. There are a few rich Jews in most of the large cities of Europe; but the majority of that race are, and always have been, as poor as their neighbours.

Let us not, therefore, deceive ourselves by supposing that it is possible for any people to emerge from barbarism, or to become wealthy, populous, and civilized, without the security of property. From whatever point of the political compass we may set out, this is the principle to which we must come at last. Security is indispensable to the successful exertion of the powers of industry. Where it is wanting, it is idle to expect either riches or civilization.[1]

Objections of Rousseau and Beccaria ill founded.

Rousseau and some other sentimental writers have made an objection to the right of property, which has been in some measure sanctioned by the Marquis Beccaria.[2] They allow that the security of property is advantageous for those who possess it; but they contend that it is disadvantageous for those who are poor and destitute. It has condemned, they affirm, the greater portion of mankind to a state of misery, and has provided for the exaltation of the few by the depression of the many! The sophistry of this reasoning is so apparent, as hardly to require being pointed out. The right of property has not made poverty, but it has made wealth. Previously to the institution of this right, those nations which are now most civilized were sunk to the same level of wretchedness and misery as the savages of New Holland and Kamtschatka. All classes have been benefited by the change; and it is mere error and delusion to suppose that the rich have been benefited at the expense of the poor. The right of property gives no advantage to any one man over any other man. It deals out justice impartially to all. It does not say, "labour, and I shall reward you;" but it says, "labour, and I shall take care that none be permitted to rob you of the produce of your exertions." This right has not made all men rich, because it could not make all men frugal and industrious. But it has done more than all the other institutions of society put together to produce that effect. It is not, as it has been sometimes ignorantly or knavishly represented, a bulwark thrown up to protect and secure the property of a few favourites of fortune. It is a rampart raised by society against its common enemies,—against rapine and violence, plunder and oppression. Without its protection, the rich man would become poor, and the poor man would never be able to become rich,—all would sink to the same bottomless abyss of barbarism and poverty. "The security of property has overcome the natural aversion of man from labour, given him the empire of the earth, a fixed and permanent residence, and has implanted in his breast the love of country and of posterity. To enjoy immediately,—to enjoy without labour,—is the natural inclination of every man. This inclination must be restrained; for its obvious tendency is to arm all who have nothing against those who have something. The law which restrains this inclination, and which secures to the humblest individual the quiet enjoyment of the fruits of his industry, is the most splendid achievement of legislative wisdom,—the noblest triumph of which humanity has to boast." (Bentham, *Traité de Législation*, tom. ii. p. 37.)

Security of Property.

Division of labour.

Division of Labour.—The division of labour naturally divides itself into two separate branches: 1*st*, The division of labour among individuals; and, 2*d*, its division among nations.

1. *Individual Division of Labour.*—The division of labour can only be imperfectly introduced in rude societies and thinly-peopled countries. But in every state of society, in the rudest as well as in the most improved, we may trace the operation and effects of this principle. The various physical powers, talents, and propensities with which men are endowed, naturally fit them for different occupations; and a regard to mutual interest and convenience necessarily leads them, at a very early period, to establish a system of barter and a separation of employments. Each individual finds that he may obtain a greater quantity of all sorts of commodities by devoting himself to some particular business, and exchanging his surplus produce for such parts of the produce of other people's labour as he may have occasion for, and they may be disposed to part with, than if he attempted directly to produce all the articles which he consumes. As society advances, this division becomes more and more extended. In process of time, one man becomes a tanner or dresser of skins, another a shoemaker, a third a weaver, a fourth a house-carpenter, a fifth a smith, and so on. Each endeavours to cultivate and bring to perfection whatever talent or genius he may possess for the species of industry in which he is employed. The wealth and comforts of all classes are, in consequence, prodigiously augmented. In a country where the division of labour is carried to a considerable extent, agriculturists do not spend their time in clumsy attempts to manufacture their own produce; and manufacturers cease to interest themselves about the raising of corn and the fattening of cattle. The facility of exchanging is the vivifying principle of industry. It stimulates agriculturists to adopt the best system of cultivation, and to raise the largest crops, because it enables them to exchange whatever portion of the produce of their lands exceeds their own wants for other commodities conducing to their comforts and enjoyments; and it stimulates manufacturers and merchants to increase the quantity and to improve the quality of their goods, that they may obtain a greater supply of raw produce. A spirit of industry is thus universally diffused; and the apathy and languor which characterize a rude state of society entirely disappear.

But it is not the mere facility of exchanging, or the being able to barter the surplus produce of one's own labour for such parts of the produce of other people's labour as we may wish to have and they may choose to part with, that renders the separation of employments of such signal advantage. The introduction of barter and the division of labour not only enables each individual to betake himself in preference to those departments which suit his taste and disposition, but it makes a large addition to the efficacy of ivision of Labour.

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[1] "Ce n'est que là où les proprietés sont assurés, où l'emploi des capitaux est abandonné au choix de ceux qui les possédent; ce n'est que là, dis-je, que les particuliers seront encouragés à se soumettre aux privations le plus dures pour compenser par leurs épargnes les retards que la profusion du gouvernement peut apporter aux progrès de la richesse national. Si l'Angleterre, malgré ses guerres ruineuses, est parvenue à un haut degré d'opulence; si, malgré les contributions énormes dont le peuple y est chargé, son capital est pourtant accrue dans le silence par l'économie des particuliers, il ne faut attribuer ces effets qu'à la liberté des personnes, et à la sureté des proprietés qui y règnent, plus que dans aucun autre pays de l'Europe, la Suisse excepté." (Storch, *Traité d'Economie Politique*, tom. i. p. 317.)

[2] Speaking of theft, Beccaria calls it "Il delitto di quella infelice parte di uomini a cui *il diritto di proprietà* (*terribile, e forse non necessario diritto*), *non ha lasciato, che una nuda essistenza.*" (*Dei Delitti e delle Pene*, § 22.)

his powers, and enables him to produce a much greater quantity of commodities than he could do did he engage indiscriminately in different employments. Smith, who has treated this subject in the most masterly manner, has classed the circumstances which conspire to increase the productive powers of industry, when labour is divided, under the following heads:—*First*, The increase of the skill and dexterity of the workman; *second*, the saving of time, which is commonly lost in passing from one employment to another; and, *third*, the circumstance of the division of employments having a tendency to facilitate the invention of machines and processes for abridging and saving labour. We shall make a few observations on each of these heads.

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1*st*, *As respects the improvement of the skill and dexterity of the labourer*, it is sufficiently plain, that when a person's whole attention is devoted to one branch of business, when all the energies of his mind and powers of his body are made to converge, as it were, to a single point, he must attain to a degree of proficiency in that particular branch, to which no individual engaged in a variety of occupations can be expected to reach. A peculiar play of the muscles, or sleight of hand, is necessary to perform the simplest operation in the best and most expeditious manner; and this can only be acquired by constant practice. Smith has given a striking example, in the case of the nail manufacturer, of the extreme difference between training a workman to the precise occupation in which he is to be employed, and training him to a similar and closely allied occupation. "A common smith," says he, "who, though accustomed to handle the hammer, has never been used to make nails, if, upon some particular occasion, he is obliged to attempt it, will scarce, I am assured, be able to make above two or three hundred nails in a day, and those very bad ones. A smith who has been accustomed to make nails, but whose sole or principal business has not been that of a nailer, can seldom, with his utmost diligence, make more than eight hundred or a thousand nails in a day. But I have seen several boys under twenty years of age, who had never exercised any other trade but that of making nails, who, when they exerted themselves, could make, each of them, upwards of *two thousand three hundred nails in a day*;" or nearly three times the number of the smith who had been accustomed to make them, but who was not entirely devoted to that particular business!

ves time.

2*d*, The influence of the division of labour in preventing that *waste of time in moving from one employment to another*, which necessarily takes place when an individual is engaged in different occupations, is as obvious as its influence in improving the skill and dexterity of the labourer. When the same individual carries on different employments, in different and perhaps distant places, and with different sets of tools, it is plain he must lose a considerable portion of time in passing from one to another. If the different businesses in which a labourer is to be engaged were carried on in the same workshop, the loss of time would be less, but even in that case it would be considerable. "A man," as Dr Smith has justly observed, "commonly saunters a little in changing from one business to another. When he first begins his work, he is seldom keen or hearty; his mind is said not to go along with it, and for some time he rather trifles than applies himself to good purpose. The habit of sauntering, and of indolent, careless application, which is naturally, or rather necessarily, acquired by every country workman, who is obliged to change his work and his tools every half hour, and to apply his hand in twenty different ways almost every day of his life, renders him almost always slothful and lazy, and incapable of any vigorous application, even on the most pressing occasions. Independent, therefore, of his deficiency in point of dexterity, this cause alone must always reduce considerably the quantity of work which he is capable of performing." (*Wealth of Nations*, p. 5.)

Division of Labour.

Facilitates the invention of machines.

3*d*, As respects the influence of the division of employments in *facilitating the invention of machines, and processes for abridging and saving labour*, it is obvious that those engaged in any branch of industry will be more likely to discover easier and readier methods of carrying it on, when their whole attention is devoted exclusively to it, than if they had to attend to a variety of objects. But it is a mistake to suppose, as has been sometimes done, that the inventive genius of workmen and artificers is alone whetted and improved by the division of labour. As society advances, the study of particular branches of science and philosophy becomes the principal or sole occupation of the most ingenious men. Chemistry becomes a distinct science from natural philosophy; the physical astronomer separates himself from the astronomical observer, the political economist from the politician, and each meditating exclusively, or principally, on his peculiar department, attains to a degree of proficiency and expertness in it, which the general scholar seldom or never reaches. And hence, in labouring to promote our own ends, we all necessarily adopt that precise course which is most advantageous for all. Like the different parts of a well-constructed engine, the inhabitants of a civilized country are all mutually dependent on and connected with each other. Without any previous concert, and obeying only the powerful and steady impulse of self-interest, they universally conspire to the same great end, and contribute each in his respective sphere to furnish the greatest possible supply of necessaries, conveniencies, and enjoyments.

Division of labour limited by the extent of the market.

But it is necessary to observe, that the advantages derived from the division of labour, though they may be, and in fact are, partially enjoyed in every country and state of society, can only be reaped in their full extent where there is a great power of exchanging, or an extensive market. Many employments cannot be separately carried on out of the precincts of a large city; and, in all cases, the division becomes more perfect, according as the demand for the produce of the workmen is extended. It is stated by Smith that ten labourers employed in different departments in a pin manufactory can produce 48,000 pins a day; but it is evident that were the demand not sufficiently extensive to take off this quantity, it would be impossible to carry the division so far. The same principle holds in every case. A cotton-mill could not be constructed in a small country, having no intercourse with its neighbours. The demand and competition of Europe and America has been necessary to carry the manufactures of Glasgow, Manchester, and Birmingham to their present state of improvement.

The influence of the division of labour in increasing the quantity and perfection of the products of industry was noticed by several of the writers who preceded Dr Smith, and especially by Harris and Turgot. But neither of these writers has done what Smith did. None of them fully analysed and exhibited its various effects, or showed that the power of engaging in different employments depends on the power of exchanging; and that, consequently, the advantages derived from the division of labour are necessarily dependent on, and regulated by, the extent of the market. This is a principle of great importance, by establishing which Smith shed a new light on the whole science, and laid the foundation of many important practical conclusions. "Présentée de cette manière," says M. Storch, "l'idée de la division du travail étoit absolument neuve; et l'effet qu'elle a fait sur les contemporains de Smith, prouve bien qu'elle l'étoit réellement pour eux. Telle qu'elle se trouve indiquée dans les passages que je viens de citer, elle n'a fait aucune impression. Développée par Smith, cette idée a d'abord saisi tous ses lecteurs; tous en ont senti la vérité et l'importance; et cela suffit pour lui en assurer tout l'honneur, lors même que son génie ait été guidé par les indications de ses devanciers." (Tome vi. p. 10.)

Territorial Division of Labour.

2. *Territorial Division of Labour, or Commerce.*—Besides that sort of division of labour which enables each individual in a limited society to confine himself to a particular employment, there is another and most important branch of the division of labour, which not only enables particular individuals, but the inhabitants of entire districts, and even nations, to addict themselves in preference to certain branches of industry. It is on this *territorial division of labour*, if we may so term it, that the commerce carried on between different districts of the same country, and between different countries, is founded. The various soils, climates, and capacities of production of the different districts of an extensive country, fit them for being appropriated to certain species of industry. A district where coal is abundant, which has an easy access to the ocean, and a considerable command of internal navigation, is the natural seat of manufactures. Wheat and other species of grain are the proper products of rich arable soils; and cattle, after being reared in mountainous districts, are most advantageously fattened in meadows and low grounds. Nothing is more obvious than that the inhabitants of these different districts, by confining themselves to those branches for the prosecution of which they have some peculiar natural capability, must produce an infinitely greater quantity of useful and desirable articles than they could do were they to employ themselves indiscriminately in every different employment. It is impossible to doubt that a vastly greater supply of manufactured goods, corn, and cattle, are produced by the inhabitants of Glasgow, the Carse of Gowrie, and Argyleshire, respectively, confining themselves to manufactures, agriculture, and the rearing of cattle, than if each endeavoured directly to raise these various products.

But it is easy to see that foreign trade, or the territorial division of labour between different and independent countries, contributes to increase the wealth of each in precisely the same manner that the trade between different provinces of the same kingdom contributes to increase their wealth. There is a still greater difference between the productive powers with which nature has endowed different and distant countries than there is between the productive powers of the provinces of the same country. The establishment of a free intercourse between them must, therefore, be proportionally more advantageous. It would evidently cost infinitely more to raise the wines of France or Spain in England, than to make Yorkshire yield the same products as Devonshire. Indeed there are a multitude of products, and some of them of the very greatest utility, that cannot be raised except in particular situations. Were it not for commercial intercourse, we should not be able to obtain the smallest supply of tea, sugar, raw cotton, raw silk, gold bullion, and a thousand other equally useful and valuable commodities. Providence, by giving different soils, climates, and natural productions to different countries, has evidently provided for their mutual intercourse and civilization. By permitting the people of each to employ their capital and labour in those departments in which their geographical situation, the physical capacities of their soil, their national character and habits, fit them to excel, foreign commerce has a wonderful influence in multiplying the productions of art and industry. When the freedom of commerce is not restricted, each country necessarily devotes itself to such employments as are most beneficial for itself. This pursuit of individual advantage is admirably connected with the good of the whole. By stimulating industry, by rewarding ingenuity, and by using most efficaciously the particular powers bestowed by nature, commerce distributes labour most effectively and economically; while, by increasing the mass of necessary and useful products, it diffuses opulence, and binds together the universal society of nations by the common and powerful ties of mutual interest and reciprocal obligation. Commerce enables each particular state to profit by the inventions and discoveries of every other state. It creates new tastes and new appetites, and it also gives the means and the desire of gratifying them. The progress of domestic industry is accelerated by the competition of foreigners. Commerce has either entirely removed, or greatly weakened, a host of unworthy prejudices. It has shown that nothing can be more illiberal and absurd than that once prevalent dread of the progress of others in wealth and civilization; and that the true glory and real interest of each particular people will be more certainly advanced by endeavouring to emulate and outstrip its neighbours in the career of science and civilization, than by labouring to attain a barren pre-eminence in the bloody and destructive, though necessary, art of war.

Territorial Division of Labour.

Effect of the territorial division of labour in augmenting national wealth.

The influence of commerce in giving increased efficacy to labour, and augmenting national wealth, may be easily illustrated. Thus, in the case of the intercourse, or territorial division of labour, carried on between England and Portugal, our superior wool, and our command of coal, skilful workmen, improved machinery, and of all the instruments of manufacturing industry, enable us to produce cloth at a much cheaper rate than the Portuguese; but, on the other hand, the soil and climate of Portugal being peculiarly favourable for the cultivation and growth of the grape, she is able to produce wine at an infinitely less cost than it can be produced here. And hence it is obvious, that England, by confining herself to the manufacture of cloth, in which she has a natural advantage, and exchanging it with the Portuguese for wine, will obtain a vastly larger supply of that commodity than if she attempted to cultivate the grape at home; and Portugal, by exchanging her wine for the cloth of England, will obtain a much greater quantity of cloth than if she attempted to counteract the intention of nature, by converting a portion of her capital and industry from the raising of wine, in which she has an advantage, to the manufacture of cloth, in which the advantage is on the side of another.

Sophism of the French economists on the subject of commerce.

What has been already stated is sufficient to expose the sophism of the French economists, who contended, that as an equivalent must be always given for commodities brought from abroad, it is impossible foreign commerce should be a means of increasing wealth. How, they asked, can the wealth of a country be increased by giving equal values for equal values? They admitted, that commerce might be the means of making a *better distribution* of the wealth of the world; but as it did nothing more than exchange one sort of wealth for another, they denied that it could make any addition to its amount. At first sight, this sophistical and delusive statement appears sufficiently conclusive; but a very few words will be sufficient to demonstrate its fallacy. The advantage of commerce does not consist in its enabling either of the parties who carry it on to obtain articles of greater value than those they give in exchange. It may have cost as much to produce the cloth with which the English merchant purchases the wine of Portugal, as it did to produce the latter, or it may have cost more. But then it must be observed, that in making the exchange, the value of the wine is estimated by what it takes to produce it in Portugal, which has peculiar capabilities for that species of industry, and not by what it would take to produce it in England were the trade put an end to; and, in like manner, the value of the cloth is estimated by what it takes to produce it in England, and not by what it would take to produce it in Portugal. The advantage of the intercourse consists in this, that it enables each country to obtain commodities, for the production of which it has no natural capability, and which it would, therefore, cost vastly more to produce directly at home, at the price required to produce them in the most favourable circumstances, and with the least possible expense. The gain of the one party is not the loss of the other. Both benefit by the intercourse; for erritorial vision of abour.

it enables both to save labour and expense in the production of commodities, so that the wealth of the two countries is not only better distributed, but is also greatly increased, by the territorial division of labour established between them.

To set this important principle in a clearer point of view, let it be supposed that in England a given number of men can, in a given time, manufacture 10,000 yards of cloth and raise 1000 quarters of wheat, and that the same number of men can, in a given time, manufacture in Poland 5000 yards of cloth and raise 2000 quarters of wheat. It is plain, that the establishment of a free intercourse between the two countries would, in these circumstances, enable England, by manufacturing cloth and exporting it to Poland, to obtain *twice* the quantity of corn in exchange for a given outlay of capital and labour that she would obtain in return for the same outlay on cultivation at home; and Poland would, on her part, be enabled to obtain *twice* as much cloth in exchange for her corn as she would have done had she attempted directly to manufacture it. How ridiculous then to contend, that commerce is not a means of adding to the efficacy of labour, and, consequently, of increasing wealth! Were the intercourse between England and Portugal and the West Indies put an end to, it would require, at the very least, a hundred, or perhaps a thousand times the expense to produce port wine, sugar, and coffee, directly in this country, that it does to produce the equivalents sent to Portugal and the West Indies in exchange for them. And no outlay, however great, could directly supply us with teas, spices, and fifty other most important articles.

"The commerce of one country with another is merely an extension of that division of labour by which so many benefits are conferred on the human race. As the same country is rendered richer by the trade of one province with another; as its labour becomes thus infinitely more divided and more productive than it could otherwise have been; and as the mutual interchange of all those commodities which one province has and another wants, multiplies the accommodations and comforts of the whole, and the country becomes thus in a wonderful degree more opulent and happy; so the same beautiful train of consequences is observable in the world at large, that vast empire of which the different kingdoms may be regarded as the provinces. In this magnificent empire, one province is favourable to the production of one species of produce, and another province to another. By their mutual intercourse, mankind are enabled to distribute their labour as best fits the genius of each particular country and people. The industry of the whole is thus rendered incomparably more productive; and every species of necessary, useful, and agreeable accommodation is obtained in much greater abundance, and with infinitely less expense." (Mill's *Commerce Defended*, p. 38.)

To enter into a more enlarged discussion of this interesting and important subject, would be inconsistent alike with the objects and limits of this article. In the articles on Colonies, and the Corn Trade and Corn Laws, we have examined the policy of the restrictions on the colonial and corn trades; and in the article Exchange we have pointed out the circumstances which regulate the importation and exportation of the precious metals; and have shown, that, instead of the excess of exports over imports being any criterion of an advantageous commerce, it is quite the reverse, and that it is by the excess of the value of the imports over that of the exports that the gain of the merchants, and consequently of the community, is to be estimated. In the fourth book of the Wealth of Nations, Dr Smith has examined and refuted the various arguments in favour of restrictions on commerce, in the most able and masterly manner, and with an amplitude of illustration which leaves nothing to be desired. A very complete exposure of the sophisms of the French economists, on the subject of commerce, may be found in the pamphlets of Mr Mill (Commerce Defended) and Colonel Torrens (Economists Refuted), in answer to Mr Spence's pamphlet entitled Britain Independent of Commerce. And ample information on most points relating to the practice, theory, and history of commerce, will be found in the Commercial Dictionary, by the author of this article.

Territorial Division of Labour.

Money.

When the division of labour was first introduced, barter was the only method of exchanging commodities. But according as society advanced, as the division of employments was extended, and exchanges became more numerous, the advantage of using one article as a common medium of exchange,—as an equivalent for all other commodities, and as a standard by which to ascertain their values,—soon became obvious. But this is a subject of which we have elsewhere treated at considerable length; and we beg to refer the reader, for a full investigation of the nature and functions of the common medium of exchange, to the articles Money, and Paper Money and Banks, in this work.

Accumulation and employment of capital.

Accumulation and Employment of Capital.—Capital may be defined to be "*that portion of the produce of labour saved from immediate consumption, which is employed to maintain productive labourers, or to facilitate production.*" Its accumulation and employment is indispensably necessary to the successful prosecution of almost every branch of industry. Without that species of capital which chiefly consists of tools and engines, and which has been denominated *fixed*, labour could never be rendered considerably productive; and without that species of capital which chiefly consists of the food and clothes required for the consumption of the labourer during the time he is employed in production, and which has been denominated *circulating*, he never could engage in any undertaking which did not yield an almost immediate return. An agricultural labourer, for example, might have an ample supply of carts and ploughs, of oxen and horses, and generally of all the instruments and animals used in his department of industry; but were he destitute of *circulating* capital, or of food and clothes, he would be unable to avail himself of their assistance, and, instead of tilling the ground, would have to betake himself immediately to some species of appropriative industry. And, on the other hand, supposing the husbandman to be abundantly supplied with provisions, what could he do without the assistance of *fixed* capital, or tools? What could the most skilful agriculturist perform without his spade and his plough? a weaver without his loom? or a house-carpenter without his saw, his axe, and his planes? The accumulation and employment of fixed and circulating capital is indispensable to the elevating of every nation in the scale of civilization. And it is only by their conjoined and powerful operation that wealth can be largely produced and universally diffused.

The division of labour is a consequence of the previous accumulation of capital. Before labour can be divided, "A stock of goods of different kinds must be stored up somewhere, sufficient to maintain the labourer, and to supply him with the materials and tools of his work. A weaver cannot apply himself entirely to his peculiar business, unless there is beforehand stored up somewhere, either in his own possession or in that of some other person, a stock sufficient to maintain him, and supply him with the materials and tools of his work, till he has not only completed, but sold his web. This accumulation must evidently be previous to his applying his industry for so long a time to such a peculiar business." (*Wealth of Nations*, p. 119.)

As the accumulation of stock must precede the division of labour, so its subsequent division can only be extended as capital is more and more accumulated. Accumulation and division act and re-act on each other. The quantity of raw materials which the same number of people can work up increases in a great proportion as labour comes to be more and more subdivided; and according as the operations of each workman are reduced to a greater degree of identity and simplicity, he has, as already explained, a greater chance of discovering machines and processes for facilitating and abridging labour. The quantity of industry, therefore, not only increases in every country with the increase of the stock or capital which sets it in motion, but, in consequence of this increase, the division of labour becomes extended, new and more powerful implements and machines are invented, and the same amount of labour is made to produce a much greater quantity of commodities.

Besides its effect in enabling labour to be divided, capital contributes to facilitate labour and produce wealth, in the three following ways:

Modes in which the employment of capital facilitates labour.

First.—It enables work to be executed that could not be executed, or commodities to be produced that could not be produced, without it.

Second.—It saves labour in the production of almost every species of commodities.

Third.—It enables work to be executed better, as well as more expeditiously.

1*st*, It enables us to produce commodities that could not be produced without it.

With regard to the first of those modes in which we are benefited by the employment of capital, or to its *enabling commodities to be produced that could not be produced without it*, it is plain that the production of such commodities as require a considerable period for their completion, could not be attempted unless a stock of circulating capital, or of food and clothes sufficient for the maintenance of the labourer while employed on them, were previously provided. But the employment of fixed is frequently as necessary to production as the employment of circulating capital. It would be impossible to produce a pair of stockings without the aid of wires; and though the ground might be cultivated without the aid of a plough, it could not be cultivated without the aid of a spade or hoe. If we run over the vast catalogue of the various arts practised in a polished and civilized country, it will be found that there are very few that can be carried on by the mere employment of the fingers, or tools with which man is furnished by nature. It is almost always necessary to provide ourselves with the results of previous industry, and to strengthen our feeble hands, by arming them, if we may so speak, "with the force of all the elements."

2*d*, It saves labour in the production of commodities.

In the *second* place, the employment of capital not only enables many species of commodities to be produced that could not be produced without its co-operation, but it also enables *labour to be saved in the production of many others*, and, by lowering their price, brings them within the reach of a far greater number of consumers. We have been so long accustomed to make use of the most powerful machines, that it requires a considerable effort of abstraction to render ourselves fully aware of the extent of the advantages we derive from them. But if we compare the arts practised alike by civilized man and the savage, we cannot fail to be convinced, that it is to the employment of fixed capital that we owe a very large portion of our superior comforts and enjoyments. Consider the advantages derived from the employment of the lower animals, which, in an economical point of view, are to be regarded only as machines! Consider the advantages derived from the formation of roads, bridges, harbours, and canals—the effect they have had in facilitating the conveyance of commodities, in distributing them most advantageously, and in reducing their price to the consumer! Consider the advantages derived from the construction of ships, and the improvement of navigation! But it is in vain to attempt even to glance at the numberless benefits which the employment of tools and machines has conferred on society, by cheapening and multiplying necessaries, conveniencies, and luxuries. It is by their means that our fields are cultivated, our houses constructed, our clothes manufactured, our ships built, and the treasures of knowledge and of art conveyed from one hemisphere to another! If we consult the history of the human race—if we trace their slow and gradual advancement from barbarism to refinement—we shall be convinced that their progress from their lowest and most abject, to their highest and most polished, state, has been always accompanied, and chiefly promoted, by the accumulation of fresh capital, and the invention and improvement of tools and engines.

3*d*, It enables us to execute work better, as well as more expeditiously.

The *third* advantage derived from the employment of capital consists in the circumstance of its enabling work to be done *better*, as well as more expeditiously, than it could be done without it. Cotton, for example, might be spun by the hand; but the admirable machinery invented by Hargreaves, Arkwright, and others, has not only enabled a hundred or a thousand times more yarn to be produced than could be spun by means of a common spindle, but it has also improved its quality, and given to it a degree of fineness, and of evenness, or equality, in its parts, which was never previously attained. It would require a painter months, or it might be years, to paint with a brush the cottons or printed cloths used in the hanging of a single room; and it would be very difficult, if not impossible, for the best artist to give the same perfect identity to his figures that is given to them by the admirable machinery now used for that purpose. Not to mention the other and more important advantages derived from the invention of moveable types and printing, it is certain that the most perfect manuscript—one on which years of patient and irksome labour have been expended—is unable, in point of delicacy and correctness, to match a well-printed work, executed in the hundredth part of the time, and at a hundredth part of the expense, required to copy the manuscript. The great foreign demand for English manufactured goods results no less from the superiority of the manufacture, than from their greater cheapness; and for both these advantages we are principally indebted to the excellence of our machinery.

The power to employ labour depends on the amount of capital.

There are other considerations which equally illustrate the extreme importance of the accumulation and employment of capital. The produce of the labour of a nation cannot be increased otherwise than by an increase in the number of its labourers, or of their productive powers. But without an increase of capital, it is in most cases impossible to employ another workman with advantage. If capital be not augmented, and if the food and clothes destined for the support of the labourers, and the tools and machines with which they are to operate, be all required for the maintenance and efficient employment of the labourers in existence at any given period, there can be no additional demand for them. In such circumstances the rate of wages cannot rise; and if the number of inhabitants be increased, they must be worse provided for. Neither can the productive powers of the labourer be augmented, without a previous increase of capital. It is only by the better education and training of workmen, by the greater subdivision of their employments, or by an improvement of machinery, that their productive powers can ever be materially increased. But in almost all these cases additional capital is required. It is only by its means that workmen can be better trained, or that the undertaker of any work can either provide his workmen with better machinery, or make a more proper distribution of employment among them. When the work to be done consists of a number of parts, to keep every man constantly employed in a particular part requires a much larger stock than where every man is occasionally employed in different parts of the work. "When," says Dr Smith, "we compare the state of a nation at two different periods, and find that the annual produce of its land and labour is evidently greater at the latter than at the former,—

Employment of Capital.

that its lands are better cultivated, its manufactures more numerous and more flourishing, and its trade more extensive,—we may be assured that its capital must have increased during the interval between these two periods, and that more must have been added to it by the good conduct of some, than had been taken from it, either by the private misconduct of others, or by the public extravagance of government." (*Wealth of Nations*, p. 152.) It is therefore apparent that no country can ever reach the stationary state, so long as she continues to add to her capital. So long as she does this, she will have an increasing demand for labour, and will be constantly augmenting the mass of necessaries, luxuries, and conveniencies, and consequently also the numbers of her people. But with every diminution of the previous rate at which capital had been accumulating, the demand for labour will decline. When no additions are made to capital, no more labour will be, or, indeed, can be employed. And should the national capital be diminished, the condition of the great body of the people would be greatly deteriorated—for the wages of labour would be reduced, and pauperism, with its attendant train of vice, misery, and crime, would spread its ravages throughout the largest portion of society.

ccumula- ion of ca- ital.

dvantage f high rofits.

Having thus endeavoured to point out the vast importance of the employment of capital, and the manner in which it co-operates in facilitating production, we proceed to explain the circumstances most favourable for its accumulation. Now, as capital is nothing but the accumulated produce of previous industry, it is evident that its increase will be most likely to be most rapid where industry is most productive, or, in other words, where *the profits of stock are highest.*[1] The man who can produce a bushel of wheat in three days, may accumulate twice as fast as the man who, either from a deficiency of skill, or from having to cultivate a bad soil, is forced to labour six days to produce the same quantity; and the capitalist who can invest stock so as to yield him a profit of ten per cent., has it equally in his power to accumulate twice as fast as he who can only obtain five per cent. for his capital. Experience, too, shows, that while high profits afford greater means of saving, they act as incentives to accumulation. Hence it is found that, in those countries most rapidly increasing in wealth and population, the rate of profit is always comparatively high. Thus in the United States the rate of profit is usually twice as high as in Great Britain or France; and it is to this that the more rapid advancement of the former in wealth and population is entirely to be ascribed. We do not mean to say that high profits are necessarily and in every instance accompanied by a great degree of prosperity. Countries with every other advantage for the profitable employment of industry and stock, may be subjected to a despotical government, which does not respect the right of property; and the want of adequate security thence resulting may be sufficient to paralyse all the exertions of those who are otherwise placed in the most favourable situation for the accumulation of capital. But we have no hesitation in laying it down as a principle which holds in every case, and from which there is really no exception, that, if the governments of any two or more countries be about equally liberal, and property in each about equally well secured, their comparative prosperity will depend on the rate of profit. Wherever profits are high, there is a great demand for labour, and the society rapidly augments both in population and riches. On the other hand, wherever they are low, the demand for labour is proportionally reduced, and the progress of society rendered so much the slower.

Accumulation of Capital.

Parsimony necessary to accumulation.

But however high the rate of profit, had men always *lived up to their incomes*, that is, had they always consumed the whole produce of their industry in the gratification of their immediate wants and desires, it is obvious there could have been no such thing as capital in the world. High profits are advantageous, because they afford the means of amassing capital; but something more is necessary to make us use these means, and this is the accumulating principle. The desire implanted in the breast of every individual of rising in the world, and improving his condition, has prompted mankind to save a portion of their income, or of the produce of their industry, from immediate consumption, and to set it apart as a fund, or capital, to assist them in their future undertakings. It is to this principle, therefore, or rather to its effect, parsimony, that we owe capital; and it is to capital that we owe almost all our comforts and enjoyments. Without its assistance and co-operation, labour could not have been divided; arts could not have made any progress; and mankind must have continued to shelter themselves, as in the earliest ages, in caves and forests, and to clothe themselves with the skins of wild animals. All the accumulated riches of the world,—the cities which cover its surface, the ships which traverse its seas, and the innumerable variety of improvements,—owe their origin to this principle,—to the desire to rise in the world, and consequently to save and amass.

It has been wisely ordered, that this principle should be as powerful as it is advantageous. "With regard to profusion," says Smith, "the principle which prompts to expense is the passion for present enjoyment; which, though sometimes violent, and very difficult to be restrained, is in general only momentary and occasional. But the principle which prompts to save is the desire of bettering our condition; a desire which, though generally calm and dispassionate, comes with us from the womb, and never leaves us till we go into the grave. In the whole interval which separates these two moments, there is scarce perhaps a single instance in which any man is so perfectly and completely satisfied with his situation as to be without any wish of alteration, or improvement of any kind. An augmentation of fortune is the means by which the greater part of men propose and wish to better their condition. It is the means the most vulgar and the most obvious; and the most likely way of augmenting their fortune is to save and accumulate some part of what they acquire, either regularly and annually, or upon some extraordinary occasion. Though the principle of expense, therefore, prevails in almost all men upon some occasions, and in some men upon almost all occasions, yet in the greater part of men, taking the whole course of their life at an average, the principle of frugality seems not only to predominate, but to predominate very greatly." (*Wealth of Nations*, p. 151.)

It is this principle which carries society forward. The spirit of parsimony, and the efforts which the frugal and industrious classes make to improve their condition, in most instances balance not only the profusion of individuals, but also the more wasteful profusion and extravagance of government. The spirit of economy has been happily compared by Smith to the unknown principle of animal life—the *vis medicatrix naturæ*—which frequently restores health and vigour to the constitution, in spite both of disease and of the absurd prescriptions of the physician.

But, however great the capacity of the principle of accumulation to repair the waste of capital, we must take care not to fall into the error of supposing, as very many have done, that its operations are in all cases promoted by a

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[1] To avoid all chance of misconception, it is necessary to observe, that this refers to *nett* profit, or to the sum which remains to the capitalist after all his outgoings are compensated, including therein a sum sufficient to insure his capital against risk, and to make up for whatever may be peculiarly disagreeable in his business.

Accumulation of Capital.

large public expenditure. To a certain extent, indeed, this is true. A moderate increase of taxation has the same effect on the habits and industry of a nation, that an increase of his family, or of his necessary and unavoidable expenses, has upon a private individual. Man is not influenced solely by hope; he is also powerfully operated upon by fear. Taxation brings the latter principle into the field. To the desire of rising in the world, inherent in the breast of every individual, an increase of taxation superadds the fear of being cast down to a lower station, of being deprived of conveniencies and gratifications which habit has rendered almost indispensable; and the combined influence of the two principles produces efforts that could not be produced by the unassisted agency of either. They stimulate individuals to endeavour, by increased efforts of industry and economy, to repair the breach taxation has made in their fortunes; and it not unfrequently happens that their efforts do more than this, and that consequently the national wealth is increased through the increase of taxation. But we must be on our guard against the abuse of this doctrine. To render an increase of taxation a cause of greater exertion, economy, and invention, its increase should be slow and gradual; and it should never be carried to such a height as to incapacitate individuals from meeting the sacrifices it imposes on them, by such a moderate degree of increased exertion and economy as it may be in their power to make, without requiring any very violent change in their habits. The increase of taxation must not be such as to render it impracticable to overcome its influence, or to induce the belief that it is impracticable. Difficulties that are seen to be surmountable sharpen the inventive powers, and are readily grappled with; but an apparently insurmountable difficulty, or such an excessive weight of taxation as it was deemed impossible to meet, would not stimulate, but destroy exertion. Instead of producing new efforts of ingenuity and economy, it would produce only despair. Whenever taxation becomes so heavy that the produce it takes from individuals can no longer be replaced by fresh efforts, these efforts uniformly cease to be made; the population becomes dispirited, industry is paralysed, and the country rapidly declines.

Ambition to rise is the animating principle of society. Instead of remaining satisfied with the condition of their fathers, the great object of mankind in every age has been to rise above it, to elevate themselves in the scale of wealth. To continue stationary, or to retrograde, is not natural to society. Man from youth grows to manhood, then decays and dies; but such is not the destiny of nations. The arts, sciences, and capital of one generation become the patrimony of that which succeeds them, and in their hands are augmented and rendered more efficient; so that, if not counteracted by the want of security, or by other adventitious causes, the principle of improvement would always operate, and would secure the constant advancement of nations in wealth and population.

To this same principle we owe the discovery and improvement of machinery. In every period, men endeavour to increase their productive powers, and improve their condition, by availing themselves of natural agents, and making them assist in performing tasks which must otherwise be performed by the hand only. The savage employs a club and a sling to facilitate the acquisition of game; and the same principle which prompted him to construct and use these rude instruments, never ceases to operate. It is always producing some new improvement, and, in an advanced and refined period, substitutes ships for canoes, muskets for slings, steam-engines for clubs, and cotton-mills for distaffs. "The hand of man," says Colonel Torrens, "is not armed with any efficient natural instrument, such as the beak of the bird, or the claw of the quadruped, for operating directly upon the materials presented to him; but it is admirably adapted for receiving and applying artificial implements, and for employing the powers of one substance to produce the desired changes in another. Hence almost all the grand results in manufacturing industry are brought about by means of capital. Throughout the world there are no very striking inequalities in the muscular force by which direct labour is performed; and it is mainly owing to the differences in the quantity of capital, and in the skill with which it is applied, that in one country man is found naked and destitute, and that in another all the rude productions of the earth, and all the forces of nature, are made to contribute to his comfort, and to augment his power." (*On the Production of Wealth*, p. 89.)

Accumulation of Capital.

SECT. III.—*Different Employments of Capital and Industry.—Manufactures and Commerce shown to be equally advantageous as Agriculture.—Rate of Profit true Test of Individual and Public Advantage.*

Different employments of capital and industry.

In the previous section, we endeavoured to show that the increase and diminution of capital is the pivot on which national prosperity principally hinges; that an increase of capital proportionally increases the means of supporting and employing labour, and that its diminution can hardly fail to lessen the comforts and enjoyments, and perhaps also the necessaries, of the productive classes, and to spread poverty and misery throughout the land; and we also endeavoured to show that the rise and decline of the rate of profit is the great cause of the increase and diminution of capital. But if such be the case, it seems impossible not to conclude, that such employments as yield the greatest profit, or in which industry is most productive, are the most advantageous. Dr Smith, however, with Mr Malthus and others, have objected to this standard. They allow that if two capitals yield equal profits, the employments in which they are engaged are equally beneficial to their possessors; but they contend, that if one of these capitals be employed in agriculture, it will be productive of greater public advantage. We believe, however, notwithstanding the deference due to the authorities referred to, that this opinion rests on no good foundation; and that the average rate of profit is the test by which we should always judge which employment is most and which is least advantageous.

A capital may be employed in *four* different ways, viz. *first*, in the production of raw products; or, *secondly*, in manufacturing and preparing these raw products for use and consumption; or, *thirdly*, in transporting the raw and manufactured products from one place to another, according to the demand; or, *fourthly*, in dividing particular portions of either into such smaller parcels as may suit the convenience of those who want them. The capital of all those who undertake the improvement or cultivation of lands, mines, or fisheries, is employed in the first of these ways; that of all master manufacturers in the second; that of all wholesale merchants in the third; and that of all retailers in the fourth. It is difficult to conceive that a capital should be employed in any way which may not be classed under some one or other of these heads.

Employment of capital in agriculture.

It is unnecessary to enlarge on the importance of employing capital in the acquisition of raw produce, and especially in the cultivation of the soil. It is from the latter, including therein mines and fisheries, that the matter of all commodities that minister to our necessities, comforts, or enjoyments, must be originally derived. The industry which appropriates the raw or spontaneous products of the earth preceded every other. But these are always extremely limited. And it is by agriculture only, that is, by the united application of immediate labour and of capital to the cultivation of the ground, that large supplies of those species of raw produce which form the principal part of the food of man can be obtained. It is not quite certain whether any of the principal bread corns, as wheat, barley, rye, oats, &c. have been discovered growing spontaneously. But although this must originally have been the case, their extreme scarcity, and the labour required to raise them in considerable quantities, prove beyond all question that it is to agriculture we are almost exclusively indebted for them. The transition from the pastoral to the agricultural mode of life is decidedly the most important step in the progress of society. Whenever, indeed, we compare the quantity of food, and of other raw products, obtained from a given surface of a well-cultivated country, with those obtained from the same extent of an equally fertile country, occupied by hunters or shepherds, the powers of agricultural industry in increasing useful productions appear so extraordinary, that we cease to feel surprise at the preference which has been so early and generally given to agriculture over manufactures and commerce; and are disposed to subscribe without hesitation to the panegyric of Cicero when he says, "*Omnium autem rerum ex quibus aliquid acquiritur, nihil est agricultura melius, nihil uberius, nihil dulcius, nihil homine libero dignius.*"

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But are there any really just grounds for this preference? Are not manufactures and commerce as advantageous as agriculture? It is plain that without agriculture we should never possess any considerable supply of the materials out of which food and clothes are made; but is it not equally plain, that without a knowledge of the arts by which they are converted into food and clothes, the largest supply of these materials could be of little or no service? The labour of the miller and baker is as necessary to the production of bread, as that of the husbandman who tills the ground. It is the business of the agriculturist to raise flax and wool; but if the industry of the spinner and weaver did not give them utility, and fit them for being made a comfortable dress, they would be nearly, if not entirely, worthless. Without the labour of the miner who digs the mineral from the bowels of the earth, we should be destitute of the matter of which many of our most useful implements and splendid articles of furniture are made; but if we compare the ore when dug from the mine with the finished articles, we shall certainly be convinced that the labour of the purifiers and refiners of the ore, and of the artists who afterwards converted it to useful purposes, has been quite as advantageous as the industry of the miner.

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But not only is it certain that manufacturing industry, or that species of industry which fits and adapts the raw produce of nature to our use, is requisite to render its acquisition of any considerable value; but it is also certain, that without manufacturing industry this very raw produce could never have been obtained in any considerable quantity. The mechanic who fabricates the plough contributes as efficaciously to the production of corn as the husbandman who guides it. But plough-wrights, mill-wrights, smiths, and all those artisans who prepare tools and machines for the husbandman, are really manufacturers, and differ in no respect from those employed to give utility to wool and cotton, except that they work on harder materials. Tools and machines are the produce of the industry of the tool and engine manufacturer; and without their aid it is impossible that agricultural, or any other sort of labour, should ever become considerably productive.

"Distinguer," says the Marquis Garnier, "le travail des ouvriers de l'agriculture d'avec celui des autres ouvriers, est une abstraction presque toujours oiseuse. Toute richesse, dans le sens dans lequel nous la concévons, est nécessairement le résultat de ces deux genres de travail, et la consommation ne peut pas plus se passer de l'un que de l'autre. Sans leur concours simultané il ne peut y avoir de chose consommable, et par conséquent point de richesse. Comment pourrait-on donc comparer leurs produits respectifs, puisque, en séparant des deux espèces de travail, on ne peut plus concévoir de véritable produit, de produit consommable et ayant une valeur réele? La valeur du blé sur pied résulte de l'industrie du moissonneur qui récueillera, du batteur qui le séparera de la paille, du méunier et du boulanger qui le convertiront successivement en farine et en pain, tout comme elle résulte du travail du laboureur et du sémeur. Sans le travail du tisserand le lin n'aurait pas plus le droit d'être compté au nombre des richesses que l'ortie, ou tout autre végétal inutile. A quoi pourrait-il donc servir de rechercher lequel de ces deux genres de travail contribue le plus à l'avancement de la richesse nationale? N'est-ce pas comme si l'on disputait pour savoir lequel, du pied droit ou du pied gauche, est plus utile dans l'action de marcher?"[1]

No real difference between agricultural and manufacturing industry.

In fact, there is not at bottom any real distinction between agricultural and manufacturing industry. It is, as already seen, a vulgar error to suppose that the operations of husbandry add anything to the stock of matter already in existence. All that man can do, and all that he ever does, is merely to give to matter that particular form or shape which fits it for his use. But it was contended by Quesnay and the French economists, and their opinions have in this instance been espoused by Smith, that the labour of the husbandman in adapting matter to our use is powerfully facilitated by the vegetative powers of nature, while the labour of the manufacturer has to perform everything itself without any such co-operation. "No equal quantity of productive labour, employed in manufactures," says Dr Smith, "can ever occasion so great a reproduction (as if it were employed in agriculture). In them nature does *nothing,* man does *all;* and the reproduction must always be in proportion to the strength of the agents that occasion it. The capital employed in agriculture, therefore, not only puts into motion a greater quantity of productive labour than any equal capital employed in manufactures, but, in proportion, too, to the quantity of productive labour which it employs, it adds a much greater value to the annual produce of the land and labour of the country, to the real wealth and revenue of its inhabitants. Of all the ways in which a capital can be employed, it is by far the most advantageous to the society." (*Wealth of Nations,* p. 162.)

Opinion of Dr Smith respecting the superior productiveness of agriculture.

Error of this opinion.

This is perhaps the most objectionable passage in the Wealth of Nations; and it is really astonishing that so acute and sagacious a reasoner as Smith should have maintained a doctrine so manifestly erroneous. It is unquestionably true, that nature powerfully assists the labour of man in agriculture. The husbandman prepares the ground for the seed, and deposits it there; but it is nature that unfolds the germ, that feeds and ripens the growing plant, and brings it to maturity. But does not nature do as much for man in every other department of industry? The powers of water and of wind, which move our machinery, support our ships, and impel them over the deep,—the pressure of the atmosphere, and the elasticity of steam, which enable us to work the most stupendous engines,—are they not spontaneous gifts of nature? In fact, the advantage of machinery consists exclusively in its having enabled us to press the powers of nature into our service, and to make them perform the principal part of what would otherwise have been wholly the work of man. In navigation, for example, is it possible to doubt, that the powers of nature,—the buoyancy of the water, the impulse of the wind, and the polarity of the magnet,—contribute fully as much as

Nature cooperates with man in manufactures and commerce.

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[1] *Discours Préliminaire,* p. 58, 2d ed. of trans. of the Wealth of Nations.

Different Employments of Capital and Industry.

the labour of the sailor to waft our ships from one hemisphere to another. In bleaching and fermentation the whole processes are carried on by natural agents. And it is to the influence of heat in softening and melting metals, preparing food, and warming houses, that we owe many of our most powerful and convenient instruments, and that these northern climates have been made to afford a comfortable habitation. So far, indeed, is it from being true that nature does much for man in agriculture, and nothing in manufactures, that the fact is more nearly the reverse. There are no limits to the bounty of nature in manufactures, but there are limits, and those not very remote, to her bounty in agriculture. The greatest possible amount of capital may be expended in the construction of steam-engines, or of any other sort of machines, and after they have been multiplied to infinity, the last will be as powerful and efficient in saving labour and producing commodities as the first. Such, however, is not the case with the soil. Lands of the first quality are speedily exhausted; and it is impossible to apply capital indefinitely, even to the best soils, without obtaining a progressively diminishing rate of profit. The rent of the landlord is not, as Smith supposed, the recompense of the work of nature remaining, after all that part of the product is deducted which can be regarded as the recompense of the work of man. But it is, as will be hereafter shown, the excess of produce obtained from the best soils in cultivation, over that which is obtained from the worst; it is a consequence, not of the increase, but of the diminution of the productive power of the labour employed in agriculture.

Employment of capital in commercial industry.

But if the giving utility to matter be, as it really is, the exclusive object of every species of productive industry, it is plain that the capital and labour employed in carrying commodities from where they are produced to where they are to be consumed, and in dividing them into minute portions, so as to suit the wants of the consumers, are really as productive as if they were employed in either agriculture or manufactures. The miner gives utility to matter, to coal, for example, by bringing it from the bowels of the earth to its surface; but the merchant, or carrier, who transports this coal from the mine whence it has been dug, to the city or place where it is to be burned, gives it a further and perhaps a more considerable value. We do not owe our fires exclusively to the miner or coal-merchant. They are the result of the conjoint operations of both, and also of the operations of all those who have furnished them with the tools and implements used in their respective employments.

Advantage of retail dealers.

Not only, however, must commodities be brought from where they are produced to where they are to be consumed, but it is further necessary that they should be divided into such small and convenient portions, that each individual may be able to purchase the precise quantity he is desirous to obtain. "If," says Dr Smith, "there was no such trade as a butcher, every man would be obliged to purchase a whole ox or a whole sheep at a time. This would generally be inconvenient to the rich, and much more so to the poor. If a poor workman was obliged to purchase a months' or six months' provisions at a time, a great part of the stock which he employs as a capital in the instruments of his trade, or in the furniture of his shop, and which yields him a revenue, he would be forced to place in that part of his stock which is reserved for immediate consumption, and which yields him no revenue. Nothing can be more convenient for such a person than to be able to purchase his subsistence from day to day, or even from hour to hour, as he wants it. He is thereby enabled to employ almost his whole stock as a capital. He is thus enabled to furnish work to a greater value, and the profit which he makes by it in this way much more than compensates the additional price which the labour of the retailer imposed upon the goods. The prejudices of some political writers against shopkeepers and tradesmen are altogether without foundation. So far is it from being necessary either to tax them or to restrict their numbers, that they can never be multiplied so as to hurt the public interests, though they may so as to hurt one another. The quantity of grocery goods, for example, which can be sold in a particular town, is limited by the demand of that town and its neighbourhood. The capital, therefore, which can be employed in the grocery trade, cannot exceed what is sufficient to purchase that quantity. If this capital is divided between two different grocers, their competition will obviously tend to make both of them sell cheaper than if it were in the hands of one only; and if it were divided among twenty, their competition would be just so much the greater, and the chance of their combining together in order to raise the price just so much the less. Their competition might perhaps ruin some of themselves; but to take care of this is the business of the parties concerned, and it may safely be trusted to their discretion. It can never hurt either the consumer or the producer; on the contrary, it must tend to make the retailers both sell cheaper and buy dearer than if the whole trade was monopolized by one or two persons. Some of them, perhaps, may occasionally decoy a weak customer to buy what he has no occasion for. This evil is, however, of too little importance to deserve the public attention, nor would it necessarily be prevented by restricting their numbers." (*Wealth of Nations*, p. 160.)

Agriculture, manufactures, and commerce equally advantageous.

Thus it appears that all the modes in which capital can be employed in productive industry, or, in other words, that the raising of raw produce, the fashioning of this raw produce, after it is raised, into useful and agreeable articles, the carrying of the raw and manufactured products from one place to another, and retailing them in such portions as may suit the public demand, are equally advantageous; that is, the capital and labour employed in any one of these departments contributes, equally with that employed in the others, to increase the mass of necessaries, conveniencies, and luxuries. Without a previous supply of raw produce, we should have no manufactures; and without these and commercial industry, the greater part of this raw produce would be entirely worthless, and would neither satisfy our wants nor contribute to our comforts. Manufacturers and merchants are to the body politic what the digestive powers are to the human body. We could not exist without food; but the largest supplies of food cannot lengthen our days when the machinery by which nature prepares and adapts it for our use, and incorporates it with our body, is vitiated and deranged. Nothing therefore can be more silly and childish than the estimates so frequently put forth of the comparative advantages of agricultural, manufacturing, and commercial industry. They are all intimately connected, and depend upon, and grow out of, each other. "Land and trade," to borrow the just and forcible expressions of Sir Josiah Child, "are twins, and have always, and ever will, wax and wane together. It cannot be ill with trade but lands will fall, nor ill with lands but trade will feel it." This reasoning cannot be controverted; and on its authority we are entitled to condemn every attempt to exalt one species of industry, by giving it factitious advantages at the expense of the rest, as being alike impolitic and pernicious. No preference can be given to agriculturists over manufacturers and merchants, or to the latter over the former, without occasioning the most extensively ruinous consequences. Men, in every instance, should be allowed to follow their own inclinations in the employment of their stock and industry. Where industry is free, the interests of individuals can never be opposed to those of the public. Those who succeed best in increasing their own wealth, must necessarily also succeed best in increasing the wealth of the state of which they are subjects.[1]

This mutual dependence of the different branches of industry on each other, and the necessity of their co-operation to enable mankind to make any considerable progress in civilization, have been ably illustrated in an early number of the Edinburgh Review. " It may safely be concluded, that all those occupations which tend to supply the necessary wants or to multiply the comforts and pleasures of human life, are equally productive, in the strict sense of the word, and tend to augment the mass of human riches, meaning, by riches, all those things which are necessary, or convenient, or delightful to man. The progress of society has been productive of a complete separation of employments originally united. At first, every man provided, as well as he could, for his necessities as well as his pleasures, and for *all* his wants as well as *all* his enjoyments. By degrees a division of these cares was introduced; the subsistence of the community became the province of one class, its comforts of another, and its gratifications of a third. The different operations subservient to the attainment of each of these objects were then intrusted to different hands; and the universal establishment of barter connected the whole of these divisions and subdivisions together—enabled one man to manufacture for all, without danger of starving by not ploughing or hunting, and another to plough or hunt for all, without the risk of wanting tools or clothes by not manufacturing. It has thus become as impossible to say exactly who feeds, clothes, or entertains the community, as it would be to say which of the many workmen employed in the manufacture of pins is the actual pin-maker, or which of the farm-servants produces the crop. All the branches of useful industry work together to the common end, as all the parts of each branch cooperate to its particular object. If you say that the farmer feeds the community, and produces all the raw materials which the other classes work upon, we answer, that unless those other classes worked up the raw materials, and supplied the farmer's necessities, he would be forced to allot part of his labour to this employment, whilst he forced others to assist in raising raw produce. In such a complicated system, it is clear that all labour has the same effect, and equally increases the whole mass of wealth. Nor can any attempt be more vain than theirs who would define the particular parts of the machine that produce the motion, which is necessarily the result of the *whole powers combined*, and depends on each particular one of the mutually connected members." (Vol. iv. p. 362.)

Much has been said respecting the extraordinary mortality of large manufacturing establishments. The ready communication of contagion where people are crowded together,—the want of sufficient ventilation,—the confinement of children,—and the positive unhealthiness of some particular processes,—are circumstances from which most writers have been led to infer that the mortality in manufacturing cities *must* be unusually great, without giving themselves the trouble to inquire whether it really was so. The returns under the population acts have shown the fallacy of these opinions. Great Britain was infinitely more of a manufacturing country in 1820 and 1830 than in 1780; but, notwithstanding the vast increase during the intermediate period of what we have been in the habit of considering unhealthy employments, the average mortality in England and Wales during the *five* years ending with 1820, was one in every fifty-five, and during the five years ending with 1830 it was one in every fifty-one, of the existing population, whereas in 1780 it was one in every forty. It may perhaps be said, that this increased healthiness is owing to improvements in agriculture,—to the drainage of bogs and marshes, the inclosure and cultivation of commons and wastes,— and not to the extension of manufactures. But suppose this were admitted, still we should have to inquire what had occasioned these extraordinary improvements in agriculture. And a moment's reflection would suffice to convince us that they have principally resulted from the improvement of manufactures,—from the increased demand of the manufacturing population for the raw produce of the soil. In point of fact, however, it is certain, that much of this diminution of mortality is a direct, and not an indirect, consequence of the improvement and extension of manufactures. Every one knows the vast importance in respect of health, of the people having the means of providing themselves with comfortable clothes at a cheap rate. And this is one of the many advantages which improvements in manufacturing industry bring along with them. The reduction in the price of cotton goods only, occasioned by the greater facility with which they are now produced, has enabled the poorest classes to clothe themselves in a comfortable and elegant dress; and has been productive of an increase of enjoyment, of which it is extremely difficult for us, who have so long experienced its beneficial effects, to estimate the extent.

Manufactures not productive of increased mortality.

Division of labour does not degrade the labourer.

The effect of the extreme subdivision of labour in manufacturing establishments, and the exclusive attention it requires the workman to bestow on one operation, has been supposed to exert a most pernicious influence over his mental faculties. The genius of the master is said to be cultivated, but that of the workman to be condemned to perpetual neglect. Most mechanical arts, we are told, succeed best under a total suppression of sentiment and reason. A habit of moving the hand or the foot is said to be independent of either; and the workshop has been compared to an engine, the parts of which are men! (Ferguson *on Civil Society*, p. 303.) Smith, who has given so admirable an exposition of the benefits resulting from the division of labour, has notwithstanding concurred with the popular prejudices on this subject; and has gone so far as to affirm that constant application to a particular occupation in a large manufactory, " necessarily renders the workman as *stupid and ignorant as it is possible to make a human being.*" Nothing can be more marvellously incorrect than these representations. Instead of its being true that the workmen employed in manufacturing establishments are less intelligent and acute than those employed in agriculture, the fact is distinctly and completely the reverse. The weavers and other mechanics of Glasgow, Manchester, and Birmingham, possess infinitely more general and extensive information than is possessed by the agricultural labourers of any county of the empire. And this is really what a more unprejudiced inquiry into the subject would have led to anticipate. The variety of occupations in which the husbandman has successively to engage, their constant liability to be affected by so variable a power as the weather, and the perpetual change in the appearance of the objects which meet his eyes, and with which he is conversant, occupy his attention, and render him a stranger to that ennui and desire for extrinsic and adventitious excitement which must ever be felt by those who are constantly engaged in burnishing the point of a pin, and in performing the same endless routine of precisely similar operations. This want of excitement cannot, however, be so cheaply or effectually gratified in any other way as it may be by cultivating, that is, by stimulating, the mental powers. The generality of workmen have no time for dissipation; and if they had, the wages of labour in all old-settled and densely-peopled countries are too low, and the propensity to save and ac-

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[1] For an examination of Smith's opinion with respect to the advantages of different species of commerce, see Ricardo's Principles of Political Economy and Taxation, 1st ed. p. 497; and the Edinburgh Review for July 1819, p. 71.

Different Employments of Capital and Industry.

Eulogium of Mr Malthus on manufactures.

cumulate too powerful, to permit any very large portion of them seeking to divert themselves by indulging in riot and excess. They are thus driven to seek for recreation in mental excitement; and the circumstances in which they are placed afford every possible facility for their amusing and diverting themselves in this manner. By working together, they have constant opportunities of entering into conversation; and a small contribution from each enables them to obtain a large supply of newspapers and of the cheaper class of periodical publications. But whatever difference of opinion may exist respecting the cause, there can be no doubt of the fact, that the workmen employed in manufactures have become more intelligent according as their numbers have increased, and as their employments have been more and more subdivided. We do not believe that they ever were less intelligent than the agriculturists; but, whatever may have been the case formerly, none will now venture to affirm that they are inferior to them in intellectual acquirements, or that they are mere machines without sentiment or reason. Mr Malthus, whose leanings were all on the side of agriculture, has justly observed, that "Most of the effects of manufactures and commerce on the general state of society are in the highest degree beneficial. They infuse fresh life and activity into all classes of the state, afford opportunity for the inferior orders to rise by personal merit and exertion, and stimulate the higher orders to depend for distinction upon other grounds than mere rank and riches. They excite invention; encourage science and the useful arts; spread intelligence and spirit; inspire a taste for conveniencies and comforts among the labouring classes; and, above all, give a new and happier structure to society, by increasing the proportion of the *middle classes*,—that body on which the liberty, public spirit, and good government of every country must mainly depend. (*Observations on the Effects of the Corn Laws*, p. 29.)

Rate of profit true test of the advantage of different employments.

Thus then we arrive, by a different route, at the same result we have already endeavoured to establish. The inextinguishable passion for gain—the *auri sacra fames*—will always lead capitalists to employ their stocks in those branches of industry which yield, all things considered, the highest rate of profit. And it is clear to demonstration, that employments yielding the highest profits are those in which it is most for the public interest that capital should be invested. The profits of a particular branch of industry are rarely raised except by an increased demand for its produce. Should the demand for cottons increase, there would be a greater competition for them; and as their price would, in consequence, be augmented, the manufacturers would obtain comparatively high profits. But the rate of profit in different employments has a natural tendency to equality; and it can never, when monopolies do not interpose, continue either permanently higher or lower in one than in the rest. As soon, therefore, as the rise in the price of cottons had taken place, additional capital would begin to be employed in their production. The manufacturers engaged in the cotton trade would endeavour to borrow additional capital, and the capitalists engaged in less lucrative employments would gradually contract their businesses, and transfer a portion of their stock to where it would yield them a larger return. The equilibrium of profit would thus be again restored. For the additional capital employed in the production of cottons, by proportioning their supply to the increased demand, would infallibly reduce their price to its proper level. Such is the mode in which the interests of individuals are, in every case, rendered subservient to those of the public. High profits attract capital; but high profits in particular businesses are the effect of high prices; and these are always reduced, and the commodities brought within the command of a greater number of purchasers, as soon as additional capital has been employed in their production. It is clear, therefore, that that employment is the best which yields the greatest profit; and hence, if two capitals yield equal profits, it is a proof that the departments of industry in which they are respectively invested, how much soever they may differ in many respects, are equally beneficial. Nothing can be more nugatory than to apprehend that the utmost freedom of industry should attract capital to a comparatively disadvantageous employment. If capital flow to manufactures or commerce rather than to agriculture, it is only because it has been found to yield larger profits to the individual, and consequently to the state.

Different Employments of Capital and Industry.

PART III.

DISTRIBUTION OF WEALTH.

Having thus endeavoured to trace the various methods by which that labour which is the only source of wealth may be rendered most productive, and to exhibit the relation and dependence of the different kinds of industry, we proceed to the second division of our subject, or to an investigation of the laws regulating the proportions in which the various products of art and industry are distributed among the different classes of the people.

SECT. I.—*Primary Division of the Produce of Industry.—Value of Commodities measured in the Earliest Stages of Society by the Quantities of Labour expended in their Production.*

Primary division of the produce of industry.

It is evident that only three classes—labourers, capitalists, and proprietors of land, are ever directly concerned in the production of commodities. It is to them, therefore, that all that is derived from the surface of the earth, or from its bowels, by the united application of immediate labour and of capital, must primarily belong. The other classes of society have no revenue except what they derive, either voluntarily or by compulsion, from these three classes.

But although there be no state of society in which any class besides labourers, landlords, and capitalists, participates directly in the produce of industry, there are states of society in which that produce belongs exclusively to one only of these classes; and others in which it belongs to two of them, to the exclusion of the third. The reason is, that, in the earliest stages of society, there is little or no capital accumulated, and the distinction between labourers and capitalists is, in consequence, unknown; and that, in all newly-settled and unappropriated countries, abundance of fertile land may be obtained without paying any rent.

Quantity of labour the regulating principle of value.

In that remote period which preceded the establishment of a right of property in land, and the accumulation of capital or stock—when men roamed, without any settled habitations, over the surface of the earth, and existed by means of the labour required to appropriate its spontaneous productions—the whole produce of labour would belong to the labourer, and the quantity of labour expended in procuring different articles would plainly form the only standard by which their relative worth or exchangeable value could be estimated. "If among a nation of hunters," says Dr Smith, "it usually costs twice the labour to kill a beaver that it does to kill a deer, one beaver would naturally exchange for or be worth two deer. It is natural, that what is usually the produce of two days' or two hours' labour, should be worth double of what is usually the produce of one day's or one hour's labour.

"If the one species of labour should be more severe than the other, some allowance will naturally be made for this superior hardship; and the produce of one hour's labour in

Primary Division of the Produce of Industry.

the one way, frequently exchanges for that of two hours' labour in the other.

"Or if the one species of labour requires an uncommon degree of dexterity and ingenuity, the esteem which men have for such talents will naturally give a value to their produce, superior to what would be due to the time employed about it. Such talents can seldom be acquired but in consequence of long application, and the superior value of their produce may frequently be no more than a reasonable compensation for the time and labour which must be spent in acquiring them. In the advanced state of society, allowances of this kind, for superior hardship and superior skill, are commonly made in the wages of labour; and something of the same kind must probably have taken place in the earliest and rudest period.

"In this state of things, the whole produce of labour belongs to the labourer; and the quantity of labour commonly employed in acquiring or producing any commodity, is the only circumstance which can regulate the quantity of labour (of other commodities) which it commonly ought to purchase, command, or exchange for." (*Wealth of Nations*, p. 22.)

Thus far there is no room for doubt or difference of opinion. When there are none but labourers, all the produce of labour must obviously belong to them; and the quantity of labour required to produce commodities forms the only standard by which their exchangeable worth or value can be estimated. It is at this point, therefore, that we are to begin the investigation of the laws regulating the division of the produce of industry among the three great classes of labourers, capitalists, and landlords; and we shall do this by endeavouring, in the first place, to acquire a knowledge of the laws which regulate the exchangeable value of commodities in an advanced period of society, when circulating and fixed capital are employed in their production, and when land is appropriated and rent paid. A previous acquaintance with the circumstances which determine the value of commodities will be found to be indispensable to enable us to ascertain the principles which regulate their distribution.

SECT. II.—*Preliminary Considerations.—Equality of Wages and Profits.—Inquiry into the Effect of Variations of Demand and Supply on Price.—Cost of Production shown to be its regulating Principle.*

Preliminary considerations.

If the popular opinions on this subject were well founded, the inquiry on which we are now about to enter might be disposed of in a very few words. The exchangeable value of commodities, when compared with each other, and their value or price when compared with money, is held almost universally to depend on their abundance or scarcity in the market, compared with the demand. We believe, however, that this opinion rests on no good foundation, and that the cost of production is the grand regulating principle of price. But before proceeding further, it may be proper, the better to facilitate our investigations in this and the following sections, to premise, that wherever industry is free, the rate of wages earned by the labourers engaged in any particular department, and the rate of profit derived from the capital vested in it, cannot, for any considerable period, either fall below, or rise above, the rates of wages and profits accruing to the labourers and capitalists engaged in other departments.

Equality of the wages earned by the labourers engaged in different branches of industry.

With regard to the *first* of these positions, or to the equality of the wages earned by those engaged in different employments, it is not meant to infer that all labourers receive precisely the same sum of money, or the same proportion of the produce of their labour. Such an opinion would be equally at variance with fact and with principle. Wages are a compensation made to the labourer for the exertion of his physical powers, or of his skill or ingenuity. They must, therefore, vary according to the greater intensity of the labour to be performed, and to the degree of skill and ingenuity required. Wages would not be equal if a jeweller or engraver, for example, received no higher rate than a common farm-servant or scavenger. A long course of training is required to instruct a man in the businesses of jewellery and engraving; and if this were not compensated by a higher rate of wages, none would choose to learn so difficult an art, and all persons would addict themselves, in preference, to such employments as hardly require any training. The cost of producing artificers or labourers regulates the wages they obtain, in the same way that the cost of producing commodities regulates their value. A man who practises a difficult or nice business loses all the time spent in his apprenticeship, and generally all the clothes and provisions he consumes during the same period. He should, therefore, besides receiving the same rate of wages as husbandry labourers, and those who do not require to serve an apprenticeship, receive an additional rate, proportional to the extra time and expense spent in learning his business. If he did not obtain this additional rate, it is plain he would not be so well paid as the husbandry labourers; and if he obtained more than a fair and reasonable compensation for the greater expense to which he had been put, there would be an influx of labourers into that particular business, and competition would not fail to reduce wages to their proper level.

Equality of Wages and Profits.

Besides this prominent cause of apparent inequality, wages vary in amount proportionally to the ease and hardship, the agreeableness and disagreeableness, the constancy and inconstancy, of employment. In the greater part of manufactures, a journeyman may, except in periods of general distress, usually obtain constant employment. But there are several businesses, such, for example, as those of masons and bricklayers, that can neither be carried on in hard frost nor foul weather. Their earnings should, therefore, be able not only to maintain them while they are employed, but also while they are idle, and to make them some compensation for those anxious and desponding moments which the thought of so precarious a situation must sometimes occasion. Hence, says Dr Smith, "where the computed earnings of the greater part of manufacturers are nearly upon a level with the day-wages of common labourers, those of masons and bricklayers are generally from a half more to double those wages. Where common labourers earn four and five shillings a week, masons and bricklayers frequently earn seven and eight; and where the former earn nine or ten, as in London, the latter commonly earn fifteen and eighteen." (*Wealth of Nations*, p. 47.)

But these variations, instead of being inconsistent with the principle we have been endeavouring to establish, plainly result from it. Wages are equal, not when each workman earns the same number of shillings or of pence in a given space of time; but when each is paid in proportion to the severity of the labour he has to perform, to the degree of previous education and of skill that it requires, and to the other causes of variation. So long, indeed, as the principle of competition is allowed to operate without restraint, or while every one may employ himself as he pleases, the higgling of the market will always adjust the rate of wages in different employments on the principle now mentioned, and it will, taking everything into account, be very nearly equal. If the rate of wages in one department were depressed below the common level, labourers would leave it to go to others; and were it to rise above this common level, labourers would be attracted from those departments where wages were lower, until the increased supply had sunk them to their just level. A period of greater or less duration, according to the circumstances of the country at the time, is always required to bring about this equalization. But all theoretical inquiries, and such as have the establishment of principles for their

Equality of Wages and Profits.

object, either are, or should be, founded on periods of average duration; and whenever such is the case, we may always, without occasioning the slightest error, assume that the wages earned in different employments are, all things considered, about equal.

Equality of the profits of the capital employed in different businesses.

In like manner, the profit accruing to the capitalists engaged in different businesses varies proportionally to the greater or less risk, and other circumstances specially affecting the capital they employ in them. It is obvious, indeed, that profits have not attained their level until they have been adjusted so as to balance these different advantages and disadvantages. None would engage in unusually hazardous undertakings, did the capital employed in them only yield the same profit that might be obtained by employing it in more secure businesses. No one will voluntarily place his fortune in a situation of comparative danger. Extraordinary risk must be compensated. And hence the well-known distinction between *gross* and *nett* profit. Gross profit varies according to the risk, respectability, and agreeableness of different employments, whereas nett profit is at any particular period the same, or very nearly the same, in them all. A gunpowder manufacturer, for example, must obtain as much profit, over and above that obtained from the capital engaged in the securest businesses, as will suffice to guarantee or *insure* his capital from the extraordinary risk to which it is exposed in a business of such extreme hazard. Were he to obtain *more* than this rate, additional capital would be attracted to his business, and were he to obtain *less*, capital would be withdrawn from it. The constantly-acting principle of competition, or, which is the same thing, the self-interest of every individual, will not permit the wages or profits of any particular set of workmen or capitalists, taking all things into account, to continue either long below or long above the common and average rate of wages and profits obtained by those who are employed, or have capital vested in other businesses. It is by this common standard that the wages and profits of particular businesses are always regulated; they can never diverge considerably from it; they have a constant tendency to equalization; and may, in theoretical inquiries, be supposed, without occasioning any error of consequence, exactly to coincide.

The equality, or rather the constant tendency to equality, of the wages earned by the labourers, and of the profits derived from the capital employed at the same time in the various branches of industry, was pointed out by Mr Harris, and also by Mr Cantillon in his work entitled The Analysis of Trade, &c. published in 1759; but it was first fully demonstrated in the eighth, ninth, and tenth chapters of the first book of the Wealth of Nations. The establishment of this principle was one of the greatest services rendered by Dr Smith to the science. Nothing can be more convincing and satisfactory than his reasoning on this subject. The equality of wages and of profits has, since the publication of his work, been always assumed as admitted and incontestible.

Variations of demand and supply exert no permanent influence on price.

The equality of wages and profits once established, it is easy to see that variations in the demand and supply of commodities can exert no lasting influence over price. The cost of production, denominated by Smith and the Marquis Garnier necessary or natural price, is the ultimate regulator of the value of every commodity not subject to a monopoly, and which may be indefinitely increased in quantity by the application of fresh capital and labour to its production. That the market price of such commodities and their cost do not always coincide, is certain; but they cannot, for any considerable period, be far separated, and have a constant tendency to equality. It is plain that no man will continue to produce commodities if they sell for *less* than the cost of their production; that is, for less than will repay the outlay upon them, including the ordinary rate of profit on the capital employed. This is a limit below which it is obvious prices cannot be permanently reduced; and it is equally obvious that were they, for any considerable period, to rise above it, additional capital would be attracted to the advantageous business, and the competition of the producers would lower prices.

Equality of Wages and Profits.

The will and the power to purchase necessary to constitute demand.

A demand, to be effectual, must be such as will cover the expense of production. If it be insufficient to do this, it cannot make commodities be produced and brought to market. A real demander must have the *power*, as well as the *will*, to purchase. A person with a sovereign in his pocket may be as anxious—nay, he may be ten times more anxious—to become the purchaser of a coach than of a hat; why then does he not obtain the one as readily in exchange for his sovereign as the other? The reason is obvious; a sovereign will pay the expense of producing the one, but it will not pay the expense of producing the other. Were such an improvement made in the art of coachmaking as should enable coaches to be manufactured as cheaply as hats, then a sovereign would buy a coach as easily as it can now buy a hat. The demand for any particular commodity may become ten or twenty times more extensive, or it may decline in the same proportion; but if the cost of its production continue the same, no permanent variation will be occasioned in its price. Suppose, for example, that the demand for hats were suddenly doubled: that circumstance would undoubtedly occasion a rise of price, and the hatters would, in consequence, make large profits; but this rise would only be of very limited duration; for the large profits would immediately attract additional capital to the hat manufacture; an increased supply of hats would be brought to market, and if no variation took place in the cost of production, their price would infallibly sink to its former level. Suppose, on the other hand, that the demand for hats is increased tenfold, and that the cost of their production is diminished in the same proportion: we should, notwithstanding the increased demand, be able, in a very short time, to buy a hat for the tenth part of what it now costs. Again, suppose the demand for hats to decline, and the cost of producing them to increase, the price would, notwithstanding the diminished demand, gradually rise, till it had reached the point at which it would yield the hatters the common and average rate of profit on the capital employed in their business. It is admitted that variations of demand and supply occasion temporary variations of price. But it is essential to remark, that these variations are only temporary. The cost of production is the grand regulator of price—the centre of all those transitory and evanescent oscillations on the one side and the other; and wherever industry is free, the competition of the producers will always elevate or sink prices to this level.

Cost of production the regulating principle of price.

In certain branches of industry, such, for example, as agriculture, which are liable to be seriously affected by variations of the seasons, and from which capital cannot be easily withdrawn, there is a somewhat longer interval than in others before the market price of produce and the cost of its production can be equalized. But that such an equalization will be brought about in the end is certain. No farmer, and no producer whatever, will continue to bring corn or other products to market, unless they sell for such a price as will pay the expense of their production, including therein the common and average rate of profit on the capital employed.[1] An excess of supply occasionally de-st of uction egulat- Princi- f Price.

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[1] Some of the advocates of the agricultural interest have represented this as one of the "dangerous dogmas" of the Scotch Economists! But it can boast of a much more remote origin:—"*Nemo enim sanus*," says Varro, "*debet velle impensam ac sumptum facere in culturam, si videt non posse refici.*" (*De Re Rustica*, lib. i. § 2.)

presses the prices of corn and other farm produce below this level; and the occupiers of land are, in consequence, involved in the greatest difficulties; but such gluts do not continue. The cultivators of the worst soils are driven from their employment; a smaller supply is, in consequence, brought to market; and prices are adjusted so as to yield the customary rate of profit, and no more, to the agriculturists who continue the cultivation of the poorest soils. The interest of the cultivators will not permit prices to be permanently depressed below this level; and the interest of the public will not permit them to be permanently raised above it; for, if they were raised above it, the cultivators would gain more than the common and average rate of profit, and capital would, of course, be immediately attracted to agriculture, and would continue flowing in that direction, until the natural equilibrium of profit had been restored—that is, as will be afterwards seen, until the price of agricultural produce had fallen to such a sum as would yield the average rate of profit to the cultivators of the worst soils, or the improvers of the best. This is the point at which *average* prices continue stationary, or about which market prices oscillate, until the cost of production increase or diminish. Were any great discovery made in agriculture—such a one, for instance, as would reduce the cost of cultivation a half, the price of agricultural produce would speedily fall in the same proportion, and it would continue to sell at that reduced rate until the increase of population forced recourse to soils of a decreasing degree of fertility. Whenever this took place, prices would again rise, unless the influence of the decreasing fertility were countervailed by some new improvement. Why is the price of corn almost invariably higher in England than in France? Is it because we have a greater demand for it, or because of the greater cost of production in this country?

son y gold more uable n silver.

A pound-weight of gold is at present worth about *fifteen* pounds of silver. It cannot, however, be said that this is a consequence of the demand for gold being greater than that for silver, the reverse being the fact. Neither can it be said to be a consequence of an absolute scarcity of gold; for, those who choose to pay a sufficient price for it may obtain it in any quantity they please. The cause of this difference in the price of the two metals consists entirely in the circumstance of its costing about *fifteen* times as much to produce a pound of gold as to produce a pound of silver. That this is really the case, is plain from the admitted fact, that the producers of gold do not gain any greater profit than the producers of silver, iron, lead, or any other metal. They have no monopoly of the business. Every one may send capital to America, and become a producer of gold; and wherever this is the case, the principle of competition will always force the product to be sold at such a price as will pay the expenses of its production, and no more. Were a gold-mine discovered of equal productiveness with the silver-mines, the production of gold would immediately become the most advantageous of all businesses; an immense supply of that metal would, in consequence, be thrown upon the market, and its price would, in no very lengthened period, be reduced to the same level as silver.

son cot- s have lined in ce.

In further illustration of this principle, take the case of cottons. None can deny that the demand for them has been prodigiously augmented within the last fifty or sixty years; and yet their price, instead of increasing, as it should have done had the popular theory of demand and supply been well founded, has been constantly and rapidly diminishing. If it be said that this is a consequence of the supply of cottons having augmented in a still greater ratio than the demand, we answer that this is not enough to explain the fall of price. The supply could not have been brought to market, had not the diminution of prices, which has been constantly going on since the invention of spinning-jennies in 1767, been balanced by an equal diminution of the cost of production. It is to this principle—to the vastly increased facility of production, occasioned by the stupendous inventions and discoveries of Hargreaves, Watt, Arkwright, Crompton, and others—that the lower price and increased demand for cottons is exclusively owing. The increased facility of production has brought them within reach of all classes; and enabled the poorest individuals to clothe themselves in a dress which, at the accession of George III., was fully as expensive as silk.

Cost of Production the regulating Principle of Price.

Competition of the producers in a civilized society will always sink prices to the cost of production.

If a set of men were brought together from various countries, ignorant of each other's wants, and of the labour and expense necessary to produce the commodities which each possesses, these would be bought and sold according to the wants and fancies of the parties. In such circumstances, a pound of gold might be given for a pound of iron, and a gallon of wine for a gallon of small beer. As soon, however, as a commercial intercourse is established, and as the wants of society and the powers of production come to be well and generally known, an end is put to this method of bartering. Thousands of sellers then enter the market. But when such is the case, it is no longer possible to sell a pound of gold for a pound of iron; and why? because the producers of iron will undersell each other until they have, by their competition, reduced its price to such a sum as will suffice to pay the expense of its production. This is in every civilized society the pivot on which exchangeable value always turns. A civilized man may obtain articles from a savage, in exchange for toys or trinkets, which it cost infinitely less to produce; but if he try to obtain the same advantage over his own countrymen, a very short experience will satisfy him that they are quite as clear-sighted and attentive to their own interests as he is.

Thus, then, it appears, that no variation of demand, unaccompanied by a variation in the cost of production, has any lasting influence over price. If the cost of production be diminished, price will equally decline, though the demand should be increased to any conceivable extent. If the cost of production be increased, price will equally rise, though the demand should sink to the lowest possible limit.

Influence of monopolies.

It must always be remembered, that this reasoning applies only to those commodities on which competition is allowed to operate without restraint, and whose quantity may be indefinitely increased by the application of fresh capital and industry to their production. When a particular individual, or class of individuals, obtains the exclusive privilege of manufacturing certain species of goods, the principle of competition is suspended with respect to them, and their price must, therefore, entirely depend on the proportion in which they are brought to market compared with the demand. If monopolists supplied the market liberally, or kept it always as fully stocked as it would be were there no monopoly, the commodities produced by them would sell at their natural price, and the monopoly would have no further disadvantage than the exclusion of the public from an employment which every one should have power to carry on. In point of fact, however, the market is never fully supplied with commodities produced under a monopoly. All classes of producers endeavour to obtain the highest possible price for their commodities; and when they are protected by a monopoly, against being undersold by others, they either keep the market understocked, or supply it with inferior articles, or both. Under such circumstances, the price of the commodity, if it cannot be easily smuggled from abroad, or clandestinely produced at home, will be elevated to the highest point to which the competition of the buyers can raise it, and may, in consequence, be sold for five, ten, or twenty times the sum it would fetch were competition permitted to operate in its production. The *will* and *power* of the purchasers to offer a high price forms the only limit to the rapacity of monopolists.

Cost of Production the regulating Principle of Price.

Besides the articles produced under artificial monopolies, there is another class whose quantity cannot be increased by human industry, and whose price is not, therefore, dependent on the cost of production. Ancient statues, vases, and gems, the pictures of the great masters, some species of wines produced in limited quantities only from soils of a particular quality and exposure, and a few other articles, come under this description. As their supply cannot be increased, their price varies inversely as the demand, and is totally unaffected by anything else.

Average price always coincident with cost of production.

But with these exceptions, which, when compared to the great mass of commodities, are but few and unimportant, wherever industry is unfettered and competition allowed to operate, the *average* price of the various products of art and industry always coincides with the cost of their production. Should a fall take place in the market price of any commodity, it cannot be said whether it is really advantageous, or whether a part of the wealth of the producers be not gratuitously transferred to the consumers, until it be learned whether the cost of production has been equally diminished. If this be the case, the fall of price will not be disadvantageous to the producers, and will be permanent; but if this be not the case—if the cost of production continue the same—the fall must be injurious to the producers, and prices will, in consequence, again attain their former level. It is the same with a rise of prices. No rise can be permanent unless the cost of production be proportionally increased. If that cost have remained stationary, or have not increased in a corresponding ratio, prices will decline as soon as the ephemeral causes of enhancement have disappeared.

The extreme importance of having correct opinions respecting the regulating principle of price, and the discordant and erroneous opinions so very prevalent with regard to it, will, we hope, be deemed a sufficient apology for the length of the previous remarks, and for the insertion of the following paragraph from the *Histoire de la Monnaie* of the Marquis Garnier, in which the doctrine we have been endeavouring to establish is enforced with equal ability and eloquence.

Opinion of the Marquis Garnier.

"Mais les producteurs tendent continuellement à régler la quantité des productions sur la somme des demandes; ils ne resteront pas au-dessous de ce point, sans être tentés d'accroître la masse de leurs produits; et ils ne peuvent le dépasser sans s'exposer à perdre. Ces deux quantités, celle des produits et celle des demandes, s'efforcent donc à se mettre en équilibre l'une avec l'autre. Il existe donc un point de repos vers lequel elles gravitent chacune de son côté; un point qui est leur niveau, et c'est ce point qui constitue le *prix naturel* de la chose vénale. Quelle est la limite au-délà de laquelle le producteur ne peut porter la quantité de ses produits? C'est le prix naturel; car, s'il ne peut obtenir ce prix pour tout son produit, il sera en perte. Quelle est la borne des demandes du consommateur? C'est le prix naturel; car il ne veut pas donner plus que l'équivalent de ce qu'il reçoit. Si, par une découverte, ou par un perfectionnement de l'industrie, le producteur est mis à même d'établir l'article sur lequel il s'exerce à moins de temps et de dépense, alors le prix naturel baissera, mais aussi la somme des demandes accroîtra dans une proportion pareille, parce que plus de consommateurs seront en état de payer ce prix naturel, moins élevé que l'ancien. Le prix naturel sera toujours, pour chaque chose vénale, la limite commune au-délà de laquelle la somme des demandes de cette chose et la quantité de sa production ne devront plus faire de progrès. Quand le prix courant est le prix naturel, le producteur et le consommateur se donnent réciproquement l'équivalent de ce qu'ils reçoivent. Quand le prix courant s'écarte du prix naturel, ou c'est la consommation qui souffre au profit de la production, ou c'est la production qui souffre au profit de la consommation. Cet état de souffrance ne peut durer, et de-là procèdent les variations du prix courant. Ces variations, que Smith a expliquées et analysées avec une si parfaite lucidité, ne sont autre chose que les efforts pour revenir au prix naturel. Tenter d'expliquer ces variations, sans reconnaître l'existence d'un prix naturel, ce serait vouloir expliquer les oscillations du pendule sans convenir de sa tendance vers un centre de gravitation; ce serait supposer un effort sans but et sans mobile; ce serait admettre le mouvement et nier le repos; enfin, en voyant les phénomènes du cours des fluides et de l'équilibre des solides, ce serait contester les lois du niveau et de la pesanteur. Si les choses vénales n'ont point de prix naturel, alors les mouvements de la circulation seront dirigés par une force aveugle et inconnue; les prix moyens ne seront plus que le résultat de chances purement fortuites; il n'y aura plus d'équivalent réel; les valeurs n'auront plus de mesure naturelle; l'économie politique ne pourra plus aspirer à être au rang des sciences, puisqu'elle manquera du caractère essentiel qui les constitue telles, et que les faits dont elle traite ne seront plus fondés sur les lois immuables de la nature." (Tome i. *Introduction*, p. 62.)

Cost of Productio the regula ing Princi ple of Pric

Having thus shown that the *cost of production* is the regulating principle of price, we shall now proceed to investigate the elements which enter into and constitute this cost in an advanced state of society, when rent is paid for land, and circulating and fixed capital employed to facilitate the labour of the workman. This is, of all others, the most important, as it is the most radical inquiry in the science of the distribution of wealth; and it is indeed impossible, without possessing accurate notions on this subject, to advance a single step without falling into errors. We shall begin by endeavouring to ascertain whether rent enters into the cost of production.

SECT. III.—*Nature, Origin, and Progress of Rent.—Not a Cause, but a Consequence, of the High Value of Raw Produce.—Does not enter into Price.—Distinction between Agriculture and Manufactures.*[1]

Definition of rent.

Rent is properly "that portion of the produce of the earth which is paid by the occupier to the landlord for the use of the *natural and inherent* powers of the soil." If buildings have been erected on a farm, or if it have been enclosed, drained, or in any way improved, by an expenditure of capital and labour, the sum which a farmer will pay to the landlord for its use will be composed, not only of what is properly rent, but also of a remuneration for the use of the capital laid out on its improvement. In common language these two sums are always confounded, under the name of rent; but in an inquiry of this nature, it is necessary to consider them as perfectly distinct. The laws by which rent and profits are regulated being totally different, those which govern the one cannot be ascertained if it be not considered separately from the other.

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[1] The theory of rent explained in this chapter was first promulgated and satisfactorily established in a tract on the Corn Laws, Edinburgh, 1777 (see p. 45–47). The author of this original and most important theory, Dr James Anderson, was a native of Hermandston in Mid-Lothian, and subsequently editor of the Bee and other publications; in one of which (Observations on Agriculture and Natural History, &c. v. pp. 401–405), he gave a new exposition of his theory. But notwithstanding the clear and able manner in which he explained his doctrines, and their ingenuity and importance, they do not appear to have attracted the least attention, and seem to have been completely forgotten. So much so was the case, that when Mr Malthus[*] and Sir Edward West[†] published tracts in 1815, explaining the nature and origin of rent, they were universally believed to be the authors of the theory. There is, we believe, no doubt as to their originality. Still, however, they were merely expositors of what had been clearly and ably explained about forty years previously to the publication of their pamphlets.

[*] An Inquiry into the Nature and Progress of Rent.

[†] Essay on the Application of Capital to Land, by a Fellow of University College, Oxford (Sir E. West).

rent on the set- g of any ntry.

On the first settling of any country abounding in large tracts of unappropriated land, no rent is ever paid; and for the obvious reason, that no person will pay rent for what may be procured in unlimited quantities for nothing. Thus, in New Holland, where there is an ample supply of unappropriated land, it is certain, that, until the best lands are cultivated, no such thing as rent will ever be heard of. Suppose, however, that tillage has been carried to this point, and that the increasing demand can, in the actual state of the science of agriculture, be no longer supplied by the best lands; it is plain, in this case, that either the increase of population must cease, or the inhabitants consent to pay such an additional price for raw produce as will enable the *second* quality of land to be cultivated. No advance short of this will procure them another bushel of corn; and competition will not, as will be immediately seen, allow them to pay more for it. They have, therefore, but one alternative. If they choose to pay a price sufficient to cover the expense of cultivating land of the second quality, they will obtain additional supplies; if they do not, they must want them. Suppose, now, that the consumers offer such a price as will pay the expense of producing corn on soils which, in return for the same expenditure as would have produced 100 quarters on lands of the *first quality*, will only yield 90 quarters; it is plain it will then be indifferent to a farmer whether he pay a rent of ten quarters for the first quality of land, or farms the second quality, which is unappropriated and open to him, without paying any rent. If the population went on increasing, lands which would yield only 80, 70, 60, 50, &c. quarters in return for the same expenditure that had obtained 100 quarters from the best lands, might be successively brought under cultivation. And when recourse had been had to these inferior lands, the rent of the higher qualities would plainly be equal to the difference, or the value of the difference, between their produce and the produce of the worst quality under cultivation. Suppose, for example, that the worst quality under cultivation yields 60 quarters, then the rent of the *first* quality will be 40 quarters, or 100 — 60; the rent of the *second* quality would, in like manner, be equal to the difference between 90 and 60, or 30 quarters; the rent of the third quality would be equal to 80 — 60, or 20 quarters, and so on. But it is material to remark, that the produce raised on the land last cultivated, or with the capital last applied to the soil, is always sold at its *necessary price*, or at that price which is just sufficient to yield the cultivators the common and average rate of profit, or, which is the same thing, to cover the cost of its production. If the price were above this level, then agriculture would be the best of all businesses, and tillage would be immediately extended; while, on the other hand, if the price fell below this level, capital would be withdrawn from the soil, and the poorer lands thrown out of cultivation. Under such circumstances, it is clear that no rent would enter into the price of the produce raised by means of the capital last applied to the soil. Its price is exclusively made up of wages and profits. The proprietors of the superior lands obtain rent; but this is the necessary result of their greater fertility. The demand cannot be supplied without cultivating inferior soils; and, to enable them to be cultivated, their produce must fetch such a price as will afford the ordinary rate of profit to their cultivators. This price will, however, yield a surplus over and above the ordinary rate of profit to the cultivators of the more fertile lands, and *this surplus is rent.*

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An increase of rent is not, therefore, as is very generally supposed, occasioned by improvements in agriculture, or by an increase in the fertility of the soil. It results from the necessity of resorting, as population increases, to soils of a *decreasing* degree of fertility, and from the inability to apply capital indefinitely to the best land, without a diminished return. Rent varies in an inverse proportion to the amount of produce obtained by means of the capital and labour employed in cultivation; that is, it increases when the profits of agricultural labour diminish, and diminishes when they increase. Profits are at their maximum in countries like New Holland, Indiana, and Illinois, and generally in all situations in which no rent is paid, and the best lands only cultivated; but it cannot be said that rents have attained their maximum so long as capital yields any surplus in the shape of profit.

A quarter of wheat may be raised in the Vale of Gloucester, or the Carse of Gowrie, at perhaps a *fourth* or a *fifth* part of the expense necessary to raise it on the worst soils in cultivation. There cannot, however, be at the same time two or more prices for the same article in the same market. And it is plain, that unless the average market price of wheat be such as will indemnify the producers of the portion of the crop raised on the worst soils, they will cease bringing it to market, and the required supplies will no longer be obtained; and it is equally plain, that if the market price of wheat exceed this sum, fresh capital will be applied to its production, and competition will soon sink prices to their natural level—that is, to such a sum as will afford the common and ordinary rate of profit to the raisers of that portion of the required supply which is produced in the most unfavourable circumstances, and with the greatest expense. The cost of producing this portion will always determine the average price of all the rest. And therefore it is plainly indifferent to the consumers whether, in an advanced stage of society, the excess of return over the cost of production on lands of the first quality belong to a non-resident landlord or an occupier. It must belong to the one or the other. Corn is not high because a rent is paid, but a rent is paid because corn is high—because the demand is such that it cannot be supplied without cultivating soils of a diminished degree of fertility, as compared with the best. Suppose there is an effectual demand for ten millions of quarters, and that *one* million of them must be raised on lands which yield nothing but the common and average rate of profit to their cultivators; it is clear that the relinquishing of the rents payable by the superior lands would be no boon to the cultivators of the inferior lands. It would not lessen their expenses; that is, it would not lessen the amount of capital and labour necessary to produce the portion of the required supply raised under the most unfavourable circumstances; and, unless it reduced this expense, it is quite impossible, supposing the demand not to decline, that it should lower prices. Although, therefore, landlords were to give up the whole of their rents, their doing so would have no influence upon the price of corn. Such an act would turn farmers into landlords, and landlords into beggars; but there its effect would stop. But the case is altogether different when the cost of production varies. If it be diminished, the competition of the producers will infallibly sink prices in an equal proportion. If it be increased, no supplies will be brought to market, unless the price rise to a corresponding level. In no case, therefore, whether the demand be great or small—whether for one or a million quarters—can the price of raw produce permanently exceed or fall below the sum required to pay the cost of producing that portion of the necessary supply that is raised on the worst land, or with the last capital laid out on the soil.

Objections to this theory.

Two objections have been made to this theory. In the *first* place, it has been said that, though it may hold in a country like New Holland, where land is not appropriated, yet that the worst land in every civilized and appropriated country, like England, always yields some small rent to the proprietor; and that, therefore, it cannot be said that the price of produce is, in such countries, determined by the cost of raising it on that quality of land which pays no rent.

It has been justly observed of this objection, that even were it well founded, it would not practically affect any of the conclusions we have endeavoured to establish. There are in England and Scotland thousands upon thousands of acres of land which do not let for L.100; but to cultivate them would require an outlay of many millions, and the rent would consequently bear so small a proportion to the expenses of production, as to become altogether evanescent and inappreciable.

Land in every extensive country which yields no rent.

There can be no doubt, however, that there is in this, and most other extensive countries, a great deal of land which yields no rent. In the United States and Russia such is unquestionably the case; and yet no one presumes to say that the laws which regulate rent in these countries are different from those which regulate it in England and France. The poorest lands are always let in immense tracts. If it were attempted to let particular portions of these tracts separately, they would bring no rent; but they appear to yield rent, because rent is paid, not for them, but for the more fertile spots intermixed with them.

Payment of rent on all soils not inconsistent with the principle that rent does not enter into price.

But although it were really true that every rood of land in Britain paid a high rent, it would still be true that such rent did not, and could not, enter into the price of raw produce. The rent of a country consists of the difference, or the value of the difference, between the produce obtained from the capital first applied to the land, and that which is last applied to it. It would, as has been already seen, be exactly the same thing to the cultivator, whether he paid a rent of ten quarters for land yielding, with a certain outlay, a hundred quarters of corn, or employed the same capital in cultivating inferior land yielding only ninety quarters, for which he paid no rent. Were it possible always to obtain a hundred quarters for every equal additional capital applied to the superior soils, no person, it is obvious, would resort to those of inferior fertility. But the fact that, in the progress of society, new and less fertile land is always brought into cultivation, demonstrates that additional capital and labour cannot be indefinitely applied with the same advantage to the old land. The state of society in any particular country may be such, the demand for agricultural produce may be so great, that every quality of land actually yields rent; but it is indifferent, if there be any capital employed on land which yields only the return of stock with its ordinary profits, whether that capital be employed on old or new land. Now, that there is a very large amount of capital employed in such a manner in this and every other country, is abundantly certain. A farmer who rents a farm, besides employing on it as much capital as will, at the existing prices of raw produce, enable him to pay his rent, to obtain the average rate of profit, and to replace his stock previously to the expiration of his lease, will employ additional capital, if it will only replace itself, and afford the ordinary rate of profit. His employing this additional capital depends entirely on the price of raw produce being such as will repay his expenses and profits; for he knows he will have no additional rent to pay. Even at the expiration of his lease, his rent will not be raised; for if the landlord should require rent because an additional capital had been employed, he would withdraw it; since, by employing it in agriculture, he gets only the same profits he might get by employing it in any other department of industry. If the capital last applied to the soil yield *more* than the common and average rate of profit, fresh capital will be vested in agriculture, and competition will sink prices to a level that will enable them to yield this rate, and no more; if the capital last applied to the soil yield *less* than this common and average rate of profit, it will be withdrawn, until, by the rise of price, the last remaining capital yields this common rate. In every case, therefore, whether the last quality of land taken into cultivation yields rent or not, the last capital applied to the soil yields only the common and average rate of profit; and, consequently, the price of the produce which it yields, and which regulates the price of all the rest, is totally unaffected by rent.

Does not suppose that landlords will allow farmers to occupy their lands without paying rent.

It has, in the *second* place, been objected to this account of the nature and causes of rent, that it takes for granted, that, in all extensive countries, landlords permit the farmers of the worst lands to occupy them without paying any rent. But it is easy to see that this is a mistake. The price of raw produce is kept down to its necessary price by the competition of farmers, and not by that of landlords. Though there must necessarily be a very wide difference, in any country of considerable extent, between the best and worst soils, the gradation from the one extreme to the other is gradual, and almost imperceptible. The best differ but little from those immediately inferior to them, and the worst from those immediately above them. And hence it is quite as impossible to point out the precise point where the first quality ends and the second begins, or where the second ends and the third begins, as it is to point out the precise point where the contiguous colours of the rainbow differ. Now, suppose that the numbers 1, 2, 3, 4, 5, 6, 7, &c. designate the different qualities of soil in an extensive country, and suppose that the effectual demand for raw produce is such as will afford the common and average rate of profit to those who cultivate land of the *fifth* degree of fertility, or that represented by No. 5; when such is the case, there can be no doubt that No. 5 will be cultivated; for, besides the peculiar attractions which agriculture possesses, it would be quite as advantageous to cultivate it as to engage in any other business. It would not, however, be more advantageous; for its produce would yield no surplus in the shape of rent. But suppose that a combination took place among the proprietors of Nos. 1, 2, 3, 4, and 5, to withhold a portion of their produce from market; and that, in consequence of this or any other cause, the price of corn is raised a little above the expense of its production on No. 5; in that case it is obvious that soils of the *very next* degree of fertility, or that that portion of No. 6 which, in point of productive power, differs extremely little from No. 5, would be brought under cultivation; and the increased supply would infallibly sink prices to the level that would afford the average rate of profit, and no more, to the cultivators of No. 5, or of the poorest soils which the supply of the effectual demand renders it necessary to cultivate. It is quite the same, therefore, in so far as price is concerned, whether a country be appropriated or not. When it is appropriated, prices are kept down to their lowest limit by the competition of the landlords. And it is by the same principle—the cost of producing that portion of the necessary supply raised under the most unfavourable circumstances—that the price of raw produce is determined in England and France, and in New Holland and Illinois.

Does not account both for a rise and fall of price in the same way.

But then it is said that this reasoning involves a contradiction; that it accounts for a rise and a fall of price in the same way, or by an extension of cultivation! In point of fact, however, it does no such thing. The market price of corn will always be low where it is cheaply produced, as in Poland; and it will occasionally be low where it costs a great deal to produce it, when a redundant supply is brought to market. Suppose, as before, that the effectual demand for corn in Great Britain is such as will enable lands of the *fifth* degree of fertility to be cultivated; but that, owing to variable harvests, to injudicious encouragement held out by the legislature, the ardour of speculation, the miscalculation of farmers, or any other cause, lands of the *sixth* degree of fertility have been cultivated; the increased quantity of produce that must thus be thrown on the market will plainly depress prices to such an extent that, instead of yielding average profits to the cultivators of No. 6, they will not yield them to the cultivators of No. 5. But they will yield *more* to them than to the cultivators of No. 6. The latter, therefore, will be first driven from their business; and when they have retired, prices will rise, not indeed to such a height as to enable No. 6 to be cultivated, but so high as to enable the cultivators of No. 5 to continue their business; that is, as has been already shown, to such a sum as will enable the raisers of the last portion of the necessary supply to obtain the common and average rate of profit. Should the demand, instead of continuing stationary, increase so that it could not be supplied without cultivating Nos. 6 and 7, the price will rise in proportion to the increased expense of their cultivation. But to whatever extent the demand might increase, still, were such an improvement made in agriculture, or in the art of raising corn, as would enable the supply to be obtained from No. 1 only, the price would infallibly fall to the sum that paid the expenses of its cultivators, and rent would entirely disappear.

stinction ween riculture d manu- tures d com- rce.

This analysis of the nature and causes of rent discovers a fundamental distinction between agricultural and commercial and manufacturing industry. In manufactures, the worst machinery is first set in motion, and its powers are progressively improved by new inventions; and it is rendered capable of yielding a greater amount of produce with the same expense. And as no limits can be assigned to the quantity of improved machinery that may be introduced; as a million of steam-engines may be constructed for the same, or rather for a less, proportional expense than would be required for the construction of one; the competition of capitalists never fails to reduce the price of manufactured commodities to the sum which the least expensive method of production necessarily requires for their production.

ndency nanufac- red pro- ts to fall price.

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In agriculture, on the contrary, the best machinery, that is, the *best soils*, are first brought under cultivation, and recourse is afterwards had to inferior soils, requiring a greater expenditure of capital and labour to produce the same supplies. The improvements in the construction of farming implements, and meliorations in agricultural management, which occasionally occur in the progress of society, countervail to a greater or less extent the decreasing fertility of the soil. But the fall of price, which is permanent in manufactures, is only temporary in agriculture. A fall in the price of raw produce, by enabling every class to obtain greater quantities than before for their products or their labour, raises the rate of profit, and leads, of course, to an increased accumulation of capital; and this necessarily leads to a greater demand for labour, to higher wages, to an increased population, and, consequently, to a further demand for raw produce and an extended cultivation. Agricultural improvements check for a while the necessity of having recourse to inferior soils and the rise of rents; but the check cannot be lasting. The stimulus which they at the same time give to improvement and population is sure in the end to raise prices, and, by forcing recourse to poor lands, to raise rents.

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Malthus, in illustrating this important distinction between agricultural and manufacturing industry, set the doctrine of rent in a striking point of view. "The earth," he observes, "has been sometimes compared to a vast machine, presented by nature to man for the production of food and raw materials; but, to make the resemblance more just, as far as they admit of comparison, we should consider the soil as a present to man of a great number of machines, all susceptible of continued improvement by the application of capital to them, but yet of very different original qualities and powers.

"This great inequality in the powers of the machinery employed in procuring raw produce, forms one of the most remarkable features which distinguishes the machinery of the land from the machinery employed in manufactures.

"When a machine in manufactures is invented which will produce more finished work with less labour and capital than before, if there be no patent, or as soon as the patent is over, a sufficient number of such machines may be made to supply the whole demand, and to supersede entirely the use of all the old machinery. The natural consequence is, that the price is reduced to the price of production from the best machinery; and if the price were to be depressed lower, the whole of the commodity would be withdrawn from the market.

"The machines which produce corn and raw materials, on the contrary, are the gifts of nature, not the works of man; and we find by experience that these gifts have very different qualities and powers. The most fertile lands of a country, those which, like the best machinery in manufactures, yield the greatest products with the least labour and capital, are never found sufficient to supply the effective demand of an increasing population. The price of raw produce, therefore, naturally rises till it becomes sufficiently high to pay the cost of raising it with inferior machines, and by a more expensive process; and as there cannot be two prices for corn of the same quality, all the other machines, the working of which requires less capital compared with the produce, must *yield rents in proportion to their goodness.*

"Every extensive country may thus be considered as possessing a gradation of machines for the production of corn and raw materials, including in this gradation not only all the various qualities of poor land, of which every large territory has generally an abundance, but the inferior machinery which may be said to be employed when good land is further and further forced for additional produce. As the price of raw produce continues to rise, these inferior machines are successively called into action; and as the price of raw produce continues to fall, they are successively thrown out of action. The illustration here used serves to show at once the necessity of the actual price of corn to the actual produce, and the different effect which would attend a great reduction in the price of any particular manufacture, and a great reduction in the price of raw produce.

"I have no hesitation, then, in affirming, that the reason why the real price of corn is higher and continually rising in countries which are already rich, and still advancing in prosperity and population, is to be found in the necessity of resorting constantly to poorer land,—to machines which require a greater expenditure to work them,—and which consequently occasion each fresh addition to the raw produce of the country to be purchased at a greater cost;—in short, it is to be found in the important truth, that corn is sold at the price necessary to yield the actual supply; and that, as the production of this supply becomes more and more difficult, the price rises in proportion.

"I hope to be excused for having dwelt so long, and presented to the reader in various forms, the doctrine that corn, in reference to the *quantity actually produced*, is sold at its necessary price, like manufactures, because I consider it as a truth of the highest importance, which has been entirely overlooked by the economists, by Dr Smith, and all those writers who have represented raw produce as selling always at a monopoly price." (*Inquiry into the Nature and Progress of Rent*, p. 37.)

It appears, therefore, that in the earliest stages of society, and when only the best lands are cultivated, no rent is paid. The landlords, as such, do not begin to share in the produce of the soil until it becomes necessary to cultivate lands of an inferior degree of fertility, or to apply capital to the superior lands with a diminished return. Whenever this

Nature and Causes of Rent.

is the case, rent begins to be paid; and it continues to increase according as cultivation is extended over poorer soils, and diminishes according as they are thrown out of cultivation. Rent, therefore, depends exclusively on the extension of tillage. It is high where tillage is widely extended over inferior lands, and low where it is confined to the superior descriptions only. But in no case does rent enter into price; for the produce raised on the poorest lands, or with the capital last applied to the soil, determines the price of all the rest; and this produce yields no surplus above the common and average rate of profit.

It being thus established that the circumstance of land being appropriated, and rent paid to the landlords, does not affect the price of commodities, or the principle which regulates their exchangeable value in the earliest stages of society, we have, in the next place, to inquire into the effects of the accumulation and employment of capital, and of the rise and fall of wages on the value of commodities.

SECT. IV.—*Influence of the Accumulation and Employment of Capital, and of Fluctuations in the Rate of Wages on Exchangeable Value.*

Value of commodities regulated by the amount of immediate labour and capital expended in their production.

It will be remembered, that the quantity of labour required to produce commodities, and bring them to market, formed, in the earliest stages of society, and before capital was accumulated, the standard by which their exchangeable value was regulated. But capital is merely the accumulated produce of *anterior labour;* and when it is employed in the production of commodities, their value is determined, not by the quantity of immediate labour only, but by the total quantity of immediate labour and of accumulated labour, or capital, necessarily laid out on them. Suppose that an individual can by a day's labour, without the assistance of capital, kill a deer; but that it requires a day's labour to construct the weapons necessary to enable him to kill a beaver, and another day's labour to kill it; it is evident, supposing the weapons to have been rendered useless in killing the beaver, that it took as much labour to kill the latter as was required to kill two deer, and the beaver must, therefore, be worth the two deer. The durability of the weapons, or capital of the beaver hunter, is obviously an element of the greatest importance in estimating the value of the animals he has killed. Had the weapons been more durable than has been supposed,—had they served, for example, to kill twenty beavers instead of one, then it is plain the quantity of labour required to kill a beaver would only have been one twentieth part, or five per cent., more than that required to kill a deer, and the animals would, of course, have been exchanged in that proportion. With every extension of the duration of the weapons, the value of the deer and the beaver would obviously be brought still nearer to equality.

It appears, therefore, inasmuch as capital is nothing but the produce of anterior labour, that its accumulation and employment cannot affect the principle which makes the value of commodities depend on the quantities of labour required for their production. A commodity may be altogether produced by capital, without the co-operation of any immediate labour; and if so, its value will be determined by the quantity of capital, that is, of antecedent labour, expended in its production: or it may be partly produced by capital, and partly by immediate labour, and then its value will be proportioned to the sum of the two, or, which is the same thing, to the total quantity of labour bestowed upon it. The principles now laid down are almost self-evident, and we are not aware that they have been disputed by any economist of consideration; but a considerable difference of opinion is entertained respecting the influence on value of the employment of workmen by capitalists, and of fluctuations in the rate of wages.

Exchangeable Value.

The employment of workmen by capitalists does not raise the price of commodities.

It does not, however, seem that there is much room for these differences. Suppose that a certain quantity of goods, twenty pairs of stockings, for example, manufactured by independent workmen, freely exchange for forty pairs of gloves also manufactured by independent workmen; they would necessarily continue to do so, provided the quantity of labour formerly required for their production continued invariable, though the workmen were employed by some master manufacturer. In the first case, it is true, as Dr Smith has observed, that the whole goods produced by the workmen belonged to themselves, and that, in the second case, they had to share them with others. But it must be recollected, that in the first case the capital made use of in the production of the commodities also belonged to the workmen, and that in the latter case it has been furnished them by others. The question then comes to be,—does the circumstance of labourers voluntarily agreeing to give a portion of the commodities produced by them, as an *equivalent* or compensation for the wages, that is, for the capital furnished them by others, afford any ground for raising the value of commodities? It is evident it cannot. The profits of stock are only another name for the wages of accumulated labour. They make a part of the price of every commodity in whose production any portion of capital has been wasted. But whether the capital belong to the labourer, or is supplied to him by another, is obviously of no consequence. When the capital does not belong to the labourer, the commodities he produces are divided into *two* specific portions, whereof one is the return for the immediate labour, and the other for the capital, or accumulated labour, expended on their production. But the value of the commodities is the same, into how many portions soever they may be divided. A shoemaker who manufactures shoes on his own account, must obtain the same rate of profit on their sale, that would accrue to a master-shoemaker were he employed by him as a workman. He must possess a capital adequate to maintain himself and his family until his shoes are disposed of, and he must also be able to provide himself with a workshop and tools, to advance money to the tanner to pay his leather, and to provide for various other outgoings. If he did not, exclusive of the ordinary wages of labour, realize a rate of profit, or a return for his capital, equal to the profit obtained by the master-shoemaker, it would obviously be for his advantage to lend his capital to the latter, and to work on his account; and it is plain, inasmuch as his shoes could not be sold for a higher price than those of the capitalist, that he could not realize a greater rate of profit.

It appears, therefore, that the circumstance of the accumulated labour or capital, and the immediate labour required to produce commodities, being furnished by different classes of people, makes no difference whatever on the principle which shows that their value depends on the total quantity of labour necessary for their production. It now only remains to trace the influence of fluctuations in the rate of wages on price. When this is done, the subject will be exhausted.

Effect of fluctuations in the rate of wages on exchangeable value:—

To simplify this inquiry, we shall divide it into two branches. We shall inquire, *first*, whether fluctuations in the rate of wages have any, and, if any, what effects, on the value of commodities produced by the aid of capitals of equal degrees of durability; and, *second*, whether these fluctuations have any, and, if any, what effects, when the capitals employed are of unequal degrees of durability.

I. When all classes of producers employ fixed or circulating capitals, of precisely the same degree of durability, they must be all equally affected by a rise or fall of wages. This is a principle assented to by every one, and is indeed self-evident. But when such is the case, it is plainly impossible that a rise or fall of wages should occasion any variation in the value of commodities. To revert to our *t*, Effect f these uctua-ons when e capitals mployed produc-on are of e *same* egree of rability.

former example, let it be supposed that wages, at the rate of a shilling a day, were paid by the stocking manufacturer, one pair of whose stockings exchanged for two pairs of gloves, and that, from some cause or other, the wages of his work-people have been doubled, or raised to two shillings; the question is, will he now obtain a greater quantity of gloves in exchange for his stockings? It is obvious he will not. He cannot urge the fact of his having to pay a greater amount of wages to his workmen, as a reason why the glove manufacturer should give him more gloves in exchange for his stockings; for the latter would have it in his power to reply, that the same rise of wages affected him to precisely the same extent! If, therefore, one pair of stockings were previously worth two pairs of gloves, they would continue to preserve this relation to each other, so long as the quantities of labour required for their production were not varied, whatever might be the fluctuation of wages—whether they fell to a sixpence, or rose to five shillings, a day. Even if the price of commodities rose, which it could not, when wages rose, that would be of no advantage to the producers. Commodities are always bought by commodities, or by labour. Of what consequence, then, would it be to a capitalist, when wages rose, to sell his commodities at an equal advance; when he, in his turn, would be obliged to give so much more for every article which he purchased? Were wages to rise fifty per cent. a producer, a farmer, for example, would be precisely in the same condition, whether he sold his corn for fifty per cent. advance, and gave an additional fifty per cent., as he would be obliged to do, for his hats, shoes, clothes, &c. &c. or sold his corn at its former price, and bought all the commodities which he consumes at the prices he had formerly paid for them.

In order farther to illustrate this principle, we may be allowed to make a supposition, which, although it can never actually take place, will serve to set this doctrine in a clearer point of view. Should the quantities of labour required for the production of every species of commodities be increased in exactly the same proportion, it is plain their exchangeable values would remain unaltered. Their cost would, however, be augmented. A bushel of corn would not then exchange for a greater quantity of muslins or of broad cloth than it did before the increased expense of its production; but each would be the produce of more than the former quantity of labour. Under such circumstances, the prices of commodities would remain stationary, while the wealth and comforts of the society would be materially diminished. Every person would have to make greater exertions to obtain a given quantity of any one commodity; but as the expense of producing *all* commodities is, by the supposition, equally increased, it would not be necessary to make any greater exertions to obtain one than another, and their values, as compared with each other, would be totally unaffected.

In this statement it is taken for granted that the value of money has been all the while invariable, that is, that the same quantity of labour continues necessary to produce the same quantity of money. If the value of money fluctuate,—if it become either more or less difficult of production,—then, undoubtedly, both the rate of wages and the price of commodities will vary. But they will do so, not because the labourer gets a greater or less amount of wages, but because the value of the commodity, or standard in which wages and prices are estimated, has varied. Wages, though most commonly paid in money, really consist of a portion of the produce of the industry of the labourer; consequently, they bear a high proportional, or cost value, when the labourer gets a comparatively large share of the produce of his industry, and a low proportional value when he gets a comparatively small share of that produce. Instead of being identical with wages estimated in money or commodities, proportional wages are often lowest when money wages are highest, and they are often rising at the moment that money wages are falling, and *vice versa*. And hence, in order to avoid falling into endless mistakes, it is best, in all theoretical investigations with respect to value, to consider wages in the light of a certain proportion of the produce of industry; as being really invariable, so long as this proportion continues unchanged; and as having really risen when it is increased, and really fallen when it is diminished.

The mistaking of fluctuations in the rate of money wages for fluctuations in the rate of proportional wages, has been the source of much error and misapprehension. A man whose wages are one shilling a day, must get two shillings to keep them at the same level, should the value of money decline a half; and the hat which now sells for ten shillings must then, for the same reason, sell for twenty shillings. It is obviously false to call this a real rise, either of wages or prices: this, however, is what is generally done. The manufacturer who gives sixpence a day more to his men, and who sells his goods at a proportionally higher price because of a fall in the real value of money, rarely suspects that there has been any such fall, and almost invariably concludes that the rise of wages has been the cause of the rise of prices, overlooking entirely the real cause of the rise of both—the decline in the value of the money or commodity in which wages and prices are estimated.

It has been seen that a general and equal increase of the labour required for the production of commodities cannot alter their relation to one another; and it is consequently obvious that this relation cannot be altered by a general and equal increase of the wages paid for that labour. Fluctuations in the rate of wages affect the proportion in which the produce of industry, under deduction of rent, is divided between capitalists and labourers—diminishing the proportion belonging to the capitalists when they rise, and increasing it when they fall. But as these changes in the distribution of commodities neither add to nor take from the quantity of labour required to produce them and bring them to market, they do not affect either their real or exchangeable value.

2*d*, Effect of these fluctuations when the capitals employed in production are of *different* degrees of durability.

II. We have seen by the investigation under the preceding head, that, where the capitals employed in production are of *equal* degrees of durability, fluctuations in the rate of wages affect all classes of producers to the same extent, and have, therefore, no influence on the value of commodities, or on their price. But when the capitals employed are of *different* degrees of durability, this is not the case. Fluctuations in the rate of wages do not, in such cases, equally affect all classes of producers, and the natural equilibrium of profit cannot be maintained without a variation in the value of their products. To illustrate this, let it be supposed that a certain quantity of goods, the produce of fixed capital or machinery fitted to last many years, freely exchanges for a certain quantity of other goods entirely produced by manual labour. It is plain they would not be exchanged on this footing after a rise or fall of wages: for the proprietor of the machinery would be very little affected by such fluctuations, whereas they would very seriously affect the proprietor of the goods produced by manual labour. And, therefore, when wages fluctuate, the values of the goods produced by capitals of different degrees of durability must also fluctuate—that is, they must be adjusted so that they may continue to yield the same common and average rate of profit. Let us endeavour to trace the mode in which this adjustment is effected.

The arguments now brought forward, to show the impossibility of fluctuations in the rate of wages affecting the value of commodities produced by capitals of the same durability, were first advanced by Mr Ricardo. He, too, was the first who endeavoured to analyse and discover the influence of fluctuations in the rate of wages on commodities, when the capitals employed in their production were *not* of the same degree of durability. The results of his researches in this more difficult branch of the science were still more important, and more at variance with the previously received opinions of political economists. Mr Ricardo not only showed that it was impossible for any rise of wages to raise the price of *all* commodities; but he also showed, that in many cases a rise of wages necessarily led to a *fall* of prices, and a fall of wages to a *rise* of prices! The novelty of these opinions, and the talent and ingenuity with which they were supported, immediately recommended them to general notice; and the repeated examinations to which they have been subjected have confirmed their truth, and set them in a still clearer point of view.

If a rise of wages lowers profits, it must lower the value of goods chiefly produced by fixed capital or machinery.

Suppose a manufacturer has a machine worth L.20,000, of a high degree of durability, and which can, without the assistance of any, or with but little, manual labour, produce commodities: If profits were at ten per cent., the commodities annually produced by this machine would sell for L.2000, together with a small addition to replace its wear and tear.[1] Now, it is quite clear, that if, from any cause whatever, profits either rise or fall, the price of the goods produced by this machine would also rise or fall. If profits were to rise to fifteen per cent., the price of the goods produced by the machine must, in order that its owner may obtain the same profit with other capitalists, rise to L.3000; and if, on the other hand, profits fall to five per cent., the price of his goods must, for the same reason, fall to L.1000. If, therefore, it can be shown that a rise of wages reduces the rate of profits, it is plain it must also reduce the price of such commodities as are chiefly produced by machinery, or fixed capital of a considerable degree of durability, or by circulating capital returnable at distant periods, and *vice versa*. But it is not difficult to see that this is really the case, and that, in point of fact, profits, supposing other things to continue the same, fall when wages rise, and rise when wages fall.

It is plain, from what has been previously stated, that to whatever extent wages might rise, it would be impossible for any class of producers, whether their capitals were returnable in a day, a week, or any other period, to obtain a larger share of the commodities produced by others of the *same class*,—that is, whose capitals were returnable in *equal periods* with their own. Suppose wages rise ten or twenty per cent., that would not enable the holder of a capital returnable every month, or every twelve months, to obtain any additional value in exchange for his commodities from such of his fellow-capitalists as were affected to the same extent with himself by the rise of wages,—that is, whose capitals were returnable in the same period as his own. This is as impossible as it is to change the relation of proportional numbers by multiplying or dividing them by the same number; and, therefore, it cannot be true that a rise of wages will raise the price of any one commodity, as compared with all other commodities.

But if a rise of wages cannot do this, it is demonstrably certain it must lower profits. Suppose that the numbers 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10, represent capitals of corresponding degrees of durability: When wages fluctuate, the proprietors of the least durable capitals, numbers 1, 2, 3, 4, and 5, are plainly more affected thereby than the proprietors of the more durable capitals, numbers 6, 7, 8, 9, and 10. Suppose, now, that wages rise, and let us endeavour to discover what would be the effect of this rise on the holder of a capital of the *tenth* degree of durability. It has been already seen that, whatever might be the amount of the rise—whether it were one, ten, or a hundred per cent.—the holder of such capital could not obtain any additional quantity of the commodities belonging to other producers whose capitals were also of the *tenth* degree of durability; and in so far, therefore, as this class of commodities is concerned, profits will be reduced to the precise extent that wages have risen. But the holders of the other capitals are all of them *more* affected by the rise of wages than the holders of No. 10; and if we took any one of them as a standard by which to measure profits, they would appear to have fallen in a still greater proportion.

Profits vary inversely as wages.

Hence it is plain, that while other things remain the same, profits vary inversely as wages; that is, they fall when wages rise, and rise when wages fall. But, owing to the different and ever-varying proportions in which fixed and circulating capital and immediate labour are employed in the production of commodities, it is extremely difficult to discover the precise extent to which any given fluctuation in the rate of wages affects profits. We shall, however, state three different cases, which will briefly, and, it is hoped, satisfactorily, elucidate the manner in which fluctuations in the rate of wages always operate, and the method to be followed in estimating their influence on profits.

Method of estimating the effects of fluctuations in the rate of wages on profits.

1. If all commodities were produced by immediate labour, or by capital employed in the payment of wages, it is obvious that every rise of wages would cause an equal fall of profits. A capitalist who employed L.1000 in the payment of wages must, if profits were at ten per cent., sell the commodities for L.1100. But when wages rise five per cent., or to L.1050, he would not be able to sell his commodities for more than L.1100; for money is itself a commodity, and as, by the supposition, all commodities are produced by immediate labour, the rise of wages would affect the producers of money in the same degree that it affects other producers. In this case, therefore, it is plain every rise of wages will equally sink profits, and every fall of wages will equally raise them.

2. If all commodities were produced, *one half* by immediate labour, and the *other half* by capital, profits would only fall to half the extent that wages rose. Suppose a capitalist employs L.500 in the payment of wages, and L.500 as a fixed capital, when profits are at ten per cent., the commodities produced must, as before, sell for L.1100. If wages rose five per cent., the capitalist would have to pay L.525 as wages, and would, consequently, only retain L.75 as profits. In this case, therefore, a rise of wages to the extent of five per cent. would, because of the employment of equal quantities of capital and immediate labour in the production of commodities, only sink profits two and a half per cent.

3. If *all* commodities were produced by capital of a high degree of durability, the capitalists, it is obvious, would not be at all affected by a rise of wages, and profits would, of course, continue as before.

Now, suppose that commodities, instead of being wholly produced by immediate labour, as in the first case, or wholly by equal quantities of immediate labour and of capital, as in the second, or wholly by fixed capital, as in the third, are partly produced in the one mode and partly in the other, and let us see what effect this increase of five per cent. in the rate of wages would have on their relative values. To facilitate this inquiry, we shall distinguish these three descriptions of commodities by the Nos. 1, 2, and 3. Now, it is quite evident that the rise of wages has affected No. 1 two and a half per cent. more than it has affected No. 2, and five per cent. more than it has affected No. 3. No. 1

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[1] So small a sum as two shillings and elevenpence would be sufficient for this purpose, if the machine would last for 100 years; for an annuity of two shillings and elevenpence, accumulating for 100 years at ten per cent., would at the end of that period amount to L.20,000.

must, therefore, as compared with No. 2, have risen two and a half per cent. in value, and, as compared with No. 3, it must have risen five per cent.; No. 2 must have fallen two and a half per cent. as compared with No. 1, and risen two and a half per cent. as compared with No. 3; and No. 3 must have fallen five per cent. as compared with No. 1, and two and a half per cent. as compared with No. 2. If wages, instead of rising, had fallen, the same effects would obviously have been produced, but in a reversed order. The proprietors of the commodities of the class No. 1 would gain five per cent. by the fall, those of No. 2 would gain two and a half per cent., and those of No. 3 nothing; and the relative values of their commodities would be adjusted accordingly.[1]

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Thus, then, it appears, inasmuch as any commodity taken for a standard by which to estimate the values of other commodities, must itself be produced by capital returnable in a certain period, that when wages rise, commodities produced by less durable capitals than those which produce the commodity taken for a standard, will rise in exchangeable value, and those produced by more durable capitals will fall; and conversely when wages are reduced. Suppose, as before, that the Nos. 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10, represent capitals of corresponding degrees of durability: If a commodity produced by the least durable capital, No. 1, and which may be supposed to be wholly employed in the payment of wages, be taken for a standard, all commodities whatever produced by the other and more durable capitals would fall in value when wages rose; and if we suppose those produced by No. 2 to decline one per cent., those produced by No. 3 would decline two per cent., those produced by No. 4, three per cent., and so on until we arrive at No. 10, which will have fallen nine per cent. If, on the other hand, a commodity produced by the most durable capital, No. 10, and which may be supposed to consist wholly of highly durable machinery, be made the standard, when wages rise, all the commodities produced by the other less durable capitals would also rise; and if those produced by No. 9 rose one per cent., those produced by No. 8 would rise two per cent., and those produced by No. 1, nine per cent. If a commodity produced by capital of a medium degree of durability, as No. 5, and which may be supposed to consist half of circulating capital employed in the payment of wages, and half of fixed capital or machinery, be taken as a standard, the commodities produced by the less durable capitals, Nos. 4, 3, 2, and 1, will rise with a rise of wages, on the former hypothesis, the first, or No. 4, one per cent., the second, or No. 3, two per cent., &c.; while those produced by the more durable capitals, Nos. 6, 7, 8, 9, and 10, will fall, the first, or No. 6, one per cent., the second, or No. 7, two per cent., &c. exactly the reverse of the other.

Hence it is obvious that the influence which variations in the rate of wages have on price will principally depend on the nature of the capital employed in the production of gold and silver. Whatever may be the proportions of circulating and fixed capital employed in the production of money, all commodities produced by the agency of a greater quantity of labour, and with less fixed capital and machinery, will rise when wages rise, and fall when wages fall; but those that are produced by the agency of a less quantity of labour, and with more fixed capital or machinery, will fall when wages rise, and rise when wages fall; and those that are produced in nearly the same circumstances, or by the agency of the same quantities of circulating and fixed capital as money, will not be affected by fluctuation of wages.

Variations of exchangeable value caused by fluctuations in the rate of wages confined within narrow limits.

It should be observed, however, that variations in the exchangeable value of most commodities, caused by variations in the rate of proportional wages, are confined within comparatively narrow limits. It has been already seen, that were all commodities produced wholly by immediate labour, or wholly by capital, or wholly by equal quantities of both, no variation in the rate of wages would have any influence on their value. But, in point of fact, a very large class of commodities are produced by means of nearly equal portions of fixed and circulating capital; and as every rise of proportional wages that may take place must, under such circumstances, be balanced by a fall in the rate of profit, or by a proportional increase in the productiveness of industry, it is evident that the value of the commodities in question, as compared with each other, would remain nearly stationary. Although, therefore, a rise of wages has a necessary tendency to raise the exchangeable value of one class of commodities, and consequently to lower that of another, the fall of profits, which must inevitably follow every rise of wages that is not accompanied by an increased productiveness of industry, has a contrary effect, and tends to sink the value of the commodities which the increased rate of wages would raise, and to elevate the value of those which the same increased rate would sink. And it is only in extreme cases, or in the case of commodities produced almost wholly by direct manual labour on the one hand, or in that of those produced almost wholly by the aid of fixed capital or machinery on the other, that a variation in the rate of proportional wages occasions a considerable variation in their relative values.

It must also be observed, that though fluctuations in the rate of wages occasion some variation in the exchangeable value of particular commodities, they neither add to nor take from the total value of the entire mass. If they increase the value of those produced by the least durable capitals, they equally diminish the value of those produced by the more durable capitals. Their aggregate value continues, therefore, always the same. And though it may not be strictly true of a particular commodity, that its exchangeable value is directly as its cost or real value, or as the quantity of labour required to produce it and bring it to market, it is most true to affirm this of the mass of commodities taken together.

In thus endeavouring to trace the cost of all descriptions of non-monopolized commodities to the quantity of labour required for their production, it is not meant to deny that a very large portion of the useful or desirable qualities of such commodities may be the result of the action or labour of natural agents. But it is, as was previously seen, the peculiar and distinguishing feature of natural agents or powers, that they render their services gratuitously. Whatever they do is done without fee or reward. And hence, though their co-operation be necessary to the production of every species of useful and desirable articles, they add nothing to their value. This is a quality that can be communicated only by the labour of man, or by the instrumentality of capital appropriated or accumulated by his labour. In estimating the value of a quantity of corn, for example, we include only the labour of the individuals employed, as ploughmen, reapers, thrashers, &c. the value of the corn used as seed, and the value of the services rendered by the horses and instruments made use of in the different operations. Nothing whatever is set down to account of the aid derived from the vegetative powers of nature, and the action of the sun and showers; for though without them the crop could not be obtained, and our utmost exertions would be altogether fruitless, yet, as they are the free gift of Providence, they add nothing to the value of the produce, that is, they add nothing to its power of exchanging for or buying labour, or other things procured by the intervention of labour.

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[1] These examples are substantially the same with those given by Mr Mill. See *Elements of Political Economy*, p. 77.

It may be thought, perhaps, that this principle is at variance with what is observed to take place in the production of certain descriptions of commodities. Thus, if a cask of new wine be kept for a definite period, or till it arrive at maturity, it will acquire a higher value: now, as the change produced on the wine is entirely brought about by the operation of natural agents, and as, without the change, the wine would have no higher value, it has been contended that this is a case in which the labour of natural agents is plainly productive of an increased value. But it is easy to see that this is a mistake. The cask of wine is a capital, or is the result of the labour employed in cultivating, gathering, pressing, and otherwise preparing the grapes from which it was made. But it is necessary, in order to give time for the processes of fermentation, decomposition, &c. to effect the desired changes in the wine, that it should be laid aside until they are completed. The producer of wine would not, however, employ his capital in this way, unless it were to yield the same return that is derived from capital employed in other businesses. And hence it follows, that though the processes carried on by nature render the wine more desirable, or bestow on it a greater degree of utility, they add nothing to its value; the additional value which it acquires being a consequence of the profit accruing on the capital required to enable the processes to be carried on.

Besides the objection now stated, it has been contended by Colonel Torrens, in his valuable work on the Production of Wealth, in opposition to the theory we have been endeavouring to establish, that, after capital has been accumulated, the value of commodities is no longer, as in the early stages of society, determined by the total quantities of labour required to bring them to market, but by the quantities of capital required for that purpose. At bottom, however, this theory is identical with that now explained. Capital is the accumulated produce of anterior labour; and its value, like that of everything else, is estimated by the quantity of labour required to procure it. In this respect, too, there is no difference, as has been already seen, between labourers and any other species of machines. A labourer is himself a portion of the national capital, and may, without impropriety, be considered, in theoretical investigations of this sort, in the light of a machine which it has required a certain outlay of labour to construct; the wages which he earns may be looked upon as a fair remuneration for his services, or, if we may so speak, they yield him the common and ordinary rate of profit on his capital, exclusive of a sum to replace its wear and tear, or to supply the place of the old and decayed labourers with new ones. Whether, therefore, a commodity have been produced by the outlay of a capital which it cost a certain quantity of labour to provide, or whether it have been produced by the expenditure of that amount of labour directly upon it, is of no moment. In either case it is the result of the same outlay of labour, or, if it be deemed a better phrase, of capital. There is, in truth, no substantial difference between the manual labour of man and the action of machinery. Men are themselves, in so far as their mere physical powers are concerned, and it is of such only that we are now talking, to be looked upon as capital, or to be considered in the same point of view as the tools or engines with which they perform their tasks; and to say that the exchangeable value of commodities depends on the quantities of capital expended on their production, is not to contradict, but is, in fact, only another way of expressing the identical proposition we have been endeavouring to illustrate.[1]

SECT. V.—*Division of the Produce of Industry, under deduction of Rent, between Capitalists and Workmen.—Definition of Profits.—Mr Ricardo's Theory of Profits; sense in which it is true.—Causes which occasion a Rise or a Fall of Profits.—Influence of the Decreasing Fertility of the Soil and of Taxation on Profits.*

Division of the produce of industry between capitalists and workmen.

Before attempting to investigate the circumstances which determine the rate of profit, it is necessary to be aware of those which determine the proportions in which the whole produce of industry, under deduction of rent, is divided between labourers and capitalists.

This preliminary inquiry may be disposed of in a few words. We have seen, that the whole produce of the land and labour of every civilized society is always divided, in the first instance, into three, and not more than three, portions; the first of which goes to the labourers, the second to the capitalists or proprietors of stock, and the third to the landlords; and we have also seen, that the portion of the produce of industry, or of rent, which belongs to the landlords, as proprietors of the soil, and not as capitalists, is altogether extrinsic to the cost of production; and that the circumstance of the landlords' consenting to give it up, would not occasion any change in the productiveness of industry, or any reduction in the price of raw produce. Supposing, then, that rent is deducted or set aside, it is obvious that all the remaining produce of the land and labour of every country must be primarily divided between the two great classes of labourers and capitalists. And it is further obvious, that were there no taxes in a country, or were the rate of taxation invariable, the proportion of the whole produce of industry, under deduction of rent, falling to the share of the labourers, could not be increased except by an equivalent reduction in the proportion falling to the share of the capitalists, and *vice versa*. Suppose, still better to illustrate this proposition, that the whole produce of industry in Great Britain is represented by the number 1000; suppose farther, that the landlords get 200 of this sum as rent, and that the remaining 800 is divided in equal portions between labourers and capitalists. Under these circumstances, it is quite obvious that nothing could be added to the proportion of the produce, or to the 400, falling to the labourers, except at the expense of the capitalists; nor to the proportion or 400 falling to the latter, except at the expense of the former.

Whether the 800 were increased to 1600, or reduced to 400, so long as those between whom it must be divided receive each a half, their relative condition must continue the same. And hence the propriety of the distinction between proportional and real wages, or wages estimated in parts of the produce raised by the labourer, and those estimated in definite quantities of money or produce. If the productiveness of industry were to diminish, proportional wages might rise, notwithstanding that real wages, or the absolute quan-

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[1] Sir William Petty stated, so early as 1667, that the value of commodities is always regulated by the quantity of labour required to produce them; there is, however, the same difference between his statements and the analysis and investigations of Mr Ricardo, whom we have principally followed in this section, that there is between the conjectures of Pythagoras respecting the true system of the world and the demonstrations of Newton. But as the statement of Petty is curious, we subjoin it:

"If," says he, "a man can bring to London an ounce of silver out of the earth in Peru in the same time that he can produce a bushel of corn, then one is the natural price of the other; now, if, by reason of new and more easie mines, a man can get two ounces of silver as easily as formerly he did one, then corn will be as cheap at 10s. the bushel, as it was before at 5s. *cæteris paribus.*" (*Treatise of Taxes and Contributions*, ed. 1679, p. 31.)

Division the Pro- uce of In- ustry be- ween Ca- pitalists d Work- men.

tity of the products of industry received by the labourer, might be diminished; and if, on the other hand, the productiveness of industry were to increase, proportional wages might be diminished, while real wages might, at the same time, be increased.

It is plain, therefore, that were taxation unknown or constant, the whole produce of industry, under deduction of rent, would be divided between capitalists and labourers; and that the proportion of that produce falling to either party would vary inversely as the proportion falling to the other—that is, the proportion falling to the capitalists would be increased when that falling to the labourers was diminished, and diminished when it was increased.

efinition profits.

Profits must not, however, be confounded with the produce of industry primarily received by the capitalists. They really consist of the produce, or the value of the produce, remaining to those who employ capital in industrious undertakings, after all their payments to others have been deducted, and after the capital wasted or used in the undertakings has been replaced. If the produce derived from an undertaking, after defraying the necessary outlay, be insufficient to replace the capital expended, a loss will have been incurred; if the capital be merely replaced, and there is no surplus, there will neither be loss nor profit; and the greater the surplus, the greater of course will be the profit. Profits are not measured by the proportion which they bear to the rate of wages, but by the proportion which they bear to the capital by the agency of which they have been produced. Suppose an individual employs a capital equivalent to 1000 quarters of corn in the cultivation of a farm, and that he expends 700 quarters in the payment of wages, and 300 in seed and other outgoings: suppose now that the return to this capital is 1200 quarters. Under these circumstances, the proportion of the produce falling to the labourers as wages, will be to that falling to the capitalists as seven to two; for of the 1200 quarters that fall, in the first instance, to the capitalist, 200 only are profits, 1000 being required to replace the capital he has expended. In this case, therefore, the rate of profit would be said to be twenty per cent., meaning, that the excess of produce belonging to the cultivator, after the capital employed in its production was fully replaced, amounted to twenty per cent. upon that capital.

Ricar- theory profits.

We have been thus particular with respect to the definition of profits, because, from not keeping it sufficiently in view, Mr Ricardo has been led to contend, that the rate of profit depends on the proportion in which the produce of industry, under deduction of rent, is divided between capitalists and labourers; that a rise of profits can never be brought about except by a fall of proportional wages, nor a fall of profits except by a corresponding rise of proportional wages. It is evident, however, that this theory is true only in the event of our attaching a radically different sense to the term profit from what is usually attached to it, and supposing it to mean the real value of the entire portion of the produce of industry falling, in the first instance, to the share of the capitalist, without reference to the proportion which this produce bears to the capital employed in its production. If we understand the terms in this sense, Mr Ricardo's theory will hold universally; and it may be affirmed, that so long as the proportion in which the produce of industry, under deduction of rent, is divided between capitalists and labourers, continues the same, no increase or diminution of the powers of production will occasion any variation in the rate of profit. But if we consider profits in the light in which they are invariably considered in the real business of life—as the produce accruing to the capitalists, after the capital expended by them in payments and outgoings of all sorts is fully replaced—it will immediately be seen, that there are innumerable exceptions to Mr Ricardo's theory.

Profits and Wages.

Profits in agriculture.

It will facilitate the acquisition of clear and precise ideas respecting the circumstances which determine the average rate of profit in different employments, as that term is commonly understood, if we confine our attention, in the first place, to those that determine profits in agriculture,—both because the latter admit of being accurately measured, and because they may be taken as representing profits in other businesses. Agriculture is a branch of industry that must be carried on at all times, and under all circumstances; but it would not be carried on, if it did not, at an average, yield as great a return to the capital vested in it as other businesses; nor would these other businesses be carried on if they yielded a less return than is derived from agriculture. It necessarily follows, therefore, that the returns obtained from agricultural industry, or agricultural profits, may, in ordinary cases, be considered as identical with the returns or profits obtained from other businesses. Whenever, for example, the average return to an outlay of capital or labour worth a hundred quarters of wheat, employed in the cultivation of the soil, amounts to a hundred and ten quarters, we may safely infer that L.100 employed in manufactures is also yielding L.110: for a regard to their own interest will not permit those engaged in such departments to prosecute them for less profit than is obtained in agriculture, and the competition of the agriculturists will not permit them to obtain more.

Circumstances which occasion a rise or fall of profits.

Taking, then, as we are entitled to do, agricultural profits as a standard of all other profits, let us suppose that a landlord employs a capital equal in value to 10,000 quarters, or L.10,000, in the cultivation of an estate; that he expends 5000 quarters, or L.5000, of this capital in seed, in the keeping of horses, and in defraying the wear and tear of implements and machines; and 5000 quarters, or L.5000, in paying the wages of his labourers. Suppose, now, that the return obtained by this landlord is 12,000 quarters, or L.12,000; of which 10,000 quarters, or L.10,000, go to replace his capital, and 1000 quarters, or L.1000, to pay his taxes, leaving 1000 quarters, or L.1000, as profits, being ten per cent. on the capital employed: it is plain from this case (and this case is, in point of principle, the actual case of all cultivators), that the rate of profit may be increased in three, but only in one or other of three, ways, viz. 1, by a fall of wages; 2, a fall of taxes; or, 3, an increased productiveness of industry.

Thus, it is obvious, 1, that if wages were reduced from 5000 to 4000 quarters, profits, supposing other things to be invariable, would be increased from 1000 to 2000 quarters, or from ten to twenty per cent.: if, 2, the burden of taxation were reduced from 1000 to 500 quarters, profits would be increased from 1000 to 1500 quarters, or from ten to fifteen per cent.: and if, 3, owing to the introduction of an improved system of agriculture, the return to a capital of 10,000 quarters were increased from 12,000 to 13,000 quarters, profits, supposing wages still to amount to 5000 and taxes to 1000 quarters, would be increased to 2000 quarters, or to twenty per cent.; and though, in this case, after the productiveness of industry had been increased, wages would form a less proportion of the whole produce of industry than they did previously, it is to be observed, that this diminished proportion is the consequence, and not the cause, of profits having risen; and, therefore, in such cases as this, and they are of very frequent occurrence, it is true to say, that proportional wages fall because profits rise: but the converse of the proposition is not true; for the rise of profits was occasioned by causes that had nothing whatever to do with wages, and which were, in fact, totally independent of them.

It is indeed true, inasmuch as the rise of profits is the result of an increased productiveness of industry, that the real value of the 13,000 quarters will not exceed the real value of the 12,000 previously obtained by the same quantity of labour; but profits, in the sense in which they are practically understood, and as we understand them, do not depend on real values, but on the excess of the commodities produced above the capital expended in their production; and whenever this excess is augmented, without any previous depression in the rate of wages, the rate of profit must evidently be increased by the operation of causes extrinsic to variations in that rate.

Nor is this all. The rate of profit may remain stationary, or rise, though the proportion of the produce of industry falling to the share of the labourer be actually increased. Suppose, to exemplify this, that a landlord employs 1000 quarters of wheat as a capital, 500 of which are expended in seed, keep of horses, &c. and 500 in paying wages; if the produce be 1200 quarters, and the taxes to which he is subjected 100, his profits will amount to 100 quarters, or ten per cent.: suppose now that, owing to the introduction of improved machinery, or improved methods of culture, he only requires to expend 400 quarters in seed, keep of horses, &c. but that wages rise from 500 to 550 quarters, and that the same return is obtained; in this case, supposing taxation to be constant, the profits of the landlord will be increased from ten to fifteen three fourths per cent., though proportional wages have risen from five twelfths to five and a half twelfths of the whole produce.

It may be said, however, that if this increased productiveness were confined to agriculture, and did not extend to most other important businesses, the price of agricultural produce would fall, while that of other produce would remain stationary; and that, in such a case, the profits of agricultural industry, if estimated in money, or in any commodity other than corn, would be diminished in consequence of the rise of wages. This is true; but Mr Ricardo has made no exception, in laying down his theory, in favour of those possible, and indeed frequently occurring cases, when, from any single circumstance, or combination of various circumstances, industry becomes generally more productive, and when, consequently, profits, estimated in money, corn, cloth, or any commodity in extensive demand, would have risen, without their rise having been occasioned by a fall of wages. And it is also true, that an increased productiveness of agricultural industry, whether it have been caused by the introduction of an improved system of agriculture, or by the repeal of restrictions on the importation of corn into a comparatively populous country, most commonly extends itself to other businesses, and has the effect of bringing about a universal rise of profits; for, as raw produce forms the principal part of the labourer's subsistence, and as he obtains a larger quantity in exchange for the same amount of money, after it has fallen in price, his condition is in so far improved; and a stimulus being, in this way, given to population, and the supply of labour increased, wages are reduced, and the rate of profit universally raised.

When industry, instead of becoming more productive, becomes less so, the opposite effects follow. Profits then fall, without any fall having previously taken place in the rate of wages. It is evident, therefore, that the proposition that a rise of profits cannot be brought about otherwise than by a fall of wages, nor a fall of profits otherwise than by a rise of wages, is true only in those cases in which the productiveness of industry and the burden of taxation remain constant. So long as this is the case, or, which is the same thing, so long as the same capital is employed, and the same quantity of produce has to be divided between capitalists and labourers, the share of the one cannot be increased without that of the other being equally diminished; and it is also true, that if profits depended on the proportion in which the produce of industry is divided between capitalists and labourers, they could not be affected by variations in the productiveness, but would be determined wholly by the state of proportional wages. But profits depend, as has been already seen, on the proportion which they bear to the capital by which they are produced, and not on the proportion which they bear to wages. Suppose an individual employs a capital of 1000 quarters, or L.1000, in cultivation; that he lays out half this capital in the payment of wages, and obtains a return of 1200 quarters, or L.1200: in this case, assuming he is not affected by taxation, his profits will amount to 200 quarters, or L.200, being at the rate of twenty per cent., and will be to wages in the proportion of two to five. Suppose, now, that the productiveness of industry is universally doubled, and let it be farther supposed, that the additional 1200 quarters, or L.1200, is divided between the capitalist and his labourers in the former proportion of two to five, or that the capitalist gets 343 quarters, or L.343, of additional profits, and the labourers 857 quarters, or L.857, of additional wages: in this case, both parties will still obtain the same proportions of the produce of industry as before; and if we look only to them, we must say that neither profits nor wages have risen. But when we compare, as is invariably done in estimating profits, the return obtained by the capitalist with the capital he employs, it will be found, notwithstanding the constancy of proportional wages, that the rate of profit has increased from twenty to fifty-four per cent.

Thus, then, it appears, as was previously stated, that profits rise in one or other of the three following ways, viz. 1, from a fall of wages; or, 2, from a fall of taxes directly or indirectly affecting capitalists; or, 3, from an increased productiveness of industry: and they fall, 1, from a rise of wages; or, 2, from an increase of taxes; or, 3, from a diminished productiveness of industry. But they can neither rise nor fall, except from the operation of one or more of the causes now stated.

Influence o
the decreas
ing fertilit
of the soil
on profits.

It is consistent with universal experience, that profits are invariably much higher in colonies, and thinly-peopled countries, than in countries that have been long settled, and where the population is comparatively dense; and that (referring to periods of average duration) their tendency is to fall in the progress of society. This sinking of profits in rich and populous countries has been ascribed by Dr Smith to the competition of capitalists. He supposes that when capital is augmented, its owners endeavour to encroach on each other's employments; and that, in furtherance of their object, they are tempted to offer their goods at a lower price, and to give higher wages to their workmen; which has a twofold influence in reducing profits. This theory was long universally assented to. It has been espoused by MM. Say, Sismondi, and Storch, by the Marquis Garnier, and, with some trifling modifications, by Mr Malthus. But, notwithstanding the deference due to these authorities, it is easy to see that competition can never bring about a general fall of profits. It prevents any one individual, or set of individuals, from monopolizing a particular branch of industry, and reduces the rate of profit in different businesses nearly to the same level; but this is its whole effect. Most certainly it has no tendency to lessen the productiveness of industry, or to raise the average rate of wages or the rate of taxation; and if it do none of these things, it is quite impossible it should lower profits. So long as an individual, employing a capital of 1000 quarters, or L.1000, obtains from it a return of 1200 quarters, or L.1200, of which he has to pay 100 quarters, or L.100, as taxes, so long will his profits continue at ten per cent., whether he have the market to himself, or have 50,000 competitors. It is not competition, but it is the increase of taxation, and the necessity under which a growing society is placed of resorting to soils of less fertility to obtain supplies of food, that are the great causes of that reduction in the rate of profit which usually takes place in advanced periods. When the last lands taken into cultivation are fertile, there is a comparatively large amount of produce to be divided between capitalists and labourers;

and both profits and real wages may, consequently, be high. But with every successive diminution in the fertility of the soils to which recourse is had, the quantities of produce obtained by the same outlays of capital and labour necessarily diminish.[1] And this diminution will obviously operate to reduce the rate of profit—1, by lessening the quantity of produce to be divided between capitalists and labourers; and, 2, by increasing the proportion falling to the share of the latter.

The influence of the decreasing productiveness of the soil, as well on the condition and fortunes of society, as on the rate of profit, is so very powerful, that we shall endeavour to trace and exhibit its operation a little more fully. It has been shown over and over again, that the principle of increase in the human race is so very strong, as not only to keep population steadily up to the means of subsistence, but to give it a tendency to exceed them. It is true, that a peculiar combination of favourable circumstances occasionally causes capital to increase faster than population, and wages are in consequence augmented. But such augmentation is rarely permanent, at least to the whole extent; for the additional stimulus it is almost sure of giving to population seldom fails, by proportioning the supply of labour to the increased demand, to reduce wages to their old level, or to one not much above it. If, therefore, it were possible always to employ additional capital in raising raw produce, in manufacturing that produce when raised, and in conveying the raw and manufactured products from place to place, with an equal return, it is evident, supposing taxation to continue invariable, that, speaking generally, the greatest increase of capital would not occasion any considerable fall in the rate of profit. So long as labour may be obtained at the same rate, and as its productive power is not diminished, so long must the profits of stock continue unaffected. It is evident, then, that the mere increase of capital has, by itself, no lasting influence on wages, and it is obviously the same thing, in so far as the rate of profit is concerned, whether ten or ten thousand millions be employed in the cultivation of the soil, and in the manufactures and commerce of this or any other kingdom, provided the last million so employed be as productive, or yield as large a return, as the first. Now, this is invariably the case with the capital employed in manufactures and commerce. The greatest amount of capital and labour may be employed in fashioning raw produce, and adapting it to our use, and in transporting it from where it is produced to where it is to be consumed, without a diminished return. Whatever quantity of labour may now be required to build a ship or construct a machine, it is abundantly certain that an equal quantity will, at any future period, suffice to build a similar ship, or to construct a similar machine; and although these ships and machines were indefinitely multiplied, the last would be as well adapted to every useful purpose, and as serviceable, as the first. The probability, indeed, or rather the certainty, is, that the last would be much more serviceable than the first. It is not possible to assign limits to the powers and resources of genius, nor consequently to the improvement of machinery, and of the skill and industry of the labourer. Future Watts, Arkwrights, and Wedgwoods, will arise; and the stupendous discoveries of the last and present age will doubtless be equalled, and most probably surpassed, in the ages that are to come. It is therefore clear, that if equal quantities of capital and labour always raised equal quantities of raw produce, the greatest additions that might be made to them would not lessen the capacity of employing them with advantage, or sink the rate of profit. But here, and here only, the bounty of nature is limited, and she deals out her gifts with a frugal and parsimonious hand,

> ———— Pater ipse colendi
> Haud facilem esse viam voluit.

Equal quantities of capital and labour do not always produce equal quantities of raw produce. The soil is of limited extent and limited fertility; and this limitation is the real check—the insuperable obstacle—which prevents the means of subsistence, and consequently the inhabitants, of every country, from increasing in a geometrical proportion, until the space required for carrying on the operations of industry has become deficient.

It is plain that the decreasing productiveness of the soils to which every improving society is obliged to resort, will not, as was previously observed, merely lessen the quantity of produce to be divided between profits and wages, but will also increase the proportion of that produce falling to the share of the labourer. It is quite impossible to go on increasing the cost of raw produce, the principal part of the subsistence of the labourer, by forcing good or taking inferior lands into cultivation, without increasing wages. A rise of wages is seldom indeed exactly coincident with a rise in the price of necessaries, but they can never be very far separated. The price of the necessaries of life is in fact the cost of producing labour. The labourer cannot work, if he be not supplied with the means of subsistence; and though a certain period of varying extent, according to the circumstances of the country at the time, must generally elapse, when necessaries are rising in price, before wages are proportionally augmented, such an augmentation must, in all ordinary cases, be brought about in the end.

It is plain, therefore, inasmuch as there is never any falling off, but a constant increase, in the productiveness of the labour employed in manufacturing and commercial industry, that the subsistence of the labourer could not be increased in price; and, consequently, that it would not be necessary to make any additions to his natural wages, or the wages required to enable him to subsist and continue his race, were it not for the diminished power of agricultural labour, originating in the inevitable necessity under which man is placed, of resorting to inferior soils to obtain larger supplies of raw produce. The decreasing fertility of the soil is, therefore, at bottom, the great and only necessary cause of a fall of profits. The quantity of produce forming the return to capital and labour would never diminish, but for the diminution that uniformly takes place in the productiveness of the soil; nor is there any other physical cause why the proportion of wages to profits should be increased, and the rate of profit diminished, as it uniformly is, in the progress of society.

We have thus endeavoured to exhibit the ultimate influence which the necessity of resorting to poorer lands for supplies of food has on profits and wages. But though this cause of the reduction of profits be "of such magnitude and power as finally to overwhelm every other,"[2] its operations may be, and indeed commonly are, counteracted or facilitated by extrinsic causes. It is obvious, for example, that every discovery or improvement in agriculture, which enables a greater quantity of produce to be obtained for the same expense, has a similar effect on profits, as if the extent of superior soils were increased, and may, for a lengthened period, increase the rate of profit.

Had the inventive genius of man been limited in its powers, and had the various machines and implements used in agriculture, and the skill of the husbandman, speedily attained to their utmost perfection, the rise in the price of raw produce, and the fall of profits consequent to the increase of population, would have been so apparent as to force themselves on the attention of every one. When, in such a state of things, it became necessary to resort to poorer soils to raise an additional quantity of food, a corresponding increase of labour would have been required; for, supposing the perfection of art to be attained, nothing except greater exertion can overcome fresh obstacles. Not only, therefore, would additional labour have been necessary to the production of a greater quantity of food, but it would have been necessary in the precise proportion in which the difficulty of its production was increased; so that, had the arts continued stationary, the price of raw produce would have varied directly with every variation in the qualities of the soils successively brought under tillage.

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[1] This supposes, of course, either that no improvements are made, or that their influence has been taken into account.

[2] Malthus' Principles of Political Economy, &c. p. 317.

But the circumstances which really regulate the value of raw produce are extremely different. It is true, indeed, that even in those societies that are most rapidly improving, it has, as was previously shown, a constant tendency to rise; for the rise of profits consequent to every invention, by occasioning a greater demand for labour, gives a fresh stimulus to population; and thus, by increasing the demand for food, again inevitably forces the cultivation of poorer soils, and raises prices. But it is evident that improvements render these effects of this great law of nature, from whose all-pervading influence the utmost efforts of human ingenuity cannot enable man to escape, far less palpable and obvious. After inferior soils are cultivated, more labourers are, in most cases, required to raise the same quantities of food; but as the powers of labourers are gradually improved in the progress of society, a much smaller number is required, in proportion to the whole work that is performed, than if no such improvement had taken place. The natural tendency to an increase in the price of raw produce is in this way counteracted. The productive energies of the earth gradually diminish, and we are compelled to resort to less fruitful soils; but the productive energies of the labour employed in their tillage are as constantly augmented by the discoveries and inventions that are always being made. Two directly opposite and continually acting principles are thus set in motion. From the operation of fixed and permanent causes, the increasing sterility of the soil is sure, in the long run, to overmatch the improvements that occur in machinery and agriculture, prices experiencing a corresponding rise, and profits a corresponding fall. Occasionally, however, these improvements more than compensate, during lengthened periods, for the deterioration in the quality of the soils successively cultivated; and a fall of prices and rise of profits take place, until the constant pressure of population has again forced the cultivation of still poorer lands.

In so far as the general principle is concerned, the previous reasoning is applicable alike to the commercial world or to a single nation. It is plain, however, that the fall in the rate of profit, and the consequent check to the progress of society, originating in the necessity of resorting to poorer soils, will be more severely felt in an improving country, which excludes foreign corn from her markets, than in one which maintains an unfettered intercourse with her neighbours. Were a highly manufacturing and commercial country, like England, to deal with all the world on fair and liberal principles, she might avail herself of all those capacities of production which Providence has given to different countries; and besides obtaining supplies of food at the cheapest rate at which they can be raised, the numberless markets to which she could resort would prevent her from feeling any very injurious consequences from the occasional failure of her own harvests, or from deficiencies in one or a few of the sources whence she drew her foreign supplies; so that she would thus go far to secure herself constant plenty, and, what is of hardly less importance, constant steadiness of price. Such a nation would have the foundations of her greatness established on a broad and solid basis; for they would rest, not on the productive powers of her own soil only, but on those of all the countries of the world. And supposing her not to be involved to an unusual degree in war, or subjected to comparatively heavy taxes, her profits would not be reduced, nor would she get clogged in her progress, until the increase of population forced the cultivation of inferior soils in the countries whence she was in the custom of importing corn. And even then she would not be surpassed by her neighbours; her progress being retarded by a cause which equally affects them, her relative power would not be impaired; and should new markets be opened, or new discoveries made, in any quarter of the world, she would reap her full share of the advantage, and be renovated and strengthened for a new career of exertion.

But the case would be very different were foreign raw produce excluded from the markets of a nation like England, which has made an unusual progress in commerce and manufactures, and whose population is therefore comparatively dense. A government which prevents its subjects from exchanging their manufactured goods for the corn of more fertile or less densely-peopled countries, compels them prematurely to resort to poor soils at home; and profits being consequently reduced, the country is made to approach the stationary state at a period when, had the legislature acted on more enlarged principles, she might have been advancing with the same rapidity as before in the career of improvement.

It is needless here to advert to the influence of restrictions on the corn trade in aggravating the evils of scarcity, and occasioning fluctuations of price. Their operation in this respect is too well established to admit of any doubt. But supposing it were otherwise, still it must be obvious, for the reasons stated above, that such restrictions cannot fail to be exceedingly injurious. It may, one should think, be laid down as an axiom, that government should either not interfere at all with industrious undertakings, or interfere only in the view of rendering them more secure or more productive. But to exclude any article, and particularly one so important as corn, when it may be imported cheaper from abroad than it can be raised directly at home, is really to adopt the means most effectual for rendering industry least secure and least productive! It is not merely contradicting the best established principles, but it is employing the power of government to arrest the natural progress of opulence and prosperity, and to accelerate the period of old age, decrepitude, and decay! If we could, by laying out L.1000 on the manufacture of cottons or hardware, produce a quantity of these articles that would exchange for 400 quarters of Polish or American wheat; and if the same sum, when expended in cultivation in this country, would not produce more than 300 quarters; the prevention of importation occasions an obvious sacrifice of 100 quarters out of every 400 consumed in the empire; or, which is the same thing, it occasions an artificial advance of twenty-five per cent. in the price of corn. It is not even true that a system of this sort is, in any respect, advantageous to the landlords or farmers; and to suppose that it can be advantageous to those who are obliged to buy their produce, is too contradictory to merit one moment's attention.

Practically, however, we are not disposed to think that the influence of the existing restrictions on the importation of corn into Great Britain is nearly so injurious as is frequently represented. The fact is, that our average prices have been during the last seven years rapidly approximating to those of the Continent. Owing to the great increase in the imports from Ireland, and still more to the extraordinary improvement made in agriculture since 1825, partly by the greater facilities afforded by steam-navigation for bringing the produce of the more remote districts to market, and partly and principally, perhaps, by the influence of a better system of draining, and of the application of bone-manure, &c., production has latterly shot a-head of population. During the seven years ending with 1837, prices were comparatively low, and were, indeed, taking quality into account, but little, if anything, above their level in the principal markets in the western parts of continental Europe supplied with corn brought from a distance. The pernicious influence of the corn-laws is now principally felt in scarce years, or when the crop is deficient; and as their tendency is to render the country dependent on its own resources, and to hinder corn from being grown abroad for our markets, they must necessarily aggravate, in no common degree, all the mischievous consequences resulting from a bad harvest. Sound policy would, therefore, suggest their repeal, under the conditions, and in the way pointed out, in the article CORN LAWS.

PART IV.

CONSUMPTION OF WEALTH.

Having in the previous sections endeavoured to explain the means by which labour is facilitated, and wealth produced, and to investigate the laws which regulate its distribution among the various classes of society, we come now to the *third* and last division of the science, or to that which treats of the CONSUMPTION of Wealth.

Definition of Consumption.—Consumption the end of Production.—Test of Advantageous and Disadvantageous Consumption.—Error of Dr Smith's Opinions with respect to Unproductive Consumption.—Error of those who contend, that to facilitate Production, it is necessary to encourage Consumption.—Cause of Gluts.—Consumption of Government.—Conclusion.

efinition con- mption.

It was formerly seen, that by production in this science, is not meant the production of matter, that being exclusively the prerogative of Omnipotence, but the giving to matter such a shape as might fit it for ministering to our wants and enjoyments. In like manner, by consumption is not meant the consumption or annihilation of matter, that being as impossible as its creation, but merely *the consumption or annihilation of the qualities which render commodities useful and desirable.* To consume the products of art or industry, is to deprive them of the utility, and consequently of the value, communicated to them by labour. And hence we are not to measure consumption by the magnitude, weight, or number of the products consumed, but exclusively by their value. Large consumption is the destruction of large value, however small the bulk in which it may happen to be compressed.

nsump- n the d of pro- ction.

Consumption, in the sense in which the word is used by political economists, is synonymous with use. We produce commodities only that we may use or consume them. Consumption is the end and object of human industry; production is merely a means to attain that end. All the products of art and industry are destined to be consumed, or made use of; and if the consumption of a commodity fit to be used be deferred, a loss is incurred. Products are intended to satisfy the wants or to add to the enjoyments of their producers; or they are intended to be employed as capital, and made to reproduce a greater value than themselves. In the *first* case, by delaying to use them, we either refuse to satisfy a want, or deny ourselves a gratification;—and in the *second*, by delaying to use them, we allow the instruments of production to lie idle, and lose the profit derivable from their employment.

Test of advantageous consumption.

But though commodities are produced only to be consumed, we must not fall into the error of supposing, that all consumption is equally advantageous to the individual or the society. If an individual employ a set of labourers to build him a house the one summer, and to pull it down the next, their labour, or the capital paid them in exchange for it, and which they consumed during the time they were engaged in this futile employment, is evidently destroyed for ever, and absolutely lost both to their employer and the public; whereas, had he employed them in the raising of corn, or the production of any species of valuable produce, he would have obtained products equal to, or more valuable than, the capital he gave them. The value of the return, or the advantage obtained from the consumption, is, therefore, the true test of advantageous and disadvantageous, or, as it is more commonly termed, of productive and unproductive consumption. Commodities are consumed productively when the advantage or benefit accruing in consequence to their possessors, or when the value of the products obtained in their stead, exceeds their value; and they are consumed unproductively when the value of the advantage or benefit, or that of the new commodities, is less than their value. The prosperity or decay of every nation depends on this balance of consumption and reproduction. If, in given periods, the commodities produced in a country exceed those consumed in it, the means of increasing its capital will be provided, and its population will increase, or the actual numbers will be better accommodated, or both. If the consumption in such periods fully equals the reproduction, no means will be afforded of increasing the stock or capital of the nation, and society will be at a stand. And if the consumption exceed the reproduction, every succeeding period will see the society worse supplied; its prosperity and population will evidently decline, and pauperism will gradually spread itself over the whole country.

It is impossible, however, to fix on any standard by a comparison with which to obtain even a tolerable approximation to the value or advantage of different kinds of consumption. This is a point on which the sentiments of no two individuals ever exactly coincide. The opinions of each will always depend more or less on the situation in which he is placed. The rich man will naturally be inclined to give a greater extension to the limits of advantageous consumption than the man of middling fortune; and the latter than he who is poor. And it is undoubtedly true that a man's expenses should always bear some proportion to his fortune and condition in society; and that what might be proper and advantageous expenditure in one case, might be exceedingly improper and disadvantageous in another. It is, therefore, quite impracticable to frame any system of rules on the subject of expenditure applicable to the case of every individual; and even if it were practicable, there is no ground for thinking that they would be of the smallest utility. The state has no right whatever to control individual expenditure; nor, if it had such a right, could it exercise it without serious injury. The public interest requires that the national capital should, if possible, be constantly kept on the increase; or, which is the same thing, that the consumption of any given period should become the means of reproducing a greater value. But it has been sufficiently proved that this cannot, under any circumstances, be the result of a system of *surveillance* and restriction. Industry and frugality never have been, and never can be, promoted by such means. To render a man industrious, secure him the peaceable enjoyment of the fruits of his industry:—to wean him from extravagance, and make him frugal and parsimonious, allow him to reap all the disadvantage of the one line of conduct, and all the advantage of the other. The poverty and loss of station that inevitably result from improvident and prodigal consumption are a sufficient security against its ever becoming injuriously prevalent. Wherever the public burdens are moderate, property protected, and industry free, the efforts of the great body of the people to rise in the world and improve their condition occasion the continued increase of national wealth. It is idle to expect that all unproductive and unprofitable expenditure should ever be avoided; but the experience of all tolerably well governed states proves, that the wealth productively expended, is always much greater than that expended unproductively.

Luxury not disadvantageous.

It was long a prevalent opinion among moralists, that the labour bestowed on the production of luxuries, and consequently their consumption, was unproductive. But this opinion is now almost universally abandoned. Unless, indeed, all comforts and enjoyments are to be proscribed, it is impossible to say where necessaries end and luxuries begin. But if we are to understand by necessaries such products only as are absolutely required for the support of human life, everything but wild fruits, roots, and water, must be deemed superfluous; and in this view of the matter, the peasantry of Ireland, who live only on potatoes and butter-milk, must be considered as having much more of the character of productive labourers than those of Britain! The mere statement of such a doctrine is sufficient for its refutation. Everything that stimulates exertion is advantageous. The mere necessaries of life may be obtained with comparatively little labour; and those savage and uncivilized hordes, who have no desire to possess its comforts, are proverbially indolent and dissipated. To make men industrious,—to make them shake off that lethargy which is natural to them,—they must be inspired with a taste for the luxuries and enjoyments of civilized life. When this is done, their artificial wants become equally clamorous with those that are strictly necessary, and they increase exactly as the means of gratifying them increase. Wherever a taste for comforts and conveniencies is generally diffused, the wants and desires of man become altogether illimitable. The gratification of one leads directly to the formation of another. In highly civilized societies, new products and new modes of enjoyment are constantly presenting themselves as motives to exertion, and as means of rewarding it. Perseverance is, in consequence, given to all the operations of industry; and idleness, and its attendant train of evils, almost entirely disappear. "What," asks Dr Paley, "can be less necessary, or less connected with the sustentation of human life, than the whole produce of the silk, lace, and plate manufactory? Yet what multitudes labour in the different branches of these arts! What can be imagined more capricious than the fondness for tobacco and snuff? Yet how many various occupations, and how many thousands in each, are set at work in administering to this frivolous gratification!" The stimulus which the desire to possess these articles gives to industry renders their introduction advantageous. The earth is capable of furnishing food adequate for the support of a much greater number of human beings than can be employed in its cultivation. But those who are in possession of the soil will not part with their produce for nothing; or rather, they will not raise at all what they can neither use themselves nor exchange for what they want. As soon, however, as a taste for conveniencies and luxuries is introduced, the occupiers of the ground raise from it the utmost that it can be made to produce, and exchange the surplus for such conveniencies and gratifications as they are desirous of obtaining; and, in consequence, the producers of these articles, though they have neither property in the soil, nor any concern in its cultivation, are regularly and liberally supplied with its produce. In this way, the quantity of necessaries, as well as of useful and agreeable products, is vastly increased by the introduction of a taste for luxuries; and the people are, in consequence, not only better provided for, but their numbers are proportionally and greatly augmented.

It is plain, therefore, that the consumption of luxuries cannot, provided it be confined within proper limits, be justly considered as either disadvantageous or unproductive. If, indeed, a man consume more luxuries than his labour or his fortune enable him to command, his consumption will be disadvantageous. But the same thing will happen if he consume a greater quantity of necessaries than he can afford. The mischief does not consist in the species of articles consumed, but in the excess of their value over the means of purchasing them possessed by the consumers. This, however, is a fault which should always be left to be corrected by the self-interest of those concerned. The poverty and degradation caused by indulging in unproductive consumption is a sufficient guarantee against its ever being carried to an injurious extent. To attempt to lessen unproductive consumption by proscribing luxury, is equivalent to attempting to enrich a country by taking away some of the most powerful motives to production.

Dr Smith's criterion of productive and unproductive consumption.

Dr Smith has given another criterion of productive and unproductive consumption; but his opinions on this point, though exceedingly ingenious, and supported with his usual ability, appear to rest on no solid foundation. He divides society into two great classes. The *first* consists of those who fix, or, as he terms it, "realize their labour in some particular subject, or vendible commodity, which lasts for some time at least after that labour is past;" the *second*, of those whose labour leaves nothing in existence after the moment of exertion, but perishes in the act of performance. The former are said by Smith to be *productive*, the latter *unproductive*, labourers. Not that, in making this distinction, Smith meant to undervalue the services performed by the unproductive class, or to deny that they are often of the highest utility; for he admits that such is frequently the case: but he contends, that these services, however useful, do not augment the wealth of the country; and, consequently, that the commodities consumed by this class are unproductively consumed, and have a tendency to impoverish, not to enrich, society. But, to avoid all chance of misrepresentation, we shall give Dr Smith's opinions in his own words.

"There is one sort of labour," says he, "which adds to the value of the subject upon which it is bestowed; there is another which has no such effect. The former, as it produces a value, may be called productive, the latter unproductive, labour. Thus the labour of a manufacturer adds, generally, to the value of the materials which he works upon, that of his own maintenance, and of his master's profit. The labour of a menial servant, on the contrary, adds to the value of nothing. Though the manufacturer has his wages advanced to him by his master, he, in reality, costs him no expense, the value of those wages being generally restored, together with a profit, in the improved value of the subject upon which his labour is bestowed. But the maintenance of a menial servant never is restored. A man grows rich by employing a multitude of manufacturers; he grows poor by maintaining a multitude of menial servants. The labour of the latter, however, has its value, and deserves its reward, as well as that of the former. But the labour of the manufacturers fixes and realizes itself in some particular subject, or vendible commodity, which lasts for some time at least after that labour is past. It is, as it were, a certain quantity of labour stocked and stored up, to be employed, if necessary, upon some other occasion. That subject, or, what is the same thing, the price of that subject, can afterwards, if necessary, put into motion a quantity of labour equal to that which had originally produced it. The labour of the menial servant, on the contrary, does not fix or realize itself in any particular subject or vendible commodity. His services generally perish in the very instant of their performance, and seldom leave any trace or value behind them for which an equal quantity of service could afterwards be procured.

"The labour of some of the most respectable orders in the society is, like that of menial servants, unproductive of any value, and does not fix or realize itself in any permanent subject or vendible commodity, which endures after that labour is past, and for which an equal quantity of labour could afterwards be procured. The sovereign, for example, with all the officers both of justice and war who serve under him, the whole army and navy, are unproductive labourers. They are the servants of the public, and are maintained by a part of the annual produce of the industry of other people. Their service, how honourable, how necessary, or how useful soever, produces nothing for which an equal quantity of service can afterwards be procured. The protection, security, and defence of the commonwealth, the effect of their labour this year, will not purchase its protection, security, and defence for the year to come. In the same class must be ranked some both of the gravest and most important, and some of the most frivolous professions: churchmen, lawyers, physicians, men of letters of all kinds; players, buffoons, musicians, opera-singers, opera-dancers, &c. The labour of the meanest of these has a certain value, regulated by the very same principles which regulate that of every other sort of labour; and that of the noblest and most useful produces nothing which could afterwards purchase or procure an equal quantity of labour. Like the declamation of the actor, the harangue of the orator, or the tune of the musician, the work of all of them perishes in the very instant of its production." (*Wealth of Nations*, p. 146.)

r Smith's istinction etween e different classes f society own to e ill unded.

It will not, we think, be very difficult to show the fallacy of the distinction Dr Smith has here endeavoured to establish between the labour, and consequently also the consumption, of the different classes of society. To begin with the case of the menial servant:—Smith says that his labour is unproductive, because it is not realized in a vendible commodity, while the labour of the manufacturer is productive, because it is so realized. But of what, may we ask, is the labour of the manufacturer really productive? Does it not consist exclusively of comforts and conveniencies required for the use and accommodation of society? The manufacturer is not a producer of matter, but of *utility* only. And is it not obvious that the menial servant is also a producer of utility? If, for example, the labour expended in converting the wool when in the fleece into a coat be, as it unquestionably is, productive, then surely the labour expended in cleaning and brushing the coat, and rendering it fit to be worn, must be so too. It is universally allowed, that the labour of the husbandman in raising corn, beef, and other articles of provision, is productive; but if so, why is the labour of the menial servant who performs the indispensable task of preparing and dressing these articles, and fitting them to be used, to be stigmatized as unproductive? It is clear there is no difference whatever between the two species of labour—that they are either both productive, or both unproductive. To produce a fire, is it not quite as necessary that coals should be carried from the cellar to the grate, as that they should be carried from the bottom of the mine to the surface of the earth? And if it be said that the miner is a productive labourer, must we not say as much of the servant employed to make and mend the fire? The whole of Dr Smith's reasoning proceeds on a false hypothesis. He has made a distinction where there is none, and can be none. The end of all human exertion is the same—that is, to increase the sum of necessaries, comforts, and enjoyments; and it must be left to the judgment of every man to determine what portion of these he will have in the shape of menial services, and what in the shape of material products. It is an error to suppose that a man is impoverished by maintaining menial servants, any more than by indulging in any other species of expense. It is true, he will be ruined if he keep more servants than he has occasion for, or can afford to pay; but his ruin would be equally certain were he to purchase an excess of food or clothes, or to employ more workmen in any branch of manufacture than are required to carry it on, or than his capital could employ. The keeping of two ploughmen when one only might suffice, is as improvident and wasteful as the keeping of two footmen to do the business of one. It is in the extravagant quantity of the commodities we consume, or of the labour we employ, and not in the particular species of commodities or labour, that we must seek for the causes of impoverishment.

Case of the physician.

The same reasoning applies to all the other cases mentioned by Smith. Take, for example, the case of the physician. He tells us that he is an unproductive labourer, because he does not directly produce something that has exchangeable value. But if he do the same thing indirectly, what is the difference? If the exertions of the physician be conducive to health, and if, as is undoubtedly the case, he enable others to produce more than they could do without his assistance, he is indirectly, at least, if not directly, a productive labourer. Dr Smith makes no scruple about admitting the title of the workman employed to repair a steam-engine to be enrolled in the productive class; and yet he would place a physician, who had been instrumental in saving the life of an Arkwright or a Watt, among those that are unproductive! It is impossible that these inconsitsencies and contradictions should have occurred to Smith; and the errors into which he has fallen in treating this important branch of the science, show in the strongest manner the necessity of advancing with extreme caution, and of subjecting every theory, how ingenious soever it may appear when first stated, to a severe and patient examination.

The amusements furnished by players, singers, and so forth, come under the description of luxuries, and have the same effect on the public wealth as the introduction of a taste for tobacco, tea, or other superfluities. They create new wants, and, by so doing, stimulate industry to procure the means of gratifying them. They are really, therefore, a means of production; and while they furnish elegant and amusing recreation, they add to the mass of useful material products.

Public functionaries productive labourers.

The productiveness of the higher class of functionaries is still more obvious. Far, indeed, from being unproductive, they are, when they discharge properly the duties of their high station, the most productive labourers in a state. Smith says, that the results of their service, that is, to use his own words, "the protection, security, and defence of the commonwealth any one year, will not purchase its protection, security, and defence for the year to come." But this is plainly an error. We do not say that the protection and security afforded by good government is directly a cause of wealth; but it is plain that, without it, the productive powers of industry could not be brought into efficient action. Smith allows that the material products produced by the society one year, form the means of producing its supplies of necessaries, conveniencies, and enjoyments during the following year. But without the security and protection afforded by government, these products would either not exist at all, or their quantity would be very greatly diminished. How, then, is it possible to deny that those whose labour is necessary to afford this security are productively employed? Take the case of the labourers employed to construct fences; no one ever presumed to doubt that their labour is productive; and yet they do not contribute directly to the production of corn or any other valuable product. The object of their industry is to give protection and security; to guard the fields that have been fertilized and planted by the husbandman from depredation; and to enable him to prosecute his employments without having his attention distracted by the care of watching. But if the security and protection afforded by hedgers and ditchers justly entitle them to be classed among those who contribute to enrich their country, on what principle can the labours of those public servants who protect property in the mass, and render every portion of it secure against hostile aggression, and the attacks of thieves and plunderers, be said to be unproductive? If the labourers who protect a single corn-field from the neighbouring crows and cattle be productive, then surely the judges and magistrates, the soldiers and sailors, who protect every field in the empire, and to whom it is owing that every class of inhabitants feel secure in the enjoyment of their property, rights, and privileges, have a right to be classed among those whose services are supereminently productive.

That much wealth has been unproductively consumed by the servants of the public, both in this and other countries, it is impossible to doubt. But we are not to argue, from abuses extrinsic to a beneficial institution, against the institution itself. If the public pay their servants excessive salaries, or employ more than are required for the purposes of good government and security, it is their own fault. Their conduct is similar to that of a manufacturer who should pay his labourers comparatively high wages, and employ more of them than he has occasion for. But though a state or an individual may act in this foolish and extravagant manner, it would be not a little rash thence to conclude that all public servants and all manufacturing labourers are unproductive! If the establishments which provide security and protection be formed on an extravagant scale, if we have more judges or magistrates, more soldiers or sailors, than are necessary, or if we pay them larger salaries than would suffice to procure the services of others quite as competent to discharge their duties, let their numbers and their salaries be reduced. The excess, if there be any, is not a fault inherent in the nature of such establishments, but results entirely from the extravagant scale on which they have been arranged.

Consumption ought not to be encouraged for the sake of stimulating production.

But, in showing that Dr Smith was mistaken in considering the consumption of menial servants, and of lawyers, physicians, and public functionaries, unproductive, we must beware of falling into the opposite extreme, and of countenancing the erroneous and infinitely more dangerous doctrine of those who contend that consumption, even when most unproductive, should be encouraged as a means of stimulating production, and of increasing the demand for labour! The consumption of the classes mentioned by Smith is advantageous, because they render services in return, which those who employ them, and who are the only proper judges in such a case, consider of greater value than the wages they pay them. But the case would be totally different were government, and those who employ labourers, to do so, not in order to profit by their services, but to stimulate production by their consumption. It is a fallacy and an absurdity to suppose that production is ever encouraged by a wasteful consumption of the products of industry. A man is stimulated to produce when he finds a ready market for the produce of his labour, that is, when he can readily exchange them for other products. And hence the true and only encouragement of industry consists, not in the increase of wasteful and improvident consumption, but in the increase of production. Every new product necessarily forms a new equivalent for, or a new means of, purchasing some other product. It must always be remembered, that the mere existence of a demand, how intense soever it may be, cannot of itself be a means of encouraging production. To become a real demander, a man must not only have the will, but also the power, to purchase the commodity he wishes to possess; or, in other words, he must be able to offer an equivalent for it. It is not in the nature of things that there can be any limits to our wish to possess the products of art and industry. The power to give effect to our wishes, or to furnish equivalents for the things we are desirous to obtain, is the only desideratum. The more, therefore, that this power is increased, that is, the more industrious individuals become, their means of buying the products of others will be proportionally increased, and the market rendered so much the more extensive.

Unproductive consumption not necessary to prevent gluts.

M. Sismondi and Mr Malthus have indeed contended, in opposition to this doctrine, that the productiveness of industry may be carried to excess, and that where there are great facilities of production, a large unproductive consumption is necessary to stimulate industry, and prevent the overloading of the market. But if we attend to the motives which make men engage in any branch of industry, we shall be satisfied that the apprehensions of these writers are unfounded, and that the utmost facility of production can never be productive of a permanent glut of the market, or require to be counteracted by means of unproductive expenditure. In exerting his productive powers, every man's object is either directly to consume the produce of his labour himself, or to exchange it for such commodities as he may wish to get from others. If he do the first,—if he directly consume the produce of his industry, there is an end of the matter, and it is evident that no conceivable increase of such produce could occasion a glut: If he do the second,—if he bring the produce of his industry to market, and offer it in exchange for other things, then, and then only, there may be glut; but why? Not because there has been an excess of production, but because the producers have not properly adapted their means to their ends. They wanted, for example, to obtain silks, and they offered cottons in exchange for them; the holders of silks being, however, already sufficiently supplied with cottons, wanted broad cloths. The cause of the glut is therefore obvious. It consists not in over-production, but in the production of cottons, which were not wanted, instead of broad cloths, which were. Let this error be rectified, and the glut will disappear. Even supposing the proprietors of silks to be not only supplied with cottons, but with cloth and every other commodity that the demanders could produce, it would not invalidate the principle for which we are contending. If those who want silks cannot get them from the holder by means of an exchange, they have an obvious resource at hand,—let them cease to produce the things which they do not want, and directly produce the silks which they do want, or substitutes for them. It is plain, therefore, that the utmost facility of production can never be a means of overloading the market. Too much of one thing may occasionally be produced; but it is quite impossible that there should be too great a supply of everything. For every excess on the one hand there is a corresponding deficiency on the other. The fault is not in producing too much, but in producing commodities which do not suit the tastes of those with whom we wish to exchange them, or which we cannot ourselves consume. If we attend to these two grand requisites, we may increase the power of production a ten or a twenty times, and we shall be as free of all excess as if we diminished it in the same proportion. Unproductive consumption is not therefore required to prevent the overloading of the market; and though it were, no government would be justified in carrying it on for such a purpose.[1]

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[1] M. Say was the first who showed, in a satisfactory manner, that effective demand depends upon production. (See his chapter *De Debouchés*.) But the principles from which his conclusions are drawn had been stated so early as 1752, in a tract of Dean Tucker, entitled Queries on the late Naturalization Bill. As this tract is now become of rare occurrence, we subjoin the queries referred to.

Consumption of Wealth.

It must, however, be remembered, consistently with what has been previously advanced, that in deciding as to the character of the consumption or expenditure of any quantity of wealth, we must look at its indirect and ultimate, as well as its direct and immediate, effects. An outlay of capital or labour which, if we take its immediate results only into account, we should pronounce improvident and unproductive, may yet be discovered, by looking at it in its different bearings, and in its remote influences, to be distinctly the reverse; and it is also true, that cases frequently occur in which that expenditure which is ruinous to the individual may not be injurious, but beneficial, to the state.

Montesquieu has said, "*Si les riches ne dépensent pas beaucoup, les pauvres mourront de faim.*"[1] The truth of this proposition has, however, been disputed; nor is this to be wondered at, as it may be either true or false according to the sense in which it is understood. If it be construed to mean that a rich man will be able directly to employ a greater number of servants or labourers if he spend his revenue in luxurious accommodations than if he lay out a part of it on the improvement of his estate, or accumulate it as a provision for his younger children, it is plainly erroneous. The demand for labour cannot be sensibly increased without an increase of capital; and it is quite impossible for those who spend their whole revenue on immediate gratifications to amass any capital, or consequently to employ an additional individual. But the proposition advanced by Montesquieu should not be interpreted in this confined sense, or as referring only to the influence of the expenditure of wealthy individuals on their own demand for labour, but as referring to its influence on that of the society; and if we so interpret it, and suppose it to mean that the lavish expenditure and luxury of the great and the affluent becomes a means of materially benefiting the poor, by exciting the emulation of others, who cannot expect, except through an increase of industry and economy, to be able to indulge in a similar scale of expense, it will, we apprehend, be found to be perfectly correct. To suppose, indeed, that the passion for luxurious gratifications should decline amongst the rich, and that men should notwithstanding continue equally industrious, is a contradiction. Riches are desirable only because they afford the means of obtaining these gratifications; and so powerful is the influence of a taste for them, that it may be doubted whether the extravagance which has ruined so many individuals, has not been, by giving birth to new arts and new efforts of emulation and ingenuity, of material advantage to the public.

These remarks are not made in the view of countenancing extravagant expenditure, but merely to show that those who attempt to decide as to the influence, in a public point of view, of any outlay of wealth, without endeavouring to appreciate and weigh its remote as well as its immediate effects, must, when they are right in their conclusions, be so only through accident. But without insisting farther on this point, it is abundantly certain that there is nothing to fear from the improvidence of individuals. There is not, as has been already observed, an instance of any people having ever missed an opportunity to save and amass; and in all tolerably well governed countries the principle of accumulation has always had a marked ascendency over the principle of expense.

Individuals are fully sensible of the value of the articles they expend; for in the vast majority of instances they are the produce of their own industry and frugality; and they rarely consume them unless in order to subsist, or to obtain some equivalent advantage. Such, however, it must be allowed, is not often the case with the consumption of governments and their servants. They do not consume their own wealth, but that of others; and this circumstance prevents them from being so much interested in its profitable outlay, or so much alive to the injurious consequences of wasteful expenditure, as their subjects. But economy on the part of governments, though more difficult to practise, is of infinitely greater importance than economy on the part of individuals. A private gentleman may, inasmuch as he is master of his own fortune, dispose of it as he pleases. He may act on the erroneous principle of profusion being a virtue, or he may attempt to excite the emulation and industry of his fellow-citizens by the splendour of his equipages and the magnificence of his mode of living. But government can with propriety do none of these things. It is merely a trustee for the affairs of others; and it is consequently bound to administer them as economically as possible. Were the principle admitted that government might raise money, not for the protection and good government of the state, but in order to excite industry and ingenuity by the pressure of taxation, or the luxury of public functionaries, an avenue would be opened to every species of malversation. It is indeed pretty certain that no people would submit to be taxed for such purposes; but if they did, the flagrant abuses to which it would inevitably lead could scarcely fail of ending either in revolution or in national poverty and degradation. Economy in expenditure is, upon all occasions, the first virtue of a government, and the most pressing of its duties.

Conclusion.

We have now seen how labour may be rendered most productive of wealth—how that wealth is distributed among the various classes of society—and how it may be most advantageously consumed. We have seen the indissoluble connection between private and public opulence; that whatever has any tendency to increase the former, must, to the same extent, increase the latter; and that SECURITY OF PROPERTY, FREEDOM OF INDUSTRY, AND MODERATION IN THE PUBLIC EXPENDITURE, are the only, as they are the certain, means by which the various powers and resources of human talent and ingenuity may be called into action, and society made continually to advance in the career of wealth and civilization. Every increase of security or of freedom is a benefit, as every diminution, whether of the one or the other, is an evil. It is by the spontaneous and unconstrained efforts of individuals to improve their condition and rise in the world, that nations become rich and powerful. The labour and the savings of individuals are at once the source and the measure of national opulence and public prosperity. They may be compared to the drops of dew, which invigorate and mature all vegetable nature. None of them has singly any perceptible influence; but we owe the foliage of summer and the fruits of autumn to their combined action. (C. C.)

"Whether it is possible, in the nature of things, for all trades and professions to be overstocked? And whether, if you were to remove any proportional number from each calling, the remainder would not have the same grounds of complaint they had before?

"Whether, in fact, any tradesman thinks there are too many of other occupations to become his customers; though narrow selfish views lead him to wish there were fewer of his own trade?

"If a particular trade be at any time overstocked, will not the disease cure itself? That is, will not some persons take to other trades, and fewer young people be bred up to that which is least profitable? And whether any other remedy but this is not, in fact, curing one transient disorder by bringing on many which are dangerous, and will grow inveterate?

"Whether it is not an infallible maxim, that one man's labour creates employment for another?" (P. 13.)

For a farther demonstration of the same principle, see Mill's Commerce Defended, p. 80.

[1] *Esprit de Loix*, liv. vii. cap. 4.

POLL, a word used in ancient writings for the head. Hence to poll is either to vote, or to enter down the names of those persons who give their votes at an election.

Poll-*Money*, or *Capitation*, a tax imposed by authority of parliament on the person or head, either on all indifferently, or according to some known mark or distinction. Thus by the statute 18 Car. II. every subject in the kingdom was assessed by the head, or poll, according to his degree; a duke L.100, a marquis L.80, a baronet L.30, a knight L.20, an esquire L.10, and every single private person 12d. This was no new tax, as appears by former acts of parliament.

POLLARD, or Crocard, the name given to a sort of base money current in Ireland in the time of Edward I. (See Simon's *History of Irish Coins*, p. 15.)

POLLEN, the fecundating or fertilizing dust contained within the antheræ or tops of the stamina, and dispersed upon the female organ when ripe, for the purposes of impregnation. (See Botany.)

POLLICIS Pressio, and Pollicis Versio, were used at the combats of gladiators as signals of life or death to the vanquished combatant; in other words, to the victor to spare or take the life of his antagonist. The *pollicis pressio*, by which the people granted life to the prostrate gladiator, was no more than a clenching of the fingers of both hands together, and so holding upright the two thumbs close together. The *pollicis versio*, which authorized the victor to kill the vanquished as a coward, was the bending back of the thumbs. Such is the opinion of Dacier; but others say that the *pollicis pressio* was when the people held up one hand with the thumb bent, and the *pollicis versio* when they showed the hand with the thumb raised. Authors, however, are not perfectly agreed on this matter; though the phrases *pollicem premere* and *pollicem vertere* frequently occur in the Latin classics as indications of the people's will that a gladiator should live or die.

POLLIO, Caius Asinius, a celebrated Latin poet and orator, was of consular dignity, and composed some tragedies which were much esteemed, but are now unfortunately lost. He was the first who opened at Rome a library for the use of the public. Being the friend of Mark Antony, he was prevented from complying with the solicitations of Augustus, who pressed him to embrace his party. At length Augustus having written some verses against Pollio, he was urged to answer them; upon which he observed, "I shall take care of writing against a man who has the power of proscribing us." He is praised by Virgil and Horace, both of whom he patronized.

There was another *Pollio*, a friend of Augustus, who used to feed his fishes with human flesh. This cruelty was discovered when one of his servants broke a glass in the presence of Augustus, who had been invited to a feast. The master ordered the servant to be seized, but he threw himself at the feet of the emperor, and begged him to interfere, and not suffer him to be devoured by fishes. Upon this the grounds of his apprehension were examined; and Augustus, astonished at the barbarity of his favourite, caused the servant to be dismissed, all the fish-ponds to be filled up, and the crystal glasses of Pollio to be broken in pieces.

POLLOOR, a town of Hindustan, in the Carnatic, seventy-seven miles south-west from Madras. Long. 79. 15. E. Lat. 12. 30. N.

POLLUX, the son of Tyndareus king of Amyclæ, and of Leda, according to the tradition followed by Homer, was by late writers, along with his sister Helen, made the child of Jupiter, who gained the affections of Lydia in the form of a swan. He was the brother of Castor and Clytemnestra, and was born in the island Pephnos, on the coast of Laconia. Pollux was distinguished for his skill in boxing and wrestling, whilst Castor was famed for his horsemanship. They both took an active part in the hunt of the Calydonian boar, and joined Jason in his search for the golden fleece. On their return they were invited by their cousins Lynceus and Idas, the sons of Aphareus, to attend their marriage with Phœbe and Hilæira, daughters of Leucippus, prince of Messene. They, however, became so enamoured of the two brides, that they forcibly attempted to carry them off, when Castor was killed by Idas. Jupiter, enraged at this proceeding, struck Idas with a thunderbolt; and, to comfort Pollux, offered him his choice of immortality, or, if he preferred it, to live and die alternately with his brother. He chose the latter. Another tradition makes Pollux show his fraternal love by dividing his immortality in such a way that Castor lived one day and Pollux the next; but Homer does not allude to this. Pollux was said to have married Phœbe, daughter of Leucippus, and to have had by her Mnesileus. Having had a dispute with his cousin Idas respecting the division of some spoil they had driven from Messenia, he is represented by one tradition as having perished by the hands of Idas.

Pollux, *Julius*, a Greek writer of antiquity, was born at Naucrates, a town in Egypt, and flourished in the reign of the Emperor Commodus. He was educated under the Sophists, and made great progress in grammatical and critical learning. Having taught rhetoric at Athens, he became so famous that he was made preceptor of the Emperor Commodus. He drew up for the use of the latter, and inscribed to him, whilst his father Marcus Antoninus was living, an *Onomasticon*, or Greek vocabulary, which he divided into ten books. It is extant, and contains a vast variety of synonymous words and phrases, ranged under the general classes of things. It was intended to facilitate the knowledge of the Greek language to the young prince; and it is still very useful to all who have a mind to be perfect in that tongue. The first edition of the *Onomasticon* was printed at Venice by Aldus in 1502, and a Latin version was afterwards published along with it; but there was no correct and handsome edition of this work till that of Amsterdam, 1706, in folio, by Lederlinus and Hemsterhusius. Lederlinus went through the first seven books, and corrected the text and the version, subjoining his own along with the notes of Salmasius, Vossius, Valesius, and Kuhnius. Pollux wrote many other things, none of which remains. He lived to the age of fifty-eight. Philostratus and Lucian have both treated him with much contempt and ridicule. (Philostrat. *de Vit. Sophist.* lib. ii.; and Lucian *in Rhetorum Præceptore*.)

POLO, a small island, one of the Philippines, off the western coast of Luzon, about the fifteenth degree of north latitude. It is twenty-five miles in length by three in average breadth.

POLOONSHAH, a small town and district of Hindustan, in the province of Hyderabad, tributary to the nizam. It is situated in a rich and luxuriant valley, and has a fort 300 yards square, with a large round tower at each angle. It is seventy miles north-west from Rajahmundry. Long. 81. 10. E. Lat. 17. 35. N.

POLTROON, or Poltron, a coward or dastard, wanting the courage requisite to perform anything great or noble. The word is borrowed from the French, who, according to Salmasius, derived it *a pollice truncato;* because anciently those who wished to avoid going to the wars cut off their thumb. But Ménage, with more probability, derives it from the Italian *poltrone*, and that from *poltro*, a bed; because timorous and pusillanimous people take pleasure in lying a-bed. Others, again, derive the word from the Italian *poltro*, a colt, because of that creature's readiness to run away.

POLYÆNUS, the name of many famous men recorded by the ancient writers. Amongst them was Julius Polyænus, of whom we have some Greek epigrams extant in the first book of the *Anthologia*. The Polyænus whom it most concerns us to know about, is the author of the eight books of the Stratagems of Illustrious Commanders in War. He was probably a Macedonian, and perhaps a soldier in the early part of his life; but of this there is no certainty. He was undoubtedly a rhetorician and a pleader of causes; and, from the dedication of his work to the Emperors Antoninus and Verus, he appears to have lived towards the latter part of the second century. The *Stratagemata* were published in Greek by Isaac Casaubon, with notes, 1589, in 12mo; but no good edition of them appeared till that of Leyden, published in 1690, in 8vo.

We have in this work the various stratagems employed by above three hundred captains and generals of armies, chiefly Greeks and barbarians, for the Romans seldom resorted to such arts; and, besides, Polyænus has shown that he was little acquainted with Roman affairs. A great number of these stratagems appear to us to be ridiculous or impracticable; and neither the generals, nor even common soldiers, of our days, would be found simple enough to be caught by them. Few of the latter order indeed are capable of reading Polyænus's Stratagems; and if they were, they would reap but little benefit from the book. It is useful, however, to such as study the Greek language and antiquity; for many things will be found in it illustrative of the customs and opinions of ancient times. The sixth and seventh books are both imperfect.

Polyænus composed several other works besides the *Stratagemata*. Stobœus has produced some passages out of a book *De Republica Macedonum;* and Suidas mentions a piece concerning the Thebans. If death had not prevented him, he would have written Memorabilia of the Emperors Antoninus and Verus, which he promised to undertake in the preface to his sixth book of Stratagems. Casaubon, in the dedication of Polyænus to Mornæus, calls him an elegant, acute, and learned writer.

POLYANTHEA, a collection of common-places arranged in alphabetical order, for the use of orators, preachers, and others. The word is formed from the Greek ϖολυς, *much*, and ἀνθος, *flower*, and has much the same meaning with anthology or florilege. The first author of the Polyanthea was Dominic Nanni di Mirabellio, whose labour has been improved on by Amantius and Torsius; and since their time by Langius, under the title of *Polyanthea Nova*, 1613.

POLYBIUS, a celebrated Greek historian, was the son of Lycortas, a native of Megalopolis, in Arcadia, who succeeded Philopœmen in the chief direction of the Achæan league. His father, therefore, must have been one of the most distinguished men of his time; and we find him accordingly taking part in the principal transactions of his country. The exact date of his birth is unknown, but it is generally believed that it took place between B. C. 210–200; and his death was, therefore, not earlier than B. C. 129, as he lived to the advanced age of eighty-two. Plutarch tells us that the character of Polybius was formed under the eye of Philopœmen; and that at the funeral of that general he carried the urn which contained his ashes, B. C. 182. The following year he was, along with his father and the son of the celebrated Aratus, appointed as ambassador, to return thanks to Ptolemy Epiphanes for the assistance which he had offered to the Achæans; but the death of that prince took place before the ambassadors left the Peloponnesus. In the war which arose between the Romans and Perseus king of Macedonia, the opinion of Polybius and his father Lycortas was, that the Achæans should observe a strict neutrality; but they were overruled, and the Achæans were implicated in the ruin of Perseus. To break the spirit of the Achæans, and to prevent any further attempts at insurrection, more than a thousand of the principal citizens were sent to Rome, and afterwards dispersed throughout the different cities of Italy. Polybius was one of these exiles; but he was so far favoured that he was allowed to remain in Rome, where he resided for sixteen years, from B. C. 167 to 151. He became the intimate friend and instructor of Scipio the younger, at that time only eighteen years old, and who afterwards showed how much benefit he had derived from the care Polybius bestowed on his education. At last, through the influence of Scipio and Cato, the senate was prevailed on to allow the Achæan exiles to return to their country; but of the original thousand only three hundred survived to enjoy the permission thus granted to them. Polybius seems now to have employed his time chiefly in travelling, with the view of acquiring more accurate notions of geography. He examined with great care and minuteness the passes of the Alps, that he might be enabled to give a correct account of the passage of Hannibal. He afterwards visited Gaul, Spain, and Africa, to which latter country he accompanied, Scipio, B. C. 146, when that general took and destroyed Carthage. But the calamities of his own unhappy country called him away, and he hurried to the Peloponnesus, where his presence, however, was unable to save Corinth from the fate which had overtaken Carthage. He did all in his power to prevail on his countrymen to submit to a fate which they only made worse by resistance; and the Roman deputies felt such reliance on his good intentions, that they appointed him to the office of judge in all disputes that might arise in any part of the Peloponnesus. He gradually acquired the esteem of his countrymen, and many of the cities of Greece erected statues to his honour. He subsequently extended his travels into Egypt, which he visited in the reign of Ptolemy Physcon. Whether he was present with Scipio at the siege of Numantia, B. C. 134, we are nowhere told; but he left behind him a work on the subject. He also wrote a biographical sketch of Philopœmen, a work on Military Tactics, and another on the Equatorial Regions.

His principal work, however, was entitled General History, though it referred more particularly to a space of fifty-three years (from 220 to 168 B. C.), from the commencement of the second Punic war, where the historian Timæus, and Aratus of Sicyon, had stopped, to the defeat of Perseus, king of Macedonia, by the Romans. It was divided into forty books, of which we now only possess the first five entire, and rather long fragments of most of the others. The first two books are occupied with introductory matter, giving a sketch of the events that happened anterior to the second Punic war. He explains the causes which gave rise to the first Punic war, and then relates the various events which took place during the twenty-four years it lasted. He gives also some account of the contest which arose between the Carthaginians and their stipendiaries. The second book contains the wars of the Æolians, Illyrians, Achæans, the expeditions of the Romans against the Illyrians and Gauls, and the transactions of Antigonus king of Macedonia, and Cleomenes king of Sparta, occupying a period of seventeen years, from B. C. 237 to 220. The third book enters into what is more properly the subject of his history, and, after explaining what he considers to be the true causes of the second Punic war, follows the path of Hannibal's victories as far as the battle of Cannæ, B. C. 216. Yet it would appear that he was defective in method, as the fourth book carries us back to anterior events, which had happened in 220, 219, 218, B. C. After a sketch of the people of the East during the reign of Philip, son of Demetrius king of Macedonia, of Ariarathes king of Cappadocia, of Antiochus king of Syria, and Ptolemy Philopator king of Egypt, this book traces the history of wars and seditions in Greece. In the fifth book we have the victories of Philip, the wars in Syria between Antiochus and Ptolemy, and the confederated arms of Greece turned against Rome. It would be useless to give any detailed account of the fragments of the thirty-five books that have been preserved; but we know that the thirty-ninth book ended with the destruction of Corinth, B. C. 146.

There have been many editions of this work, but the most critical is that of J. Schweighäuser, eight vols. 8vo, Leipzig. 1789–1795. It has been translated into English by Hampton; into French by Folard, six vols. Par. 1727, with numerous plates and critical annotations; into German by Chr. Seybold, Lemgo; 1779–1783, and by L. Storch, Prenzl. 1828. See *Polybii et Appiani Historiarum Excerpta Vaticana recognita a J. F. Lucht*, Altona, 1830.

POLYCARP, one of the most ancient Fathers of the Christian church, was born towards the end of the reign of Nero, probably at Smyrna, where he was educated at the expense of Calista, a noble matron distinguished alike by her piety and charity. He was unquestionably a disciple of St John the Evangelist, and he conversed familiarly with others of the apostles. When of a proper age, Bucolus ordained him a deacon and a catechist of his church; and upon his death he succeeded Bucolus in the bishopric, to which he is said to have been consecrated by St John, who also directed his Apocalypse, amongst others, to him, under the title of "the angel of the church of Smyrna." When the controversy about the observation of Easter began to run high between the eastern and western churches, he went to Rome to discourse with those who were of the opposite party. The Roman see was then occupied by Anicetus, with whom he had many conferences, which were carried on in the most amicable manner; and though neither of them could bring the other to embrace his opinion, they both retained their own sentiments without violating that charity which is the great law of religion.

Whilst at Rome he particularly opposed the heresies of Marcian and Valentinus. His conduct on this occasion is related by Irenæus, who informs us, that when Polycarp passed Marcian in the street without speaking, Marcian said, "Polycarp, own us;" to which he replied with indignation, "I own thee to be the first-born of Satan." Irenæus adds, that when any heretical doctrines were spoken in his presence, he would stop his ears and say, "Good God, to what times hast thou reserved me, that I should hear such things," and immediately left the place. He was accustomed to mention, that St John, going into a bath at Ephesus, and finding in it Cerinthus the heretic, immediately started back without bathing, crying out, "Let us run away, lest the bath should fall upon us whilst Cerinthus, the enemy of truth, is in it." Polycarp governed the church of Smyrna with apostolic purity, till he suffered martyrdom in the seventh year of Marcus Aurelius. The manner of his death is thus related. The persecution waxing hot at Smyrna, and many having sealed their faith with their blood, the general cry was, "Away with the impious; let Polycarp be sought for." Upon this he privately withdrew into a neighbouring village, where he continued for some time praying day and night for the peace of the church. He was thus employed, when one night he fell into a trance and dreamed that his pillow took fire, and was burned to ashes. When he awoke, he told his friends the circumstance, and pronounced it a presage that he should be burned alive for the cause of Christ. Three days afterwards, in order to escape the incessant search after him, he retired into another village. His enemies, however, were at hand, and having seized upon two youths, one of whom they forced by stripes to confess, they were by these lads conducted to his lodging. He might have saved himself by getting into another house; but he submitted, saying, "The will of the Lord be done." He therefore came down from his bed-chamber, and saluting his persecutors with a serene and cheerful countenance, he ordered a table to be set before them with provisions, invited them to partake, and only requested for himself one hour for prayer; after which he was set upon an ass, and conducted towards Smyrna. On the road he met Herod, a justice of the province, and his father, who were the principal instigators of the persecution. Herod took him up into his chariot, and strenuously endeavoured to undermine his constancy; but having failed in the attempt, he thrust him out of the chariot with so much violence and indignation, that his thigh was bruised by the fall. When at the place of execution, there came, as is said, a voice from heaven, saying, "Polycarp, be strong, and quit thyself like a man." When before the tribunal he was urged to swear by the genius of Cæsar. "Repent," said the proconsul, "and say with us, take away the impious." Upon this the martyr, looking round at the crowd with a severe and angry countenance, beckoned with his hand, and looking up to heaven, said with a sigh, in a very different tone from what they expected, "Take away the impious." At last, having confessed himself to be a Christian, the crier thrice proclaimed his confession, and the people shouted, "This is the great doctor of Asia, and the father of the Christians; this is the destroyer of our gods, who teaches men not to do sacrifice to, or worship, the deities." When the fire was prepared, Polycarp requested not to be nailed, as usual, but only tied to the stake; and after a short prayer, which he pronounced with a clear and audible voice, the executioner blew up the fire, which increasing to a mighty flame, "Behold a wonder seen by us, who were purposely reserved," says the relator, "that we might declare it to others; the flames, disposing themselves into the resemblance of an arch, like the sails of a ship swelled with the wind, gently encircled the body of the martyr, who stood all the while in the midst, not like roasted flesh, but like the gold or silver purified in the furnace, his body sending forth a delightful fragrance, which, like frankincense or some other costly spices, presented itself to our senses. The infidels, exasperated by the miracle, commanded a spearman to run him through with a sword; which he had no sooner done, than such a vast quantity of blood flowed from the wound as extinguished the fire, and then a dove was seen to fly from the wound, which some suppose to have been his soul, clothed in a visible shape at the time of its departure."[1] The Christians endeavoured to carry off his body entire, but were not allowed by the irenarch or justice, who commanded it to be burned to ashes. The bones, however, were gathered up, and decently interred by the Christians.

Thus died St Polycarp, on the seventh of the kalends of May, in the year 167. The amphitheatre on which he suffered was mostly remaining not many years ago; and his tomb, which is in a little chapel in the side of a mountain, on the south-east of the city, was solemnly visited by the Greeks on the festival day; whilst, for maintaining and repairing it, travellers were wont to throw a few aspers into an earthen pot which stands there for the purpose. He wrote some homilies and epistles, which are now lost, except that to the Philippians, which is a truly pious and Christian production, containing short and useful precepts and rules of life, which St Jerome informs us was even in his time read in the public assemblies of the Asiatic churches. It is singularly useful in proving the authenticity of the books of the New Testament; for he has cited several passages and expressions from St Matthew, St Luke, the Acts, St Paul's Epistles to the Philippians, Ephesians, Galatians, Corinthians, Romans, Thessalonians, Colossians, the first Epistle to Timothy, first Epistle of St John, and first Epistle of

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[1] The miraculous part of this account is ridiculed by Dr Middleton in his Free Inquiry and Defence of it; but something is offered in its favour by Mr Jorton, who observes, "The circumstances are sufficient only to create a pause and a doubt." (*Remarks on Ecclesiastical History*, vol. i)

Peter; and makes particular mention of St Paul's Epistle to the Ephesians. Indeed the whole of this epistle consists of phrases and sentiments taken from the New Testament.

POLYCHORD, from the Greek πολυχορδος, a bow instrument resembling the double-bass, but smaller. It had ten strings, and a compass from C the second space in the bass clef, to C the third space in the treble clef. Its finger-board could be lengthened or shortened at pleasure, in order to tune the instrument. It was invented in 1799, by Hilmer, at Leipzig.

POLYCLETUS, a celebrated statuary and architect, who is said to have been a native of Sicyon, and a disciple of Ageladas. He was the fellow-disciple of Myron. But it seems doubtful whether he was born at Sicyon, since Plato, who was his contemporary, calls him in his dialogue entitled *Protagoras*, a native of Argos, and Maximus of Tyre expressly says that the statue of Juno was a work of Polycletus of Argos. He is not, however, to be confounded with another statuary of Argos, who lived at a later period. It is believed that he was born about 480 B. C., and was still alive 405 B. C., after the battle of Œgos-potamos, as Pausanias states that he executed one of the bronze tripods which the Spartans consecrated in the temple of Apollo at Amyclæ. By far the most celebrated of his statues was that of the Argive Juno, which is thought to have been executed about 416 B. C., eighteen years after the consecration of Jupiter of Olympia, and twenty or twenty-four years after that of the Minerva of the Parthenon. The statue of Juno was colossal, and seated on a golden throne, in a majestic attitude; the head, breast, arms, and feet, were of ivory, and the drapery of gold. She had a crown on her head, on which the artist had represented the Hours and Graces. In one hand she held a sceptre, with a cuckoo seated on it; in the other she bore a pomegranate. Her mantle was ornamented with vine branches, and her feet rested on the skin of a lion. Another celebrated statue was called *Canon*, or the Rule, because it was so perfect that it was looked upon as the model after which all others ought to be made. Galen says, that he composed a treatise on the proportions which constitute the harmony, and consequently the beauty of the human body, and that his statue was designed to illustrate his work. Winckelman suspects that this statue was also called Doryphorus, as Lysippus states that he formed his taste principally by studying it. The group called Canephoræ, two young girls carrying sacred baskets on their heads, formed part of the plunder of Verres, carried off from Messana in Sicily. It is believed that we have still a copy of his Diadumenos, in a young athlete attaching to his forehead a garland as the sign of victory, which is now in the Museo Borbonico at Naples. This Diadumenos was sold for about one hundred talents. As an architect, Polycletus is known to have constructed two buildings at Epidaurus, which are highly spoken of; the Tholus, a circular building, and a theatre, of which considerable remains are still to be seen. Varro thought that he had too much sameness in his statues; and Quintilian says that he never was able to represent the awful majesty of the gods, probably meaning such statues as the Jupiter and Minerva of Phidias. Amongst his pupils were Asopodorus, Aristides, Dinon, Athenodorus, and Pericletus the brother of Naucydes.

POLYCROTA, in the naval architecture of the ancients, a word used to express such of their galleys as had three, four, five, or more tiers of benches, seated at different heights. They were distinguished by this term from the *monocrota*, or those which had only single rows of oars. The number of rows of benches in the polycrote galleys has given occasion to some to suppose that those vessels were of such a height above the water as is scarcely credible. Commentators, however, are not at all agreed as to the construction of these vessels.

POLYDORE Virgil. See Virgil.

POLYDORUS, a son of Priam by Hecuba, or, according to others, by Laothe, the daughter of Altes, king of Pedasus. Being young and inexperienced when Troy was besieged by the Greeks, his father removed him to the court of Polymnestor, king of Thrace, to whose care he intrusted the greater part of his treasures, until his country should be freed from foreign invasion. On the death of Priam, Polymnestor made himself master of the riches which were in his possession; and to insure them the more, he murdered the young prince, and threw his body into the sea, where it was found by Hecuba. According to Virgil, his body was buried near the shore by his assassin; and there grew on his grave a myrtle, the boughs of which dropped blood, when Æneas, going to Italy, attempted to tear them from the tree.

POLYGAMIA (πολυς, *many*, and γαμος, *marriage*) is a term expressing an intercommunication of sexes, and is applied by Linnæus both to plants and to flowers. A polygamous plant is that which bears both hermaphrodite flowers, and male or female, or both.

POLYGAMY, a plurality of wives or husbands, in the possession of one man or woman at the same time.

Polygamy is so universally esteemed unlawful, and even unnatural, throughout Europe, and in all Christian countries, that we have generally reasoned upon this conviction. Both religion and reason appear at first sight at least to condemn it; and with this view of the subject mankind in general remain satisfied. But some bolder geniuses have taken the opposite side of the question, cast off the prejudices of education, and attempted to show that polygamy is not unlawful, but that it is just and necessary, and would be a public benefit. Such writers recur to the common subterfuge, of which every setter up of strange gods, and every conscientious troubler of the public peace, have artfully availed themselves, to silence the clamour of expostulation.

Dr Percival[1] has very justly observed, that the practice is brutal, destructive to friendship and moral sentiment, inconsistent with one great end of marriage (the education of children), and subversive of the natural rights of more than half of the species. Besides, it is injurious to population, and therefore can never be countenanced or allowed in a well-regulated state; for though the number of females in the world may considerably exceed the number of males, yet there are more men capable of propagating their species than women capable of bearing children; and it is a well-known fact, that Armenia, in which a plurality of wives is not allowed, abounds more with inhabitants than any other province of the Turkish empire.

Indeed it appears, that in several countries where it is allowed, the inhabitants do not take advantage of it. "The Europeans," says M. Niebuhr,[2] "are mistaken in thinking the state of marriage so different amongst the Mussulmans from what it is with Christian nations. I could not discern any such difference in Arabia. The women of that country seem to be as free and as happy as those of Europe possibly can be. Polygamy is permitted, indeed, amongst Mahommedans, and the delicacy of our ladies is shocked at this idea; but the Arabians rarely avail themselves of the privilege of marrying four lawful wives, and entertaining at the same time any number of female slaves. None but rich voluptuaries marry so many wives, and their conduct is blamed by all sober men. Men of sense, indeed, think this privilege rather troublesome than convenient. A husband is by law obliged to treat his wives suitably to their condition, and to dispense his favours amongst them with perfect equality; but these are duties not a little disagreeable to most Mussulmans; and such modes of luxury are too expensive to the Arabians, who are seldom in easy circumstances. I must, however, except one case; for it sometimes happens that a man marries a number of wives in the way of commercial speculation. I know a Mullah, in a town near the Euphrates, who had married four wives, and was supported by the profits of their labour."

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[1] Phil. Trans. vol. lxvi. part i. p. 163.

[2] Niebuhr's Travels.

Selden has proved, in his *Uxor Hebraica*, that plurality of wives was allowed, not only amongst the Hebrews, but also amongst all other nations, and in all ages. It is true, the ancient Romans were more severe in their morals, and never practised it, though it was not forbidden amongst them; and Mark Antony is mentioned as the first who took the liberty of having two wives.

From that time it became pretty frequent in the empire till the reigns of Theodosius, Honorius, and Arcadius, who first prohibited it by express law in 393. After this the Emperor Valentinian, by an edict, permitted all the subjects of the empire, if they pleased, to marry several wives. Nor does it appear, from the ecclesiastical history of those times, that the bishops made any opposition to the introduction of polygamy. In effect, there are some even amongst the Christian casuists who do not look on polygamy as in itself criminal. Jurieu observes, that the prohibition of polygamy is a positive law, but from which a man may be exempted by sovereign necessity. Baillet adds, that the example of the patriarchs is a powerful argument in favour of polygamy. Of these arguments we shall speak hereafter.

It has been much disputed amongst the doctors of the civil law whether polygamy be adultery. In the Roman law it is denominated *stuprum*, and punished as such, that is, in some cases capitally. But a smaller punishment is more consistent with the Jewish law, in which the prohibition of adultery is perpetual, but that of polygamy temporary only.

Bernardus Ochinus, general of the order of Capucins, and afterwards a Protestant, published, about the middle of the sixteenth century, Dialogues in favour of Polygamy, which were answered by Theodore Beza. And about the close of the last century, an artful treatise was published at London in behalf of a plurality of wives, under the title of *Polygamia Triumphatrix*, the author of which assumes the name of *Theophilus Aletheus*, though his true name was *Lyserus*. He was a native of Saxony, and his work has been answered by several writers.

A new argument in favour of polygamy has been adduced by Mr Bruce, on the principle, that in some parts of the world the proportion of female children is much greater than that of the males. "From diligent inquiry," says he, "into the south and scripture part of Mesopotamia, Armenia, and Syria, from Mousul or Nineveh, to Aleppo and Antioch, I find the proportion to be fully two women to one man. There is indeed a fraction over, but it is not a considerable one. From Latikea, Laodicea *ad mare*, down the coast of Syria to Sidon, the number is nearly three, or two and three fourths, to one man. Through the Holy Land, the country called *Horan*, in the Isthmus of Suez, and the parts of the Delta unfrequented by strangers, it is something less than three. But from Suez to the Straits of Babelmandel, which contains the three Arabias, the proportion is fully four women to one man; which, I have reason to believe, holds as far as the line, and 30° beyond it. The imam of Sama was not an old man when I was in Arabia Felix in 1769; but he had eighty-eight children then alive, of whom fourteen only were sons. The priest of the Nile had seventy and odd children; of whom, as I remember, above fifty were daughters.

"It may be objected, that Dr Arbuthnot, in quoting the bills of mortality for twenty years, gave the most unexceptionable grounds for his opinion; and that my single exception of what happens in a foreign country, without further foundation, cannot be admitted as equivalent testimony; and I am ready to admit this objection, as there are no bills of mortality in any of these countries. I shall therefore say in what manner I attained the knowledge which I have just mentioned. Whenever I went into a town, village, or inhabited place, dwelt long in a mountain, or travelled journeys with any set of people, I always made it my business to inquire how many children they had, or their fathers, their next neighbours or acquaintance. I then asked my landlord at Sidon, suppose him a weaver, how many children he has had? He tells me how many sons and how many daughters. The next I ask is a tailor, a smith, &c., in short every man who is not a stranger, from whom I can get the proper information. I say, therefore, that a medium of both sexes, arising from three or four hundred families, indiscriminately taken, shall be the proportion in which one differs from the other; and this, I am confident, will give the result to be three women in 50° of the 90° under every meridian of the globe."

The same author corroborates his argument by supposing that Mahommed perceived this disproportion, and that upon it he founded his institution allowing one man to have four wives. "With this view he enacted, or rather revived, the law which gave liberty to every individual to marry four wives, each of whom was to be equal in rank and honour, without any preference but what the predilection of the husband gave her."

Having thus established, as he supposes, the necessity of polygamy in the East, Bruce proceeds to consider whether there is not some other reasons why it should not be practised in Britain further than the mere equality in numbers of the sexes to one another. This reason he finds in the difference between the constitutions of the Europeans and eastern nations. "Women in England," says he, "are capable of child-bearing at fourteen; let the other term be forty-eight, when they bear no more; thirty-four years therefore an English woman bears children. At the age of fourteen or fifteen they are objects of our love; they are endeared by bearing us children after that time; and none, I hope, will pretend, that at forty-eight and fifty an Englishwoman is not an agreeable companion. The Arab, on the other hand, if she begins to bear children at eleven, seldom or never has a child after twenty. The time, then, of her child-bearing is nine years; and four women, taken altogether, have then the term of thirty-six. So that the English woman that bears children for thirty-four years has only two years less than the term enjoyed by the four wives whom Mahommed has allowed; and if it be granted that an English wife may bear at fifty, the terms are equal. But there are other grievous differences. An Arabian girl at eleven years old, by her youth and beauty, is the object of man's desire: being an infant, however, in understanding, she is not a rational companion for him. A man marries there, say at twenty; and before he is thirty, his wife, improved as a companion, ceases to be the object of his desires and a mother of children: so that all the best and most vigorous of his days are spent with a woman he cannot love; and with her he would be destined to live forty or forty-five years, without comfort to himself by increase of family, or utility to the public. The reasons, then, against polygamy, which subsist in England, do not by any means subsist in Arabia; and that being the case, it would be unworthy of the wisdom of God, and an unevenness in his ways, which we shall never see, to subject two nations under such different circumstances absolutely to the same observances."

To all this argumentation, however, it may be replied, that whatever we may now suppose to be the constitution of nature in the warmer parts of the globe, it certainly was different at the beginning. We cannot, indeed, ascertain the exact position of the Garden of Eden; but it is with reason supposed not to have been far from the ancient seat of Babylon. In that country, therefore, where Mr Bruce contends that four women are necessary to the comfort of one man, it pleased God to grant only one to the first man; and that, too, when there was more occasion for population than ever there has been since, because the whole earth was to be peopled from a single pair. Matters were not altered at the Flood; for Noah had but one wife. And this is the very argument used by our Saviour himself when speaking of divorce without any sufficient cause, and then marrying another woman, which is a species of polygamy.

Again, with respect to the alleged multiplicity of females in the eastern part of the world, it is by no means probable that the calculations of Mr Bruce or any other person can be admitted in this case. History mentions no such thing in any nation; and considering the vast destruction amongst the male part of the human species more than that of the females, by war and other accidents, we may safely say, that if four women children were born for every single male, there would in such countries be five or six grown-up women for every man; a proportion which we may venture to affirm does not, and never did, exist anywhere in the world. That it was not so in former times, we can only judge from the particular examples recorded in history, and these are but few. We read in the Greek history, indeed, of the fifty daughters of Danaus; but these are matched by as many sons of another man. Job had only one wife, yet had seven sons and but three daughters. Jacob had two wives, who bore twelve sons, and only one daughter. Abraham had only one child by his first wife, and that was a son. By his second wife Keturah he had six sons; and, considering his advanced age at the time he married her, it is by no means probable that he could have twenty-four daughters; nay, if, as Mr Bruce tells us, the women in the eastern countries bear children only for nine years, it was impossible she could have so many. Gideon, who had many wives, had no fewer than seventy sons by these wives, and even his concubine had a son; so that if all these women had produced according to Mr Bruce's proportion, of nearly three females to one male, he must have had almost two hundred and eighty-four children; a more numerous family probably than any of which Mr Bruce's eastern acquaintance can boast.

With regard to the subject, however, it must be observed, that the procreation of male or female children depends in some degree on the health and vigour of the parents. It is by no means improbable, therefore, that the eastern voluptuaries, whose constitutions are debilitated by their excesses, may have many more female than male children born to them.

The boldest defence of polygamy that has appeared in modern times is that by the Rev. Mr Madan, who published a treatise artfully vindicating and strongly recommending it, under the title of Thelyphthora, or a Treatise on Female Ruin, in its Causes, Effects, Consequences, Prevention, and Remedy. Marriage, according to this writer, simply and wholly consists in the act of personal union, or *actus coitus*. Adultery, he says, is never used in the sacred writings but to denote the defilement of a betrothed or married woman, and to this sense he restricts the use of the term; so that a married man, in his opinion, is no adulterer, if his commerce with the sex be confined to single women, who are under no obligations by espousals or marriage to other men; but, on the other hand, the woman who should dare to have even but once an intrigue with any other man besides her husband, let him have as many wives as Solomon, would, *ipso facto*, be an adulteress, and ought, together with her gallant, to be punished with immediate death. This, he boldly says, is the law of God, and on this foundation he limits the privilege of polygamy to the man; in support of which he refers to the polygamous connections of the patriarchs and saints of the Old Testament, and infers the lawfulness of their practice from the blessings which attended it, and the laws which were instituted to regulate and superintend it. He contends for the lawfulness of Christians having, like the ancient Jews, more wives than one, and labours much to reconcile the genius of the evangelical dispensation with an arrangement of this sort. With this view he asserts, that there is not a single text in the New Testament that even hints at the criminality of polygamous connection; and he would infer from St Paul's direction, that bishops and deacons should have but one wife, that it was lawful for laymen to have more. Jesus Christ, he says, was not the giver of a new law; but the business of marriage, polygamy, and divorce, had been settled before his appearance in the world, by an authority which could not be revoked. Besides, this writer not only thinks polygamy lawful in a religious, but advantageous in a civil light, and highly politic in a domestic view.

In defence of his notion of marriage, which, he says, consists in the union of man and woman as one body, the effects of which in the sight of God no outward forms or ceremonies of man's invention can add to or detract from, he grounds his principal argument on the Hebrew words made use of in Genesis (ii. 24) to express the primitive institution of marriage, viz. רכק כאשתו, rendered by the Seventy *ϖροσκολληθησεται ϖρος τη’ γυναικα αὐτου*, which translation is adopted by the evangelist (Mat. xix. 5), with the omission only of the superfluous preposition (*ϖρος*) after the verb. Our translation, "shall cleave to his wife," does not, he says, convey the idea of the Hebrew, which is literally, as Montanus renders the words, "shall be joined or cemented *in* his woman, and they shall become (by this union) one flesh." But on this criticism it is well remarked, that both the Hebrew and Greek terms mean simply and literally attachment or adherence; and are evidently made use of in the sacred writings to express the whole scope of conjugal fidelity and duty, though he would restrain them to the grosser part of it.

With respect to the Mosaic law, for which Mr Madan is a warm advocate, it was certainly a local and temporary institution, adapted to the ends for which it was appointed, and admirably calculated, in its relation to marriage, to maintain and perpetuate the separation of the Jewish people from the Gentiles. In attempting to depreciate the outward forms of marriage, this writer would make his readers believe, that because none are explicitly described, therefore none existed; and consequently that they are the superfluous ordinances of human policy. But it is evident, from comparing Ruth (iv. 10, 13) with Tobit (vii. 13, 14), and from the case of Dinah, related in Genesis (xxxiv.), that some forms were deemed essential to an honourable marriage by the patriarchs and saints under the Old Testament, exclusive of the carnal knowledge of each other's persons. It is also evident in the case of the woman of Samaria, whose connection with a man not her husband is mentioned in John, iv., that something besides cohabitation is necessary to constitute marriage in the sight of God.

Having stated his notion of marriage, the same writer urges, in defence of polygamy, that, notwithstanding the seventh commandment, it was allowed by God himself, who made laws for the regulation of it, wrought miracles in support of it by making the barren woman fruitful, and declared the issue legitimate to all intents and purposes. God's allowance of polygamy is argued from Exodus, xxi. 10, and particularly from Deut. xxi. 15, which, he says, amounts to a demonstration. This passage, however, at the utmost, only presupposes that the practice might have existence amongst so hard-hearted and fickle a people as the Jews; and therefore wisely provides against some of its more unjust and pernicious consequences, such as tended to affect the rights and privileges of heirship. Laws enacted to regulate it cannot be fairly urged in proof of its lawfulness, on the author's own hypothesis; because laws were also made to regulate divorce, which Mr Madan condemns as absolutely unlawful, except in cases of adultery. Besides, it is more probable that the "hated wife" had been dismissed by a bill of divorcement, than that she was retained by her husband; and, moreover, it is not certain but that the two wives, so far from living with the same husband at the same time, might be dead; for the words may be rendered thus, "If there *should have been* to a man two wives," &c. The words expressing the original institution of marriage (Genesis, ii. 24), compared with Matthew (xix. 4, 5, 8), afford insuperable objections against Mr Madan's doctrine of polygamy.

If we appeal on this subject from the authority of Scripture to the writings of the earliest Fathers in the Christian church, there is not to be found the faintest trace of anything resembling a testimony to the lawfulness of polygamy; on the contrary, many passages occur in which the practice of it is strongly and explicitly condemned.

In a word, when we reflect that the primitive institution of marriage limited it to one man and one woman; that this institution was adhered to by Noah and his sons, amidst the degeneracy in which they lived, and in spite of the examples of polygamy which the accursed race of Cain had introduced;—when we consider how very few, comparatively speaking, were the examples of this practice amongst the faithful; how much it brought its own punishment along with it; and how dubious and equivocal those passages are in which it appears to have the sanction of divine approbation;—when to these reflections we add another, respecting the limited views and temporary nature of the more ancient dispensations and institutions of religion; how often the imperfections and even vices of the patriarchs and people of God, in the olden time, are recorded, without any express notification of their criminality; how much is said to be commanded, which our reverence for the holiness of God and his law will only suffer us to suppose were, for wise ends, permitted; how frequently the messengers of God adapted themselves to the genius of the people to whom they were sent, and the circumstances of the times in which they lived;—above all, when we consider the purity, equity, and benevolence of the Christian law; the explicit declarations of our Lord, and his apostle St Paul, respecting the institution of marriage, its design and limitation;—when we reflect, too, on the testimony of the most ancient fathers, who could not possibly be ignorant of the general and common practice of the apostolic church;—and, finally, when to these considerations we add those which are founded on justice to the female sex, and all the regulations of domestic economy and national policy,—we must wholly condemn the revival of polygamy, and thus bear our honest testimony against the leading design of this and all similar publications.

POLYGARS' TERRITORY. This is a district in the Southern Carnatic, and it is situated between the tenth and eleventh degrees of north latitude. To the north it is bounded by Trichinopoly, to the south by Marawas and Madura, to the east it has Tanjore and the sea, and to the west Dindigul. The Polygars, amongst whom this country is divided, are military chieftains, resembling the Zemindars of Bengal. Their estates are called Pallams. The country, before it was finally subdued by the British, having been long the scene of violence and disorder, where might was the rule of right, these Polygars were extremely averse to the British yoke, and defended their independence and their properties with resolution. They were, however, brought under subjection by the irresistible power of the British arms, and forced to yield to whatever terms were imposed upon them. Those who resisted the demand of tribute imposed on them, or showed signs of turbulence, were made prisoners, and deprived of their lands; others fled to the hills, where they made inroads on the lower country, collecting the tribute of their lands, or marauding and plundering the country. They have been now, however, mostly subdued, and the country has been restored to tranquillity, under the rule of the British.

POLYGLOTT, amongst divines and critics, denotes a Bible printed in several languages. See BIBLIOGRAPHY.

POLYGNOTUS, a famous painter of Thasos, flourished about 422 years before the Christian era, and was the son and scholar of Aglaophon. He adorned one of the public porticoes of Athens with his paintings, in which he had represented the most striking events of the Trojan war. The Athenians were so pleased with him, that they offered to reward his labours with whatever he pleased to accept; but he declined the offer; and the Amphictyonic council, which was composed of the representatives of the principal cities of Greece, ordered that Polygnotus should be maintained at the public expense wherever he went. Of the talents of Polygnotus, much honourable mention is made by many of the best authors of antiquity, as Aristotle and Plutarch, Dionysius of Halicarnassus, Pliny, and others. Pausanias speaks of his pictures of the events of the Trojan war, and, in his tenth book, introduces a long description of other pictures by the same artist, painted also from Homer, in the temple at Delphos. The passage, however, gives but a confused and imperfect idea of the painter's performance. How much the art is indebted to this ancient master, what grace and softness he gave to the human countenance, what embellishments he added to the female figure and dress, are much more happily described by Pliny. See also the article PAINTING.

POLYGON, in *Geometry*, a figure with many sides, or one the perimeter of which consists of more than four sides at least; such are the pentagon, hexagon, heptagon, and others.

POLYGRAPHY, POLYGRAPHIA, or *Polygraphice*, the art of writing in various unusual manners or ciphers; as also that of deciphering the same. The word is formed from the Greek πολυ, signifying *much*, and γραφη, *scriptura*, writing.

POLYHYMNIA, in the Pagan mythology, one of the nine muses, thus named from the Greek words πολυ, *much*, and μνεια, *memory*. She presided over history, or rather rhetoric, and is represented with a crown of pearls and a white robe; her right hand in action as if haranguing, and holding in her left a caduceus, or sceptre, to show her power.

POLYHEDRON, in *Geometry*, denotes a body or solid comprehended under many sides or planes.

POLYHEDRON, in *Optics*, is a multiplying glass or lens, consisting of several plane surfaces disposed into a convex form.

POLYMATHY denotes the knowledge of many arts and sciences. The word is derived from the Greek, πολυ, *multum*, and μανθανω, *disco*.

POLYNESIA.

olynesia.

aracte- tic dis- ction.

Polynesia is a name given by several early writers on geography, but first, we believe, by De Barros, to the numerous islands scattered over the Pacific Ocean, or, as it was usually called, the Great South Sea. It is the name which is now applied by most modern geographers to the *sixth* great division of the earth's surface; a division which will probably appear, on examination, less arbitrary than some others; for whether we consider it in a political, physical, or moral point of view, the separation from America on the one hand, and from Australasia and the Asiatic islands on the other, is marked by very strong and distinct features. A considerable portion of the two last, for instance, have, ages ago, been invaded and taken possession of by foreigners, and many of them have more recently been colonized by Europeans. No colonies have yet been planted in Polynesia, with the exception of that on one of the Ladrone Islands by Spain. Of late, however, many of these islands have been visited by European missionaries, for the purpose of spreading amongst the natives the light of the gospel; and in many cases their efforts have been so far successful that they have established permanent settlements in these islands, and have instructed the natives, not only in the doctrines of the Christian religion, but in all the mechanical arts and other improvements of civilized society. The inhabitants have no political connection with any of the other divisions of the earth, and little or none exists between any two of its groups or separate islands, each being governed by its own chiefs, and confining its friendships or hostilities to some neighbouring group or island.

ysically isidered.

Physically considered, the line of separation is almost as distinct as their political seclusion. If a line be drawn in a south-easterly direction along the eastern extremity of the Philippine Islands, Mindanao, Papua or New Guinea, New Ireland, and Solomon's Archipelago, and from thence continued southerly along the eastern shores of the New Hebrides and New Zealand, this line will mark with sufficient precision the separation of the Asiatic islands (mostly to the northward of the equator) and Australasia (to the southward of the equator) from Polynesia. Besides, the geological structure of the islands which constitute the last-mentioned divisions is, generally speaking, essentially different, consisting chiefly of lofty mountains of primary or secondary formation, partaking of the same structure as those on the continent of Asia, with which some of them indeed may probably have once been connected, their rugged sides presenting as it were a broken barrier to the Great Pacific; whereas Polynesia exhibits a series of low, flat islands, scarcely rising above the level of the sea, which, with the exception of a few of the larger groups of volcanic formation, are the labours of minute sea animals, and are usually distinguished by the name of Coral Islands or Reefs.

rally sidered.

In a moral point of view, the distinctive character of the Polynesians is as strongly marked as the physical structure of the islands which they inhabit. In the Eastern Archipelago, or the Asiatic islands, and in Australasia, two distinct races of men have been traced, the *black* and the *brown*. In the archipelago, and more particularly in the Philippine Islands, a few individual families of the negro race were discovered by the early European visitors; in New Guinea and the Papuan Islands the whole population appears to consist of this race. They differ in some respects from the negroes of the western coast of Africa, resembling rather those which are found on the eastern coast, particularly in the hair, which is strongly twisted into small tufts, and very different from that of the negro of Guinea.

Polynesia.

Natives of Polynesia.

None of these negroes have been discovered on any of the islands of Polynesia, all the inhabitants being of the *brown* race, and evidently derived from the same common stock to which the Tartars, the Chinese, the Japanese, and the Malays, owe their origin. In this opinion Sir William Jones, Dr Buchanan, Dr Hunter, Mr Marsden, and Sir Stamford Raffles, unanimously concur. This race, modified, of course, by the circumstances of climate, occupations, and habits, may thus be described:—Their persons short, squat, and robust; their lower limbs large and heavy; their arms fleshy; hands and feet small; face somewhat of a lozenge shape, the forehead and chin rather sharpened, but broad across the cheek-bones, which are high, and the cheeks hollow; the eyes black, small, narrow, and placed obliquely in the head, the external angle being the highest; nose broad, but not flat, and nostrils open and circular; mouth rather wide; hair harsh, lank, and quite black.

Language.

Dispersed as the Polynesians are, and rarely and purely accidental as any communication between distant islands must be, it is perfectly certain that the different dialects spoken, from the shores of India and Africa to those of America, are the derivatives of one common language, which, according to Marsden, still forms the primitive portion of the Malay language, mixed as it now is with Sanscrit and Arabic. "The Malayan," says this learned and accurate writer, "is a branch or dialect of the widely extended language prevailing throughout the islands of the archipelago to which it gives name, and those of the South Sea, comprehending, between Madagascar on the one side and Easter Island on the other, both inclusive, the space of full two hundred degrees of longitude. This consideration alone is sufficient to give it claim to the highest degree of antiquity, and to originality, as far as that term can be applied."

Religion.

Not less remarkable is the general accordance of the Polynesians in manners, superstitions, and religious observances. The conversion of the Malays of the archipelago to Mahommedanism has obliterated nearly their ancient faith, but enough still remains on some of the Asiatic islands, and still more on the Asiatic continent, to trace the source whence the Polynesians have derived their notions and practices on matters of this kind.

General view of the islands.

These preliminary observations on the physical form, features, language, and religion of the Polynesians, are made with a view to assert their common origin, and may be taken as a general description of the natives of the various groups of islands which are scattered over the surface of the vast Pacific Ocean. These groups are exceedingly different in their extent, both as to number and size, as well as in their composition. Sometimes single islands are met with, surrounded by rocky reefs. These islands and reefs are dispersed, as already observed, over the whole of the Pacific Ocean, but chiefly between the thirtieth degree of northern and the thirtieth degree of southern latitude. The following classification will be found to embrace the greater part of those islands which are comprehended under the geographical division Polynesia:

Classification of the islands.

In the Northern Hemisphere.

1. The Marian or Ladrone Islands.
2. The Carolinas, including the Pellew Islands.
3. The Sandwich Islands.
4. The numerous reefs and coral islands scattered over the Pacific in both hemispheres.

In the Southern Hemisphere.

1. The Friendly Islands, including the group of the Tonga Islands.

2. The Navigators' Islands.
3. The Society Islands.
4. The Georgian Islands, including Otaheite or Tahiti, and the great range extending as far as Pitcairn's Island.
5. The Marquesas.
6. Easter Island.

IN THE NORTHERN HEMISPHERE.

Ladrones.

1. The Ladrone Islands were first discovered by Magelhaens on the 6th of March 1521. This name, by which they are generally known, was given to them by the Spaniards on account of the thievish disposition of the natives. They also called them Islas de los Velos Latinas, in reference to the sails of their canoes. By some they were called Los Jardinas (the Gardens), and by others Dosprazeres (the Delightful Islands); and when missionaries were first sent thither in 1668, under the patronage of Mary-Anne of Austria, queen of Philip, they took the name of Las Marianas, in honour of that lady. They consist of four larger and several smaller islands. The former are called Saypan, Tinian, Zarpan or Rosa, and Aguigan, or rather Guahan. Saypan has a lofty peak, evidently volcanic, but the rest are of a moderate height, and are surrounded by rocks of coral formation. They lie between latitude 13° and 15½° N., longitude about 144° E.

Visited by Magelhaens.

On approaching these islands, Magelhaens perceived that they were inhabited, and the natives presently came off to the ships with cocoa-nuts, yams, and rice. They were stout, well-made people, of a pale-yellow complexion, long black hair, and their teeth dyed red or black; an apron of the bark of a tree was their only covering, a lance pointed with a fish-bone their only weapon. Their boats had lateen or shoulder of mutton sails, with outriggers to prevent their upsetting, and they sailed with great swiftness. The captain-general was so delighted with the appearance of the country, that he intended to refresh his crew amongst them; but such numbers of the inhabitants flocked on board his ships, and were so addicted to thieving, that, being under the necessity of driving them away by force, hostilities ensued, and several of the natives were killed. Magelhaens had one of his boats stolen, which so exasperated him that he landed with ninety of his people, set fire to their houses, which were of wood, and carried off all the provisions he could find.

By Loyosa.

The expedition of Loyosa, commanded, after his death, by Sebastian del Cano, and at his decease by Alonzo de Salazar, touched at the Ladrone Islands in 1526, and being received in the most friendly manner, procured water and provisions in plenty for the sickly squadron. To the great surprise of the Spaniards, a countryman of theirs, named Gonzalo de Vigo, came to them from one of the islands, having deserted from one of the ships of Magelhaens; two others, he said, had deserted at the same time, but were put to death by the natives. They found no quadrupeds on the island, but plenty of excellent fruits, fish, and rice. The only birds were turtle-doves, of which the islanders appeared to be so fond, that they kept them in cages, and taught them to speak.

By Lopez de Legaspe.

In 1565, the Ladrone Islands were again visited by Lopez de Legaspe. Whilst the ships were yet two leagues from the shore, the natives came off in their canoes, but kept at a distance from the ships. The general put knives and other articles on a plank, and floated it off, and the natives showed fruits, patting their bellies, and pointing to the shore, to induce the Spaniards to land. This they did the following day on the island of Guahan, and exchanged bits of iron for provisions; but notwithstanding the regulations made by Legaspe in order to prevent quarrels, skirmishes took place, and one of the seamen, who had strolled into the woods, being found murdered, the Spaniards landed in force, set fire to their houses and canoes, wounded several of the natives, and hung upon the spot three wounded prisoners.

No kind of animal was found on the island, nor would the natives taste any other animal food except fish. "But that which caused most admiration," says Friar Gaspar, "was, that they would drink salt water, and were such expert swimmers, and passed so much of their time in the water, that, as among other animals, some are amphibious, in like manner it seemed as if these people were in their nature amphibious."

Visited b Cavendis

In 1588, our countryman Candish or Cavendish came in sight of the Ladrones, and sailed along the coast of Guahan, from which a number of canoes came off with fruits and vegetables, which were exchanged for pieces of iron; but the natives became so troublesome, that, in order to get rid of them, Cavendish ordered muskets to be fired at them.

By Olivie Van Noort

In 1600, Olivier Van Noort made the Ladrone Islands, and stopped near Guahan for two days, from which island above two hundred canoes came off to the ships with fish, fruits, and rice, to exchange for iron; and fowls are also mentioned, for the first time, in this voyage. In the same year, the Santa Margarita, a Spanish ship, having lost her captain and many of her crew by sickness, anchored off Saypan, and was taken possession of by the natives, who killed some of the crew, and took others of them on shore, where they were kindly treated, and such as survived were afterwards taken off by a Spanish ship which had been sent for the purpose.

By Spilber gen and th Nassau fleet.

In 1616, Spilbergen made the Ladrone Islands, and stopped two days to traffic with the natives for provisions of fruit, fowls, and fish, in exchange for bits of iron. In 1625, the fleet under Prince Maurice of Nassau refreshed at Guahan, and were supplied by a hundred and fifty canoes, with immense quantities of cocoa-nuts, yams, bananas, rice, and fowls, which were of infinite service, as the scurvy had made such havoc among the crews, that in some of the ships they had scarcely strength enough to manage the sails.

Of the Spa nish Jesuits.

In the year 1668, the Spaniards established a mission on the island Guahan, consisting of P. Servitores and five other fathers, with several lay-assistants, most of them natives of the Philippine Islands, and well acquainted with the Tagul language, the same as that spoken by the natives of the Ladrone Islands. For some time the chiefs of the islands behaved with great kindness to the Jesuits, and gave them ground for building a church. From this seat of the mission the fathers spread themselves amongst the other islands, where they were received with equal kindness. In short, P. Servitores says, that in the first year they had baptized more than thirteen thousand islanders, and instructed twenty thousand, in the eleven islands which they had visited. As usual, however, the imprudent zeal of the missionaries ruined their cause, by shocking the prejudices of the natives. These simple people took it into their heads that, as an infant had died shortly after being baptized, its death had been occasioned in consequence of that ceremony; and such was the terror of mothers on seeing a missionary approach, that they seized their children and ran off with them into the woods. This opinion gathered ground from the eagerness of the Jesuits to get hold of infants for the purpose of baptizing them, and more than one of these holy fathers fell martyrs to their imprudent zeal. Several murders ensued; and, as the Spaniards had taken care to strengthen the mission with a body of troops well armed, with the obvious intention of taking possession of the Ladrones as an important outpost to the Philippine Islands, after a great number of the natives had been put to death, the rest submitted to the yoke of the Spaniards; though most of the missionaries suffered in the contest, and last of all Servitores, who was killed by the man to whom he had been the greatest benefactor, because the missionary insisted on baptizing his child. Thus, at the age of forty-five, this pious and good man, for such he certainly was, fell by the hand of an assassin, after having, as we are told, "established the faith in thirteen islands, founded eight churches, established three seminaries for the instruction of youth, and baptized nearly fifty thousand of the islanders." From this time constant revolts and massacres ensued, and the most inhuman cruelties were inflicted on the unhappy islanders; so that, in 1681, the island of Guahan, which, on the first landing of the Spaniards, counted forty thousand inhabitants (some accounts make them more), had become so completely depopulated, that it was found necessary to bring inhabitants from the northern islands to cultivate the soil.

Visited by he buca-ieers.

In the year 1685, the ship of John Eaton, the bucaneer, touched at Guahan, the crew of which quarrelled with the natives, and killed some of them. Having satisfied the Spanish governor that it was done in their own defence, "he gave us toleration," says Cowley in his narrative, "to kill them all if we could."..."We took four of these infidels prisoners," continues the narrator, "and brought them on board, binding their hands behind them; but they had not been long there, when three of them leaped overboard into the sea, swimming away from the ship, with their hands tied behind them. However, we sent the boat after them, and found a strong man, at the first blow, could not penetrate their skins with a cutlass; one of them had received, in my judgment, forty shots in his body before he died; and the last of the three that was killed had swam a good English mile first, not only with his hands behind him, as before, but also with his arms pinioned." We are told by the late Captain Burney, that it is stated in Cowley's manuscript in the British Museum, that "the boat coming up with them, our carpenter, being a strong man, thought with his sword to cut off the head of one of them, but he struck two blows before he could fetch blood."

y Dam-ier.

In 1686, Dampier touched at Guahan, and states the number of natives not to exceed a hundred. He gives a particular description of their "flying proas," with their outriggers, which, he says, "sail the best of any boats in the world; that he tried the swiftness of one by his log, and that she ran twelve knots out before the half-minute glass was half out." "I believe," says Dampier, "she would run twenty-four miles an hour." Woodes Rogers, who visited the Ladrones in 1710, states it as his opinion that one of these proas would sail at the rate of twenty miles an hour.

y Anson.

In the month of August 1742, Commodore Anson anchored before the island of Tinian. It was deserted, but cattle to the number of at least ten thousand, hogs and fowls, were running about wild. Cocoa-nuts in innumerable quantities, bread-fruit, oranges, limes, water-melons, and other tropical fruits, were in the greatest abundance. The island swarmed with rats, and the flies, mosquitoes, and ticks or bugs, were very troublesome; but it was a paradise to the crew of the Centurion, in the horrible state of scurvy in which they arrived. Though now deserted, Tinian, on the arrival of the Spaniards, is said to have contained thirty thousand inhabitants. Ruins of buildings, consisting of pyramidal pillars of considerable dimensions, were met with in all parts of the island.

y Byron.

Commodore Byron anchored in the year 1765 before Tinian, and found the island overgrown with large trees and underwood, amongst which were most of the tropical fruits. He complains bitterly of the bad anchorage, brackish water, and venomous insects, from which they suffered so severely, that "we were afraid," he says, "to lie down in our beds;" and though his crew recovered fast from the scurvy, he lost two by fevers, being the first deaths in his ship since leaving England. "I am indeed of opinion," says the commodore, "that this is one of the most unhealthy spots in the world, at least during the season in which we were here;" yet it was in the same month that it had been visited by the Centurion.

By Kotzebue.

The latest account of these islands is that of Lieutenant Kotzebue, who visited Guahan in 1817. No canoes nor proas, nor happy islanders, greeted his approach; the whole race of natives had long been extirpated. "We looked," he says, "in vain for a canoe or a man on the shore; and it almost seemed as if we were off an uninhabited island. The sight of this lovely country deeply affected me. Formerly these fertile valleys were the abode of a nation, who passed their days in tranquil happiness; now only the beautiful palm groves remained to overshadow their graves; a death-like silence everywhere prevailed." Soon, however, a person appeared from the Spanish governor, and piloted the ship into the harbour; and after this, Kotzebue proceeded to the town of Agana, situated upon a beautiful plain, some hundred paces from the shore, in the midst of fine palm groves, some of the houses being built of coral rock, others of bamboo. It has a church and a convent, and two fortresses, one to protect the town from the seawards, and the other to keep the Indians in awe. The town contains about 200 houses, and 1500 inhabitants, who derive their origin from Mexico and the Philippines. The population of the island is about five thousand souls. "There is but one man and his wife," says Kotzebue, "on the whole island of the original stock; with the death of these two people, the race of the old Ladrones will be totally extinguished." "The present race," says Chamisso, "no longer know the sea, are no mariners, no swimmers; they have ceased to build boats. They now scarcely hollow out, without skill, the trunks of trees to fish within the breakers." All the other islands to the north of Guahan are entirely uninhabited, and overrun with wild cattle, hogs, and goats, which afford a supply to the American vessels trading to the Sandwich Islands and the north-west coast of America. Indeed it is said that some of these people have been allowed to settle themselves in Agrigan, on condition of acknowledging their allegiance to Spain, and that they are peopling the island by kidnapping the natives of the Sandwich Islands.

Carolinas.

2. The *Carolinas*, or Caroline Islands.—In 1686, a Spanish ship, being near the meridian of the Ladrones, fell in with an island, which her commander, Don Francisco Lazeano, named La Carolina, in honour of the king of Spain, Carlos II. This island has given the name to a very extensive chain spreading over a space of not less than six degrees of latitude and twenty-five degrees of longitude, the western extremity being the group of the Palaos or Pellew Islands, in latitude 7° north, longitude 135° east, and the easternmost island, that of Hogolen, in latitude 9° north, longitude 155° east. The whole group, as far as is known, which, however, is very imperfectly, consists of at least a hundred and fifty separate islands, and may be nearly twice as many, besides various coral reefs with islets upon them. Yet, numerous as they are, being somewhat out of the direct and usual route of the Spaniards in their voyages from South America to the Philippines, they had the good fortune to escape any intimate connection with them; a connection which has proved equally baneful to others, whether established by the cross or the sword, by their professions of friendship or avowals of hostility. Gobien, the historian of the desolating progress of the Spaniards in the Ladrones, says that Quiroga, the governor, made search for the island of Carolina, "wishing to extend the faith to its infidel inhabitants, and, for that purpose, sent some soldiers, and with them the chanionis (or chief), Don Alonzo Soon; but after a fruitless search, and much pains, they returned without finding the object of their research."

Some of these islands, however, and especially those towards the western extremity of the group, had been seen by various navigators long before that of Carolina was noticed and named by Lazeano. The Portuguese, Da Rocha, fell in with islands in 9° or 10° north latitude, in 1526, which he named Sequeira, after his pilot; and, in 1628, Saavedra, a Spaniard, in his passage to the Philippines, discovered islands in latitude 11°, which he named Los Reyes. In 1579, our countryman Drake saw some islands, to which he gave the name of the Islands of Thieves, which, from his description, have been supposed to be the Pellew Islands. In 1595, one of the islands, in about 6° north, was seen by Mendana; but two proas full of people, driven by the violence of the wind from a group of islands in the east, as far as Samal, roused the attention of the College of Jesuits at Manilla, who made several unsuccessful attempts to establish missions on those islands, which the wrecked natives described to consist of thirty-two in number. In the year 1710, the two fathers, Duberron and Cortel, embarked in the San Trinidad, with a crew of eighty-six men, to establish themselves on the Pellew Islands. They landed on Sonsorol, with the quartermaster and ensign of the troops, in all sixteen persons; but the ship being driven off by the current, made for another of the islands, called Panloque, at the supposed distance of fifty leagues from the Sonsorolles. On approaching the island, several boats came off, and some of the Palaos people swam from them to the ship, and coming on board, attempted to steal whatever they could lay their hands on. In consequence of this, they were ordered away; and having reached their boats, began to shoot arrows at the ship, which were answered by a discharge of musketry. The ship now returned to the Sonsorolles to inquire after the two missionaries and the boat; but the strong winds and currents would not suffer them to anchor, nor could they see or hear anything of their companions, though they stood in towards the shore within cannon shot. A storm coming on, left them no alternative except "to return to Manilla, with the sorrowful news of what had happened." What became of the missionaries was never ascertained. The following year, however, P. Serano departed from Manilla, in a ship fitted out for the purpose, in search of the two fathers and their companions; but she foundered three days after she departed from Manilla, and every person on board perished, except one Spaniard and two Indians, who brought back the melancholy intelligence.

In the *Lettres Edifiantes et Curieuses* is a letter and chart from P. Juan Antonio Cantova, a missionary at Guahan, addressed to the king of Spain's confessor in 1722, in which is given a more particular account of the Carolinas than any which had before or has since been published. It states that, in the preceding year, a bark, with eleven men, seven women, and six children, arrived on the east side of Guahan; and that, two days after, another canoe, with four men, one woman, and child, came to the opposite side of the island. The two parties, on being brought together, recognised each other with great joy. It appeared they had been dispersed by a gale of wind, and driven about for twenty days, without knowing where they were. Cantova thus describes them: They wore a garment open at the sides, but covering the shoulders and breast, and extending down to the knees. The women had a piece of cloth round the waist, falling, like a petticoat, to the middle of the leg. Their hair was curly, the nose large, the eyes large and penetrating, and the beards of the men moderately thick. Some had the pure colour of the Indians; others were apparently of a mixed breed between Spaniards and Indians, and others between a negro and an Indian. Cantova succeeded in learning their language, and obtained from them the following particulars respecting their islands.

The Carolinas are divided into five provinces. Beginning at the east, the first is named Cittac; the principal island, Hogolen, is much larger than Guahan; its inhabitants are negroes, mulattoes, and whites. There are eighteen principal islands in this province, besides a multitude of smaller ones. The second province consists of about twenty-six islands, of which Ulee and Lamurree are the principal ones. The third province consists of a group of islands, of which Feis is the principal, being very populous and fertile; but the chief of the group resides at Mogmog, and all the proas which approach this island lower their sails in token of respect to this chief. Of the fourth province, Yap is the principal island, about a hundred and twenty miles in circuit, very populous, and fruitful. The fifth province is the most westerly, and is named Panleu (the Palaos, or Pellew Islands), of which there are seven principal islands. It is remarkable that the inhabitants of these islands so far differ from the Carolinians in general, and from the account given of them in the romance of Mr Keats, drawn up by that ingenious gentleman from the documents furnished by Captain Wilson, that they are represented as a most barbarous race, both men and women going entirely naked, and feeding on human flesh. We are told by the naturalist of Kotzebue's expedition, that a Spaniard, who had lived nine months on the Pellew Islands, and whom they met with at Cavité, gave him a horrible account of the natives; that they were wholly without shame, that husbands lend their wives for a mere trifle, that the women are without modesty, and that they certainly eat human flesh; a great part of which was confirmed by a native of the Carolinas, who had been at the Pellew Islands.

Cantova further learned from the islanders, that to the eastward were a great number of other islands, the inhabitants of which pay adoration to the shark; that most of them are negroes, and of savage dispositions. It is supposed that Cantova returned with these islanders in the year 1722, though no account of any such voyage is on record; but in 1731 he embarked for the islands of the third province, in company with another father, of the name of Walter, from which the former never returned. The latter, however, returned to procure certain articles of which they stood in need, was driven to the Philippines, re-embarked in 1732, and was wrecked. Walter again embarked in May 1733, along with forty-four persons. On the ninth day they approached the island, and fired cannon to inform Cantova of their arrival, but no boat appeared. Standing within a musket-shot of the shore, they observed that their former habitation had disappeared, as well as the cross which had been erected near the sea-shore. Four small canoes at length approached the vessel, bringing cocoanuts. On inquiring after Cantova and his companions, the islanders were evidently embarrassed, and said they were gone to Yap. Being fearful, by their manner, that the good father had fallen by the hands of the barbarians, and willing to be satisfied on this head, they seized one of the islanders, upon which the rest swam ashore. After the strongest assurances that no harm should be done to him, provided he would tell the truth, he confessed that shortly after the departure of Walter, the natives put the Father Cantova to death, and all his companions, fourteen in number. Cantova, it seemed, from this man's account, went, with his interpreter and two soldiers, to the island Mogmog, to baptize, whilst the rest remained at Falalep. He had scarcely set his foot on shore when he was surrounded and pierced through and through with lances, the natives crying out that he was come to take away the old law, and give them a new one. They gave his body a decent burial, but the bodies of his companions were put into a canoe, which was then turned adrift upon the ocean. The same people then went over to the island of Falalep, and put to death the remainder of the companions of Cantova.

Since that time, little or no information has been procured respecting the Carolinas, with the exception of that which is contained in the narrative of Mr Keats, from the materials of Captain Wilson, who, when commander of the Antelope packet, in the service of the East India Company, was wrecked on Oroolong, one of the Pellew Islands. Whatever their general character may be, the crew of the Antelope found them a friendly, hospitable, and humane people. They were stout, well made, rather above the middle size, and their colour approaching to a deep brown; their hair long, some wearing it loose, and others turned up. The men were entirely naked; the women contented themselves with two little aprons or fringes, made of the fibres of the cocoa-nut husk, about ten inches deep and seven wide, one of which was worn before, and the other behind. Both sexes were tattooed; the men had one ear perforated, the women both, and they wore beads, tortoise-shell, or leaves, as suited their fancy; the cartilage of the nose was also bored, and a little sprig or blossom of some plant was generally stuck in the hole; their teeth were dyed black by a paste prepared of certain herbs, which, it is pretended, caused severe sickness for five days, the time required to complete the operation.

Their productions, and the manners of the natives.

Fish and cocoa-nuts are the chief articles of food, but the islands afford an abundant supply of yams, plantains, oranges, lemons, bread-fruit, carambola, and the areca-nut; the sugar-cane grew wild. No quadruped, except rats, was found on the islands; of birds, the pigeon was the most abundant, and the domestic fowl ran wild in the woods. The natives were wholly unacquainted with the use of salt. Their usual beverage consisted of the milk of the cocoa-nut. Their houses were of bamboo and plank, raised upon stones from the ground. The husk of the cocoa-nut supplied them with nets and cordage, and the tortoise-shell with hooks to catch fish. Their knives were made of mother-of-pearl, shells, or split bamboo; the cocoa-nut served them for cups, the plaintain leaf for plates, and the fibres of this plant for mats to sleep on. Their weapons were spears of wood, darts, and slings. Their boats were canoes made of the trunks of large trees, and some of them sufficiently capacious to hold from twenty to thirty persons. In the day-time they seemed to live as much in the water as on shore, and both sexes were admirable swimmers. The women mixed freely with the other sex, and their conduct was not strictly inquired into by their husbands. They seemed to have little sense of any religious duties, except in the ceremonies attending the burial of the dead, which takes place in spots set apart for that purpose, and with great solemnity; but they have some faint notion that the soul survives the body. Their graves very much resembled those in a country church-yard of England, some having earth heaped up in the same manner, and others covered with flat tombstones, and protected by fences of wicker-work.

The larger of the Pellew Islands are of a moderate height, rising into beautiful hills, well clothed with forest trees. The natural history still remains unknown, but being about the same parallel and of the same formation with the numerous group visited by Kotzebue, the plants and animals are in all probability much the same. The smaller islands are the productions of the coral-making animals, with which the larger are also surrounded to a great distance from their shores.

Sandwich Islands.

3. *The Sandwich Islands.*—This fine group of islands in the Northern Pacific had the good fortune to escape the visits of the old navigators, and the discovery of them was reserved for Captain Cook, who first touched at them in the year 1778, and lost his valuable life there in 1779. M. Fleurieu, in his introduction to Marchand's Voyage, is disposed to dispute this claim, and to assign the first discovery of these islands to Mendana, for no other reason but that it appears he passed at no great distance from Owyhee, but without seeing it, on his return voyage in 1568; and because he finds an island named Mesa laid down on the nineteenth parallel of latitude, on the obscure and unauthenticated chart of Galion de Manille. It is almost unnecessary to add, that the name by which they are now known was given to them by Captain Cook, in honour of the Earl of Sandwich, under whose naval administration geography was enriched with many important discoveries.

Extent and population.

According to Captain King, the group consists of eleven islands. But the missionaries only enumerate ten; and they reduce the population below the estimate of former voyagers. The following is the estimated length, breadth, and superficial contents of these islands. The names are given according to the orthography of the missionaries.

	Length in Miles.	Breadth in Miles.	Square Miles.	Population.
Hawaii (Owyhee)	97	78	4000	85,000
Maui (Mowhee)	48	29	600	...
Tahurawa	11	8	60	...
Ranai	17	9	100	...
Morokai (Morotoi)	40	7	170	...
Oahu, or Woahoo	46	23	520	20,000
Tanai	33	28	520	...
Niihau	20	7	80	...
Taura Morokini	Little else than barren rocks.			

The missionaries estimate the whole population at 130,000. Others raised it to 400,000. We have no data for any accurate calculation. But if Oahu and Owyhee contain, as the missionaries state, 105,000, their estimate of 130,000 for the whole must be under-stated. They are situated between latitude 18. 54. north (the south point of Owyhee), and 22. 2. north (the latitude of Woahoo), and between the longitude 199. 36. (the small island of Tahurawa), and 205. 6. (the eastern extremity of Owyhee).

The island of Owyhee is described as rising majestically in grand unbroken lines from the ocean, and forming three several mountain peaks, on two of which lies snow for the greater part of the year. They are as under:

	Height.
Mouna Roa (Great Mountain)	2482 toises.
Mouna Kuah (Little Mountain)	2180
Mouna Wororai	1687

These measurements, as given by Kotzebue, agree within a few toises with those of Marchand. The whole group is of volcanic origin, and on the summit of Mouna Wororai is an immense crater. The last eruption from the side of this mountain took place in 1801. The chain of mountains runs from the north-west point of Owyhee, over the islands Mowhee, Morotoi, and Woahoo. On Mowhee is a peak as high nearly as that of Wororai, but the latter is the only volcano in a state of activity.

Description.

These islands, though volcanic, are surrounded by coral reefs, and the plains next the sea, which are raised only a few feet above it, were once of the same description, and covered with water. These plains are generally naked and sunburnt, but the valleys amongst the mountains are beautifully picturesque and fertile, and the sides of the hills are covered with magnificent forests. The most fertile and best cultivated of the group is Woahoo, on which is the safe and capacious harbour of Hana-rura, protected by a coral reef, through a break of which lies the entrance to it. In one of the mountains a diamond mine was supposed to exist, but the products turned out to be only quartz crystals. In the Pearl River of this island oysters have been found containing pearls, but none of much value.

Natural productions.

Amongst the indigenous plants mentioned by Chamisso, the naturalist of Kotzebue's expedition, are the acacia, metrosideros, pandanus, santalum, aleurites, dracœna, amomium, curcuma, tacca. The families of rubiaceæ, contortæ, and urticæ, predominate. From the latter, as well as from the paper mulberry (*Broussonetia papyrifera*), are made their cordage and cloths. The acacia tree, used for their boats and canvass, grows only in mountains, which is the case also with the sandal-wood, the principal article of export from the islands.

Cultivation. The plants mostly in use for domestic purposes are the banana-tree, the cocoa-nut tree, the bread-fruit, sugar-cane, yam, batatos, and the taro-root (*Arum esculentum*), of indigenous growth; besides which have been introduced the tobacco plant, the melon, and water-melon, rice, and the vine, the last of which will unquestionably thrive well on the sides of the volcanic mountains; also cucumbers, cabbages, beans, and the cloth plant, together with a few oranges and pine-apples. The cultivation of the taro-root has the greatest share of attention bestowed on it; and, in fact, it constitutes a considerable portion of the food of the people. The fields or ponds in which this root is planted are enclosed with stones in the form of regular squares, from a hundred to two hundred feet each side; these squares are connected by sluices to convey the water from one to the other, pretty much in the same manner that the Chinese manage their rice-fields. "I have seen," says Kotzebue, "whole mountains covered with such fields, through which the water gradually flowed; each sluice formed a small cascade, which ran through avenues of sugar-cane, or banana, into the next pond, and afforded an extremely picturesque prospect."

Distillation of spirits. A convict from New South Wales has taught the people of these islands the art of distilling ardent spirits from sugar-cane, and a plant called the tee-root (the *Dracœna terminalis*). And, as every chief has now his still, it is probable that the use of the pernicious *kava* will give way to that of the almost equally pernicious spirituous liquors. This *kava* is the liquor or juice of a root of the pepper tribe (*Piper methysticum*), chewed and spit out into a large bowl, and then diluted with water, and this exquisite beverage is prepared for the sole use of the king and the nobles, the women being prohibited from tasting it. The baneful effects of this liquor have been noticed by most voyagers; the bodies of those who swallow it are, in process of time, covered with a white scurf, their eyes become red and inflamed, their limbs emaciated, and their whole frame trembling and paralytic.

Quadrupeds. When Captain Cook first discovered these islands, the only quadrupeds upon them were hogs, dogs, and rats. They have now horses, asses, horned cattle, many of them running wild in the mountains, and goats. Hogs are exceedingly abundant. "They are so large," says Kotzebue, "that the whole crew could not eat one in two days;" and the flavour, from being fed on sugar-cane, is very superior to European pork. Fowls, ducks, and geese, are equally abundant.

Progressive civilization. The Sandwich Islands, though last discovered, have been more frequently visited by Europeans and Americans, and particularly by the latter, than any other group of islands in the whole range of Polynesia; and they have made greater advances in civilization than any other of the Polynesian islands. They were indebted for this superiority to the enterprising character of their monarch, Tamehameha I., who seems fully to have appreciated the advantages of European improvements. When Captain Vancouver visited these islands in 1792, the king being desirous of having a vessel of European construction, this able navigator laid down the keel of one, which was speedily finished. Ten or twelve years after this, when Mr Turnbull visited the islands, he had a naval force of twenty vessels or upwards, from twenty-ty-five to fifty tons, which traded amongst the islands. He had built a house for himself, after the European manner, with windows of glass, and he imitated the English in his dress. By means of English and American seamen and artificers, some of whom deserted from ships touching there, and others obtained regular permission to remain on the islands, most of the trades exercised in Europe were partially introduced into the Sandwich Islands.

The attention of Tamehameha, though he was a decided reformer, was chiefly directed to the improvement of his dress and dwelling, to the building of forts for the protection of his islands, and to the training of his soldiers in the European mode of discipline. But he was not equally solicitous for intellectual improvements; and he adhered most tenaciously to the faith and to all the customs of his forefathers. In a visit to the Morai, pointing to the large wooden statues, he said to Kotzebue, "These are our gods, whom I worship. Whether I do right or wrong I do not know, but I follow my faith, which cannot be wicked, as it commands me never to do wrong." Such sentiments do honour to the savage; and the man who entertains them is capable of being instructed in better things.

During his reign, also, the women continued to be degraded and despised; and, notwithstanding the frequent intercourse with strangers, and the improvements which undoubtedly have been introduced, the sex do not appear to have gained a single step in the estimation of the men, or lost any part of their grossness of behaviour since they were first visited by Captain Cook. That "offensively conspicuous wantonness," which Vancouver deplores, and to which he found no parallel in the whole of Polynesia, appears to have suffered no abatement. When Campbell, the seaman, was on the island of Woahoo, the king's brother died, on which occasion, as part of the general mourning, a public prostitution of the women took place. The captain of a ship then in the harbour remonstrated with the king, who coolly observed, it was their custom, and he could not prevent it. The women, too, it seems, are more addicted to drinking than the men. The governor of Woahoo invited Kotzebue and his officers to witness a dance of the natives, at which he was not present, but sent an apology to say, that his lady was so drunk that he could not leave her. The women are also great smokers of tobacco, and continue it sometimes till they fall down senseless.

Though the women are so far degraded that they cannot eat in the same house with their lords and masters, and must not taste at all of certain articles, yet if the latter be sick, they must howl and make lamentations, tear their hair, lacerate their cheeks; and if he should die (provided he be a Jerrie, Eree, or noble), the favourite wife must die with him. The victims, both men and women, who are to be sacrificed at the death of Tamehameha, are well known; nor is it concealed even from themselves, and they glory in the distinction. "I have myself," says Kotzebue, "seen one of the devoted victims in Woahoo, a man who was always cheerful and happy." On the death of the king, these people will be led bound into the royal Morai (temple and burning place), where, after the prescribed ceremonies, they will suffer death at the hands of the priests. The ancient system of idolatry was calculated to operate on the fears of its votaries. "Its requisitions," says one of the missionary writers,[1] "were severe, and its rites cruel and bloody. Grotesque and horrid wooden figures, animals, and the bones of chiefs, were the objects of worship. Human sacrifices were offered whenever a temple was to be dedicated, or a chief was sick, or a war was to be undertaken, and these occasions were frequent. The apprehensions which the people have of a future state were undefined and fearful. The lower orders expected to be slowly devoured by evil spirits, or to dwell with the gods in burning mountains. The several professions, such as that of the fisherman, the tiller of the ground, and the builder of canoes and houses, had each their presiding deities. Household gods are also kept, which the natives worshipped in their habitations; the volcanoes had moreover a superintending power. One merciful provision, however, had existed from time immemorial, and that was sacred enclosures, places of refuge, into which those who fled from war or from any violent pursuer might enter and there be safe."

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[1] Evangelical Magazine, No. 37, January 1826, p. 30.

To violate the sanctity of the Morai is one of the greatest crimes of which a man can be guilty. Campbell was present at the execution of a man who had committed this offence, in getting drunk and running out of the Morai during *tabboo* time. He was taken back to the Morai, where his eyes were put out; in this state he remained two days, when he was strangled and his body exposed before the image of Etooah, or Eatooah, the principal deity, who, according to their belief, is the creator of the universe, and who afterwards destroyed it by an inundation that covered the whole earth except Mouna Roa, on the top of which one single pair had the good fortune to save themselves, from whom the present race of men, that is, the Sandwich Islanders, sprung.

That singular superstition by which the king, the nobles, and the priests, under the name of *tabboo*, have contrived to render sacred and inviolable whatever they may wish to appropriate to their own use, and which is in universal operation through the whole of Polynesia, is practised to a great extent in the Sandwich Islands. By means of it, a whole people are contented to be robbed of their property, and to suffer any privations that may be imposed on them, without murmuring. When their houses are *tabbooed* they dare not enter them; when their *taro-roots* or their hogs are tabbooed, they surrender them without a struggle; but in return, it must be owned, they are not scrupulous in appropriating to themselves whatever is not *tabbooed*.

Amongst the customs which they inveterately retain, is that of *tattooing* the body; this operation being also universal amongst the islanders of the Pacific. The hands and arms of the women, in particular, are marked with peculiar elegance of figure, and many of the women have the tip of the tongue tattooed. Contrary, however, to the common practice of the islanders, they do not paint their bodies, nor wear ornaments of any kind in the ears; but the women decorate their hair, which is cut short, with wreaths of flowers, and wear necklaces, bracelets, and anklets of shells, coral, and other substances. The common dress of the men is the *maro*, a piece of cloth about a foot wide, which, passing between the legs, is tied round the waist; that of the women is a short petticoat, reaching about half-way down the thigh. The chiefs, on days of ceremony, and on particular occasions, wear cloaks made of the most beautiful feathers, with an elegantly-shaped helmet to correspond. They are ambitious, however, to appear in the dress of Europeans, to enable them to do which, great quantities of old laced coats are carried out to the Sandwich Islands as articles of commerce.

The character of these islanders, like that of all savages in their natural state, is stained with every degrading vice. The missionaries who were stationed in the island, and who had the best opportunities of estimating the dispositions of the natives, describe them as lamentably debased; being in the continual practice of theft, treachery, drunkenness, gross licentiousness, and infanticide, and strangers to every social and domestic virtue. Polygamy is the common custom; and murder by poison is believed by the natives to be very frequent. Great improvements have, however, been effected by the instructions of the missionaries, who have persevered in this, as in the other islands, with an enthusiasm that has at length been crowned with success, and has laid the foundation of a great moral change in the condition of these barbarous islanders. The system of idolatry, so far as it was connected with the government, was abolished by Rhio-Rhio, or Tamehameha II., the son and successor of Tamehameha I., who laid the foundation of social improvement amongst his subjects. This took place in 1819, before any Christian missionaries came into his dominions. He was induced to adopt this policy from various causes, namely, a desire to improve the condition of his wives, who were subject, along with all other females, to many inconveniences, from the operation of the *tabboo* already explained. *2dly*, Several foreigners and intelligent chiefs advised the change; and the report of what had been done by Pomare, king of Otaheite, in the Georgian Islands, had great weight with him. Some disturbances took place in consequence of the abolition of idolatry; but the insurgents were defeated, and peace was restored. In 1820, missionaries were, after some difficulty, allowed to settle, some at Kairua, but the greater number at Honororu, on the island of Oahu or Woahoo. They had to encounter difficulties, moral as well as physical, in their ignorance of a rude unwritten language, which they mastered, however, by perseverance, and constructed an alphabet, and finally a grammar and spelling-book, which was in great demand amongst the natives. In the year 1822 they had made such proficiency that Mr Ellis began to preach in the native language; and six missionary stations were established, at each of which a church was erected, and worship regularly celebrated on the Sunday. In 1824, the king and queen of the Sandwich Islands embarked, amidst the sighs and tears of their subjects, on a voyage to Great Britain, where they died the same year. Their bodies, with their surviving attendants, were brought to the Sandwich Islands in the Blonde frigate, under the command of Lord Byron. Kamkeoli, the brother of the king, was unanimously acknowledged as his successor, under whose protection the missionaries continued their labours, often under great discouragements, in establishing schools, planting churches, training native teachers and missionaries, and in instructing the people in industry and the mechanical arts. The church at Oahu was resorted to by great numbers. It contains only seven hundred, and two thousand were often assembled without doors. According to late accounts, sixty-three schools, containing 1583 scholars, and under the superintendence of native teachers, had been visited; besides others in the vicinity of Honororu. Spelling-books to the amount of thirteen thousand had been distributed amongst the people. Amongst those who paid attention to the instructions of the missionaries, numbers made an open profession of the Christian faith; and amongst all a stricter morality prevailed. They became more humane, more industrious and honest; the females no longer, as formerly, resorted for prostitution to British ships; they adopted a different dress, after the European fashion, and many were baptized. This sudden change, however, appears to have been owing as much to the love of novelty as to the influence of a purer faith; and, accordingly, it has been found in this, as in the other islands, that the gloss of novelty having worn off, many of the wholesome restraints imposed upon their unbridled passions have been thrown off, and they have relapsed into their former barbarous and profligate habits. Still the seeds of civilization have been scattered far and wide, and in due time, we may be assured, they will bear fruit. The people may relapse to a certain degree, but they will never sink to their former state of barbarism. There is no doubt, in short, that since the missionaries have established themselves in these islands, and our ships of war have frequented them, a great change has taken place in the habits and moral character of the natives. "I was glad," says Captain Bruce of the Imogene, "that, at the spot where the intrepid navigator Cook met his untimely end, his memory is cherished with the greatest veneration, and that the prevalence of Christianity is now general throughout the island." The same observation will apply to the Society Islands, and indeed to all those where the missionaries have established themselves. The odious part of the habits and manners of the people is fast disappearing.

Coral islands and reefs.

4. *Coral Islands and Reefs.*—The number and position of the multitude of low islands, sometimes found in groups, and sometimes solitary, are by no means yet ascertained; but,

from the various tracts of ships, it is known that the whole of that part of the Pacific lying between the equator and the tenth degree of north latitude, and from the Pellew Islands to 180° longitude, being at least forty-five degrees of longitude, is completely studded with low coral islands and reefs in countless numbers, some of them inhabited, and others not; and in different stages, from the circular reef, with islets rising upon it like the beads of a necklace, with a lagoon in the centre, to the complete consolidation into one firm island. About the tenth parallel, and proceeding easterly from the Carolinas, we have Button, Tindall, Watt's, and Gilbert's Islands; and about the longitude 175° east, a whole group, extending to the southward of the equator, named on some charts "Lord Mulgrave's Range," on others "Scarborough's Range;" some of the individual islands of which are Smith's, Allen's, Gillespie's, Toulmin's, Hopper's, Chatham's, Calvert's, Robertson's, Arrowsmith's, Daniel's, Marshall's, Pott's, near to which are Kingmill's Group and Byron's Island, all of coral formation.

Various accounts have been given by Cook, Forster, Flinders, and others, of the progressive formation of these low specks of land, with which the Pacific is studded; but the best and most satisfactory is that by Kotzebue and the naturalist Chamisso. They not only saw the Lord Mulgrave's chain of islands, which extend from 1° to 12° north, of which Gilbert's Islands form the northern and Marshall's Island the southern extremity, but they discovered and examined minutely many other groups and detached islands. Between the eighth and tenth degrees of north latitude, and between longitude 188. 48. and 190. 46., they encountered no less than six distinct groups, to which they understood the natives applied the name of Radack; and they learned that to the westward were nine other groups, and three detached islands, called Ralick, besides four groups to the southward. The Radack chain probably includes those which were seen by Captain Marshall in 1788, and to which he gave the name of Chatham and Calvert Islands, though Kruzenstern thinks that these are the same as the Ralick chain. It is not of much importance in a geographical point of view, whatever it might be for the benefit of navigation.

The small size of Kotzebue's vessel gave him the advantage of sailing through the openings in the circular reefs, and of examining the lagoons within them. From his account, it would seem that the coral-making animals do not commence their labours at the very depth of the ocean, as has been supposed, but on rocky shoals, the summits, in all probability, of submarine mountains, round which they lay the foundation of their extraordinary fibres, forming an united chain, irregular in shape, but generally approaching, more or less, to a circle. The greatest depth at which they are able to derive a sufficient degree of light and heat for their operations has not yet been ascertained; but we know that marine animals have been drawn up in a living state from the depth of a thousand fathoms, and from a temperature very little above that of the freezing point. The outer edge of the reef exposed to the surf of the sea is the first that shows itself above the water; in process of time it becomes indurated, breaks, and crumbles, by the action of the sea, and at length forms a sort of barrier, within the sloping sides of which the living animals are seen carrying on their operations. Those observed by Chamisso were the *Tubipora musica*, the *Millepora cærulea, obstichopora, actimas*, and various kinds of the polypus. He found the living branches of the *lythophytes* generally attached to the dead stems; many of the latter, however, crumbled into sand, which, accumulating on the inner declivity, constitutes no inconsiderable part of the surface of the new islands that rise out of this reef, and are gradually united into one island, having in its centre a salt-water lake, that alternately grows up by a silent and slow progress, till what was at first a chain of islets, has become one connected mass of land. The progress towards a state fit for the habitation of man has been well described by Chamisso.

"As soon as it has reached such a height that it remains almost dry at low water, at the time of ebb, the corals leave off building higher; sea-shells, fragments of coral, sea-hedgehog shells, and their broken-off prickles, are united by the burning sun, through the medium of the cementing calcareous sand, which has arisen from the pulverization of the above-mentioned shells into one whole or solid stone, which, strengthened by the continual throwing up of new materials, gradually increases in thickness, till it at last becomes so high that it is covered only during some seasons of the year by the high tides. The heat of the sun so penetrates the mass of stone when it is dry, that it splits in many places, and breaks off in flakes. These flakes, so separated, are raised one upon another by the waves at the time of high water. The always active surf throws blocks of coral (frequently of a fathom in length, and three or four feet thick) and shells of marine animals between and upon the foundation stones; after this, the calcareous sand lies undisturbed, and offers to the seeds of trees and plants, cast upon it by the waves, a soil upon which they rapidly grow, to overshadow its dazzling white surface. Entire trunks of trees, which are carried by the rivers from other countries and islands, find here, at length, a resting place, after their long wanderings; with these come some small animals, such as lizards and insects, as the first inhabitants. Even before the trees form a wood, the real sea-birds nestle there; strayed land-birds take refuge in the bushes; and, at a much later period, when the work has been long since completed, man also appears, builds his hut on the fruitful soil formed by the corruption of the leaves of the trees, and calls himself lord and proprietor of this new creation."

IN THE SOUTHERN HEMISPHERE.

Friendly Islands.

1. *The Friendly Islands.*—The Friendly Islands, amongst which may also be included the Feejee Islands, were first discovered by Abel Jansen Tasman in 1643, to three of which he gave the names of Amsterdam, Middleburgh, and Rotterdam. The first of these islands is that which was afterwards visited by Captain Cook, and described by him under the name of Tongataboo; more properly, as we since learn from Mr Mariner, *Tonga*, the annexed word *Tabboo*, so extensively used throughout Polynesia, being expressive only of its sacred character. From the inhabitants of this island Tasman received yams, cocoa-nuts, bananas, hogs, and fowls, in exchange for iron, nails, beads, and pieces of linen. They had also plenty of sugar-canes. Women as well as men swam off to the ship, and it was observed that all the elder dames had the little finger of both hands cut off, but the young women had not. They wore round the middle a covering of mat-work, which reached down to their knees; the rest of the body naked. None of the men would taste wine, and they were ignorant of the use of tobacco; they had no arms of any kind, which led Tasman to conclude that they lived in perpetual peace and friendship.

Tasman next touched at Ammomooka, or, as he called it, Amsterdam Island, in the hope of meeting with better water than on the first, where it was bad and scanty. On landing, they perceived some sixty or seventy persons sitting quietly on the shore, who had no arms of any kind, and appeared to be a harmless and peaceable people. There were, besides, many women and children, the former clothed like those on Amsterdam Island; but they were of a larger size, and as strong in their bodies and limbs as the men. The party was shown to a piece of fresh water not a mile from the shore, about a quarter of a mile in circumference, and about a musket-shot from the north side of the island, where there was a good sandy bay. Here they watered their ships, and received abundance of provisions, the same in kind as those of the other island. The inhabitants are described as being great thieves, but very friendly. They have large vessels with masts, sails, and outriggers, as well as canoes, and on going into the interior of the island it was observed that all their plantations were laid out in neat and regular order. "There was not," says Captain Cook, "an inch of waste ground; the roads occupied no more space than was absolutely necessary; the fences did not take up above four inches each, and even this was not wholly lost, for in many were planted some useful trees or plants. It was everywhere the same; change of place altered not the scene; nature, assisted by a little art, nowhere appears in more splendour than here." The missionaries, too, in 1797, found these islands in as high a state of cultivation and beauty as they appeared to Tasman and to Cook.

Revolution the go- ernment.

A woful difference in their peaceable habits, according to Mr Mariner, has taken place since the visits of these Europeans. In 1799 a revolution took place, and from that time bloody wars and most savage slaughter have desolated these beautiful islands. They were first commenced, as it would appear, by a most atrocious savage, in whom the kingly power was vested, who not only practised the most barbarous cruelties on his subjects, but seized upon the sacred or ecclesiastical power, which had always, as in Japan, been kept separate from the secular arm. The sacred spell being thus broken, which rested solely on public opinion, a complete revolution followed, and from that hour these once happy islands have been the scene of slaughter, famine, and every species of horror and misery. We must not, however, give implicit credit to all that has been stated by Dr Martin, the writer of Mariner's account of these islands, but rather consider it as a romantic exaggeration of facts and descriptions, similar to that of the Pellew Islands by Mr Keats. There are shades of difference merely between the inhabitants of these and of the neighbouring islands.

In 1833, missionaries were detached from Tahiti, the centre of all the settlements in the South Seas, to these islands. They experienced on their arrival difficulties and discouragements from the barbarous inhabitants; but by perseverance they expect to obtain a footing, and to introduce amongst them the blessings of civilization, as well as into the other islands among these seas.

The Harvey Islands[1] are situated between 19° and 22° south latitude, and 160° west longitude, and are between 500 and 600 miles south-west by west from Otaheite or Tahiti. They consist of the island Manaia or Mangeca, a small island containing only 1000 or 1500 inhabitants; Rarotonga, a much larger island, containing from 6000 to 7000 inhabitants; Aitutake; Mantii or Mante; Mitiaro, a very small island; Atui. Three of these islands are not laid down in any chart. The missionaries, when they first visited them, met with every discouragement, and could scarcely preserve themselves and their wives from the violence of the king. Two missionaries, however, visited these islands in 1823, and two native teachers were also left in 1824; and in the course of two months they had made a hundred and twenty converts. In 1825, these islands were visited by missionaries from this country, and it was found that great progress had been made in civilizing and instructing the inhabitants. Many had learned to read; whilst their idolatrous and cruel practices, such as infanticide, had been abolished. More decent clothing had been adopted by the women, who were no longer so ready to offer themselves for prostitution to crews of foreign vessels when they arrived. An attempt that was made to plant the Christian religion in the Feejee Islands had failed. But a vessel from New South Wales having touched at Lageba in 1829 or 1830, the captain had a friendly conversation with the chief, who requested that a missionary might be sent. A teacher, accordingly, set sail from Otaheite, and landed on these islands in 1830.

In 1830, two missionary teachers were left on the Friendly Islands, in which, though distinct, the Feejee Islands have been included. They were kindly received, but were informed by the king that he could not embrace Christianity until after he had consulted with all the chiefs of the other islands; that they had been erecting a most extensive Morai, about seventy-six feet in height, all of stone, which had given way three times, and which misfortune they ascribed to the power of the new God. One chief, converted by native missionaries, expressed his adherence to the Christian faith, amidst the scoffs, jeers, and even threats of his countrymen.

Navigators' Islands.

2. *Navigators' Islands.*—To the north-east of the Feejee, Tonga, or Friendly Islands, are situated the Bauman or Navigators' Islands. The first name was given to them after Captain Bauman, of the Teinhoven, by Jacob Roggewein, by whom they were discovered, in 1722; and the latter name was conferred by Bougainville, who passed them in 1768. La Pérouse likewise visited these islands, and is of opinion that they are not the same as Bauman's Islands, because their geographical position does not agree with that assigned to them by Roggewein. Burney, however, has no doubt that they are identical, the only difference being in their supposed longitude, which, in the time of Roggewein, was frequently set down erroneously by several degrees.

Description of the islands and natives.

These islands form an archipelago, consisting, according to La Pérouse, of ten in number, of which Maouna, Oyolava, and Pola are the largest and most beautiful. The parallel of 14° south latitude, and the meridian of 190°, pass through the centre of the group. According to the missionaries, these islands, which they also designate as the Samoa Islands, are eight in number, four in the windward group, and four in the leeward group, two much larger than Otaheite, two others noble islands, and the remaining four small, though full of inhabitants. To the largest they gave the appellation of Savai and Upola. They are said by La Pérouse to be volcanic, but surrounded by coral reefs. Roggewein describes the hills and valleys as affording a delightful prospect. The natives came off in boats neatly made and carved, bringing fish, cocoa-nuts, and plantains. They are said to have white skins, but tanned by the sun, to be gentle in their manners towards each other, lively and good-humoured; their bodies were neither painted nor marked, and they were clothed from the waist downwards; the cultivated grounds were all enclosed; and, in short, they are described by the writer of Roggewein's voyage as the most civilized and honest people they had met with amongst the islands of the South Sea. We may conclude, indeed, from his account, that they were equally well cultivated, and the inhabitants equally mild and peaceable, with those of the Friendly Islands.

Very different, however, is the account given of them by La Pérouse. Ferocious in the highest degree, he describes them as utterly destitute of gratitude and every good moral feeling; that a look of disdain is stamped on all their countenances; and that they are eternally fighting with each other, so that their bodies are covered with scars occasioned by the blows of clubs. Tall in stature, their limbs are of colossal proportions; and their bodies are tattooed to such a degree as to make them appear clothed, though they have only a girdle of sea-weeds round their loins, which reaches to the knee. The size of the women corresponds with that of the men, and their whole behaviour is represented as highly indecent and disgusting. They had no desire for iron, preferring their own adzes and other tools made of basalt. Their huts were made with great nicety, and all their wood-work was highly polished and carved. Their matting and cloth were exceedingly beautiful; the latter woven with thread made from the nettle, and a species of flax. The sails of their boats or canoes were made of this cloth. The islands are so intersected with creeks that they travel from place to place almost universally in canoes, which have outriggers to prevent them from upsetting.

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[1] Missionary Chronicle for September 1826.

Fertility.

All the islands were clothed with trees up to the very summit of the hills, many of them laden with fruit. The villages are ranged along the margin of the streams which fall from the mountains, and are built in the midst of groves of cocoa, banana, guava, and other fruit-trees common to the South Sea Islands. The woods abound with wild pigeons and turtle-doves, which are tamed by the natives, and kept about their houses in flocks of many hundreds. Sugar-cane grows abundantly and without culture. Their animals are pigs, dogs, and the domestic fowl; these, and the fish, which they catch with great expertness, afford them an abundant supply of food. These islands were visited for the first time by the missionaries in 1830, who placed eight teachers on the large island of Savai. They were kindly received by the chiefs; and they considered that their prospects of civilizing these islands, and of reclaiming them from idolatry, were very favourable. A fierce war was waging at the time the missionaries landed, between the islands of Upola and Savai, which they interposed with their counsels to appease; and the chiefs promised that they would terminate it, and come and learn from the missionary teachers the word of God. These islands were visited, in 1834, by five missionaries from Otaheite. They were kindly received by the natives, who still continued to express the strongest desire for their instructions, and several of whom had made an open profession of the Christian faith. Four additional missionaries arrived in these islands at the close of the year 1835; and as their reception was friendly, they had commenced their labours amidst a population of 50,000, with every prospect of success.

Society Islands.

3. *Society Islands.*—The first account of these islands is given in the voyage of Jacob Roggewein, who touched at Ulietea in the year 1722; at least it is conjectured by Burney, on probable grounds, that the Verquickking or Recreation Island of that navigator is the same. On sending a boat on shore, the inhabitants assembled on the beach, and advanced into the water armed with lances to oppose their landing. The Hollanders fired upon them, and having dispersed them, landed on the beach, and the inhabitants returned in a friendly manner, and brought them cocoa-nuts and other articles of food. The Hollanders then advanced up a valley towards the mountains; but some thousands of the natives coming out of the glens and crevices, made signs to them to return. The Hollanders, however, paid no regard, but proceeded, upon which showers of stones were hurled at them, by which some were killed and others wounded. These volleys were answered by a discharge of musketry, which killed many of the islanders, who, nevertheless, continued the action, and finally drove the Dutchmen into their boats. Many of the latter subsequently died of the wounds they had received, in consequence of the bad state of their constitutions, being severely affected with the scurvy.

Description.

Captain Cook visited these islands in 1769, and again in 1777. They consist of six in number (besides small coral islets), the names of which are Ulietea and Otaha (both encompassed by the same coral reef), Huaheine, Bolabola, Tubai, and Maurua. They extend from about 16° to 17° south latitude, and from 151° to 152° west longitude. The climate, the productions, and the inhabitants, resemble so nearly those of Otaheite, that the same description will apply to both. The surfaces of all the islands are uneven and hilly, but not mountainous; and the hills are finely wooded. The inhabitants, like those of the Navigators' Islands, are generally of a larger stature than the Otaheitans. The late Sir Joseph Banks measured one of the natives of Huaheine, and found him to be six feet three inches and a half in height; and the women are described as generally more handsome and somewhat fairer than those of Otaheite. Bolabola differs from the rest of the islands by having a lofty double-peaked mountain near its centre, apparently volcanic. In Ulietea there is a large Morai, in which a number of jaw-bones are kept as trophies of war. The coral reefs which everywhere surround these islands form numerous safe and commodious harbours for shipping, and refreshments of hogs, fowls, plantains, cocoa-nuts, and yams, are generally to be had in great abundance.

In these islands, the missionaries, though long disappointed, and though their lives were frequently endangered by the contests and revolutions which agitated the country, at last succeeded, by their perseverance and intrepidity, in establishing stations in Huaheine, Ulietea or Raiatea, Taha or Otaha, and Borabora or Bolabola. It was about the year 1817 that a missionary, Williams, landed in Raiatea, where he has laboured ever since with perseverance and fidelity. The inhabitants of Taha are strongly attached to their ancient idolatrous worship. They opposed the introduction of Christianity, and even went to war with the king of Raiatea because he had agreed to renounce idolatry. But they were worsted in the contest, and the king was taken prisoner. Instead, however, of being put to death, as formerly, with cruel tortures, he was humanely treated, which made such a deep impression on his mind that he embraced Christianity; and in 1824, in Raiatea, 178 children had been baptized, and 140 taught to read. In Huaheine, missionary stations were also established, and the preachers laboured with success in the conversion of the natives. In 1830, at the public examination of the schools, 370 children were present, all very neatly dressed in European cloth; and many of the chiefs and parents were present on the occasion. The same success attended the efforts of the missionaries in Borabora. But the progress of this moral reformation experienced some serious interruption. The indolent dispositions of the people, from habit or from the heat of the climate, indisposed them to industry; and, from the introduction of spirits, both in Raiatea, Borabora, Huaheine, and in the other islands, they relapsed into all their gross excesses. One of the old chiefs, who had favoured the introduction of the missionaries, having died, his successor, who had resided at Huaheine, was much addicted to intemperance; and a person from Botany Bay having brought ashore a cask of spirits, the slumbering appetite was rekindled, and the people, encouraged by their chief, gave way to almost universal dissipation; and though the introduction of spirits had been prohibited before, they now began to erect stills for distillation in various quarters. The missionaries did all they could to repress this flood of dissipation; and they succeeded at last in putting a stop for a time to the use of spirits. In Borabora and Maupiti, the chief, Mai, desirous of having more than a single wife, left the missionary settlement, attended by a great part of his people; and at their new settlement they abandoned the profession of the Christian religion, and commenced the distillation of ardent spirits. The missionaries, however, do not relax in their labours; though the encouragements are not so great as could be desired, yet they hazard everything, even life itself, in the hope of spreading their doctrines among distant nations. They so far prevailed, that the people agreed to give up the use of spirits; and a law was enacted, inflicting a heavy penalty on any one who should be found engaged in distillation.

Georgian Islands.

4. *The Georgian Islands, including Otaheite, &c.*—Otaheite is the chief island of this vast group, which extends

over fifteen degrees of longitude, in the direction of south-east. The extreme point is Pitcairn's Island, lately become interesting on account of the discovery of the descendants of the mutineer Christian and some of his associates. The natives of this vast chain of islands, and particularly of Otaheite, may probably be considered as the most civilized, but, at the same time, the most sensual people in all Polynesia. It was first discovered by Quiros in 1606, and received from him the name of Sagittaria. The natives received the strangers with great kindness, gave them cocoa-nuts and other fruits, and a general interchange of civilities and presents soon took place. This good understanding remained uninterrupted, and the Spaniards, for once, left the island without having quarrelled with the inhabitants. In their zeal, however, they committed an act which, if discovered, might have been attended with unpleasant circumstances. The place at which they first landed was uninhabited, but in passing through a wood they discovered a Morai, in which they concluded " the enemy of mankind resided;" and, under this impression, cut down a tree, which they formed into a cross, and planted in the midst of the sacred building.

In 1765, Commodore Byron discovered two low islands to the northward of Otaheite, which, in honour of his majesty, he named George's Islands, one of which, afterwards visited by Cook, is called Tiookea. The natives of these islands were very dark coloured, robust, and apparently ferocious; and their bodies were marked with the figure of a fish.

In 1767, Captain Wallis touched at Otaheite, and went through the ceremony of taking possession of the island in the name of his sovereign; but the flag was removed by the natives in the night. Various squabbles occurred between the seamen and the natives, who, however, behaved on the whole with great kindness and hospitality. Most of the quarrels were owing to the licentious intercourse of the seamen with the native women. In 1768, M. de Bougainville visited Otaheite, and was most hospitably received; in return for which several murders were committed by the French seamen. Captain (then Lieutenant) Cook anchored in Matavai Bay in April 1769. It is from this and his several subsequent visits, together with a missionary voyage in the ship Duff, commanded by Captain Wilson, 1796–1798, that Otaheite is so well known to us.

taheite.

The island consists of two peninsulas, connected by a low isthmus, about three miles in width, covered with brushwood. The larger, Otaheite Nove, is about ninety miles in circumference, and nearly circular; the smaller, Tiaraboo, is about thirty miles; the whole nearly surrounded by a low belt of land, from a furlong to a mile in width, which is prolonged by a gradual rise to the valleys, which run up to the foot of the lofty central mountain. These valleys and their intermediate ridges are beautiful, clothed with a great variety of trees to their very summits; in the valleys are mostly met with clear streams of water, which, in the rainy season, become mountain-torrents. The island, being surrounded with coral reefs, is dangerous to approach, and the only safe harbour is that of Matavai, on the northern side, in latitude 17. 30. south, longitude 149. 13. west. This too is not free from danger from December to March. The climate is delightful, the thermometer seldom rising above 80° in summer, and ranging from 62° to 72° in winter.

oduc-
ns.

The island is so fertile as to produce everything in abundance, and without toil, for the sustenance of man. The bread-fruit is here superior to that which grows on the other islands. The fruit affords them a most nutritive food, either for present use, or made into a paste called *mahie*, which will keep till the following season; the trunk supplies them with timber for their buildings and canoes. It exudes a gum, which serves for pitch; and from the inner bark is manufactured a substantial cloth. They reckon no less than thirty varieties of this most useful tree, which, with the different exposures to the trade-winds, and the difference of elevation above the sea, afford to the natives a bread-fruit harvest at almost all seasons of the year. The cocoa-nut, next to the bread-fruit, supplies them with meat, drink, cloth, and oil. Of plantains, they reckon fifteen different sorts. Yams and sweet potatoes, taro-root of different kinds, and various other edible roots and fruits, are most abundantly produced; to which our missionaries have added the pine-apple, the grape, and various culinary vegetables of Europe; but the natural and spontaneous productions of the soil, and the consequent indolence of the people, are unfavourable to their success.

Animals.

The animals found on the island are hogs, dogs, and rats. Several attempts have been made to introduce the horse, and horned cattle, sheep, and goats, but without success. The latter are so disliked for their smell and the mischief they did to their plantations, that they drove them into the mountains, where they run wild. The breed of cats has succeeded, and they are found to be extremely useful; and rabbits have been introduced, but we know not with what success. Common poultry are abundant, and the woods supply vast quantities of wild pigeons and parrots. The tropical bird builds its nest in the steep cliffs, and as its long feathers are highly valued, it is taken on the nest by lowering down a man seated across a stick, by a rope, to the depth of thirty or forty fathoms; in which situation, by means of a long pole, he swings himself from side to side, examining all the holes as he descends, in order to take the bird on her nest. The shores abound with sea-fowl, and the sea with excellent fish, which they take with great expertness by hook and line, or by the net. Dolphins are caught at a distance from the shore, by baiting the hook with a real or artificial flying fish. Their fishing-tackle displays the greatest ingenuity, and can only be exceeded by their skill in using it. Their hooks are made of pearl-shells, bone, and hard wood. The coast abounds with lobsters, crabs, and various kinds of shell-fish.

Inhabitants.

The colour of the natives is that of olive, or light copper. The men are above the middle size; the chiefs are almost uniformly tall, muscular, and well limbed, measuring from five feet nine inches to six feet four inches, and continue healthy and vigorous to a good old age. The women of the upper ranks are likewise tall, with limbs finely turned. Their skins are soft and delicate; their eyes black, sparkling, and full of expression; their teeth beautifully white and even; their hair jet black, and generally ornamented with flowers; and in their gait they are firm, but easy and graceful. From a custom of compressing the face when infants, they can scarcely be called beauties; yet, according to the account of Captain Wilson, they possess feminine graces in an eminent degree; " their faces never being darkened with a scowl, or covered with a cloud of sullenness or suspicion." They are affable and engaging; mild, gentle, and unaffected; courteous to each other and to strangers. The whole of the body to the middle of the leg is clothed; but there is a singular custom which compels a woman to uncover her shoulders and breasts in the presence of a chief, or in passing a Morai or sacred place. The lower classes have always been described as extremely licentious, but Captain Cook says they have been much calumniated. " It is too true," say the writers of the Missionary Voyage, " that, for the sake of gaining our extraordinary curiosities, and to please our brutes, they have appeared immodest in the extreme. Yet they lay the charge wholly at our door, and say the Englishmen are ashamed at nothing, and that we have led them to public acts of indecency never before practised amongst themselves." It must be admitted, however, that the most abandoned conduct is freely indulged by the women of the Arreoy society, who, to the crime of unbounded licentiousness, add that of murdering their children the moment they are born. In recent accounts, however, it is stated that this horrible practice has been abolished, and that Christianity is making a rapid progress amongst these interesting islanders. As wives, the Otaheitan women are tenderly affectionate to their husbands and children, nursing and attending the latter with the utmost care. They never, on any occasion, strike a child. A melancholy instance of the fidelity and affection of one of these women is given in the Missionary Voyage. "The history of Peggy Stewart marks a tenderness of heart that never will be heard without emotion. She was daughter of a chief, and taken for his wife by Mr Stewart, one of the unhappy mutineers of the Bounty. They had lived with the old chief in the most tender state of endearment; a beautiful little girl had been the fruit of their union, and was at the breast when the Pandora arrived, seized the criminals, and secured them in irons on board the ship. Frantic with grief, the unhappy Peggy flew with her infant in a canoe to the arms of her husband. The interview was so affecting and afflicting, that the officers on board were overwhelmed with anguish; and Stewart himself, unable to bear the heart-rending scene, begged she might not be admitted again on board. She was separated from him by violence, and conveyed on shore in a state of despair and grief too big for utterance. Withheld from him, and forbidden to come any more on board, she sunk into the deepest dejection; it preyed on her health, she lost all relish for food and life, rejoiced no more, and pining under a rapid decay of two months, fell a victim to her feelings, dying literally of a broken heart."

The Otaheitans are generous even to a fault; they seem to be utterly unable to resist importunities, and always ready to share their last morsel with their neighbours. Poverty is no reproach, but affluence with covetousness brings contempt on the possessor. Should any one, indeed, refuse to share his property in cases of distress, the chances are that it will be destroyed, and his house pulled down over his head. The office of king is hereditary in one family; the chiefs resemble our ancient barons; under them are the vassals, and below them the *villeins* or labourers. The king and queen enjoy many privileges, one of which is, to be carried about everywhere on men's shoulders; and the reason of this is, that whatever soil they tread upon becomes sacred, and belongs to them; so also, if they enter a house, it is rendered sacred, and becomes their property. Their domestics and attendants are also *raa*, or sacred, and for thieving, plunder, and all manner of licentiousness, they are said to be the worst on the island.

In the Missionary Voyage an account is given of the ceremony of investing the new sovereign with the royal *maro*, when each chief of the island, amounting to nearly one hundred, brings one, two, or three human victims, to offer up on the occasion. They are brought before the sovereign in a lifeless state, having first been stoned to death, or knocked on the head with clubs. From each of these victims the priest scoops out an eye, and presents it to the king on a plantain leaf, and the bodies are then carried away and interred in the Morai. The reason assigned for this oblation is, that the head being accounted sacred, and the eye the most precious part, it is presented to the king as the head and eye of the people. During the presentation, the king holds his mouth open, as if devouring it, whereby it is imagined he receives additional wisdom and discernment. The royal *maro*, and the sacred canoes which brought the human sacrifices, are then deposited in the Morai; after which a series of feasts begin, which continue for two months. These abominable rites, if not entirely abolished, have in a great degree ceased by the influence of the missionaries.

In their language and their deities may be traced their Hindu origin; and though their religion is a tissue of superstitious and brutal ceremonies, they never draw near to their Eatova with carelessness and inattention. Captain Cook testifies to the decorous conduct of an Otaheitan on such occasions: "He is all devotion; he approaches the place of worship with reverential awe, uncovers when he treads on sacred ground, and prays with a fervour that would do honour to a better profession."

The early visits of the European navigators to these islands produced no advantages whatever to the inhabitants, who were only contaminated by the vices, without participating in the blessings, of civilized life. But, in later years, the visits of the missionaries to this and the other islands were solely for the purpose of improving the inhabitants, and of spreading among them the light of knowledge and of truth. A great improvement has in consequence taken place in the manners as well as in the morals of these savages. It was in the year 1796 that the London Missionary Society sent out their first missionaries to Otaheite, and to the South Seas. Their object was to communicate the knowledge of Christianity to the natives, who gladly received them, as well as several others who were afterwards sent out in the year 1800. The missionaries were, however, involved in serious trouble in 1799, from the thievish habits and riotous dispositions of the natives; and several of them were compelled to take refuge in New South Wales, whence they afterwards returned to Otaheite. Their prospects were for a long time uncertain and precarious; and they laboured with very little success to draw the attention of the natives from their cruel rites and superstitions to the purer faith of the gospel. About the year 1814, they began, however, to make some converts. In the neighbouring island of Eimeo, about fifty persons voluntarily renounced idolatry, and embraced Christianity. These first converts were continually increased by new accessions, until the great body of the inhabitants, as well as those in seven or eight of the neighbouring islands, embraced Christianity, and renounced their former impure and idolatrous rites. They now assemble regularly for public worship, as decently attired as they can afford, in congregations of four or five hundred, and occasionally seven or eight hundred persons. Their imitation of the European dress is not, however, always the most successful. They are extremely fond of gaudy colours; and the cast-off clothes of soldiers are in particular request. Sometimes a coat is worn without a shirt or any other article of European apparel; and frequently not fitting, the effect is rather ludicrous. Along with religion, they are also instructed in all the mechanical trades of Europe; they are taught to read, write, and to cast accounts, the natives with singular industry teaching each other. Great numbers have been taught to read in the Tahitian language, which the missionaries have reduced to writing; and the Scriptures have also been translated into the native language of the island, in which language also the missionaries began to preach in 1824. A great reformation has followed the propagation of Christianity throughout the island. The bloody, ferocious, and profligate practices of the Arreoy societies have been abolished; the crime of infanticide has disappeared; and human sacrifices are also abandoned, with many other idolatrous and degrading superstitions and practices. Many of the other improvements of civilized life have been adopted. The dwellings of the chiefs have been enlarged and beautified; a distinct house has been assigned to each family, in place of their being, as formerly, all crowded into one house. Land has been cultivated, and the sugar-cane raised in some districts; and the cotton cultivation has also been commenced. This island is now frequently visited by European ships, and civilization is advancing.

It was in the year 1815 that idolatry was formally abolished in this island, under the influence of Pomare, the king, who, though his character was defective in many points, being addicted to intemperance and other vices, was nevertheless steady in his friendship to the missionaries, and protected them in their efforts to introduce civilization into the country. He was anxious also to be instructed in reading and writing; and his example has contributed to diffuse a desire for knowledge among others. Schools have been established by the wives of the missionaries, where instruction is given in sewing, in reading, and writing. In these accomplishments many of the females have made considerable proficiency; and, since 1815, reading and writing has become general among the natives. A great change has also been made in the costume; the English dress has, as far as possible, been invariably adopted, by the women especially, who appear with frills round their necks, with caps on their heads, and stockings and shoes on their feet; and their other garments are also of European materials. The men, however, showed great awkwardness in first adopting the European costume; sometimes wearing stockings on their arms, or thrusting their arms through the legs of a pair of pantaloons, and wearing them on their shoulders, or wearing a coat without a shirt, as observed by the Russian navigators, or wearing a shirt on the outside of the dress. The progress of improvement, however, is begun, and will advance; and in time society in these islands will assume the aspect of civilized life. Pomare, the king of Otaheite, and the first convert to Christianity, which he professed in 1812, was born about the year 1774. He died in the year 1821, and was immediately succeeded by his son Pomare III., who was crowned with no small pomp in 1824, being then only four years of age. Shortly after his coronation he was placed at the South Sea academy in the island of Eimeo, under the care of Mr and Mrs Orsmund, for the purpose of receiving, with the children of the Missionaries, an English education. He died in 1827, of a lingering disorder, then prevalent in the islands, and was succeeded by a daughter of Pomare II., who still reigns. The monarchy is despotic, nor does it afford any adequate security for life or property. Even Pomare, notwithstanding all his apparent religious zeal, occasionally plundered his subjects, and seized their property by main force. A long era of moral improvement must elapse before any proper form of civil order, or anything like free institutions, can be established in these islands.[1]

The missionaries accordingly experienced, after the gloss of novelty had worn off their religion, a considerable defection of their proselytes; and for a time their fair prospects of usefulness were overcast. At first the natives appeared zealous in their attachment to the Christian creed, and schools and congregations multiplied in all quarters. The same success attended the efforts of the missionaries in the neighbouring islands of Eimeo and Huaheine. In a short time, however, the people began to relapse into their former course of licentiousness, and other evil practices; and the letters of the missionaries themselves contain a full and candid account of these defections. Many of the converts, they observe, grew weary of the restraints which Christianity imposed on their passions; and the introduction of ardent spirits, the licentious example and the debauchery of the European sailors when vessels touched at the islands, the propagation of delusions among the people by visionaries, and finally a bloody war which broke out in Otaheite, completed the corruption and the defection of many converts. Another difficulty has arisen from the previous irregular and indolent habits of the natives. "A state of society," it is observed, "more dissolute, and opposed to steady application and industry, than that which prevailed among them prior to the renunciation of idolatry, cannot well be imagined; and although the general and continued operation of those propensities which heathenism had nurtured and matured was restrained almost universally when the islanders first professed Christianity, numbers being influenced by the excitement of feeling in favour of the new religion, which then appeared to pervade all classes, many afterwards relapsed into their former evil practices, and have remained destitute of everything connected with Christianity excepting the name. These found, as might have been expected, their former inclinations too strong to be restrained by the feeble resistance which public opinion interposed; and though they did not revive the worship of the idols or cruelties of human sacrifices, they returned, in a great degree, to their former indolence and vices."[2] The missionaries have spared no pains to counteract this tendency to vice. They have established throughout the island temperance societies, and have prevailed on the chiefs to restrain the importation of spirits. The Queen Pomare, and most of the chiefs, who show an ardent desire for the instruction of the people, have joined these societies, and have countenanced the efforts of the missionaries, who have in some degree succeeded in stemming the torrent of profligacy which was inundating these countries, and was fast sweeping away all traces of that purer morality which had been planted among the natives. "The demon of intemperance," says one of the missionaries, "which brought moral sterility and desolation, nipping and stunting the young plants of promise, has again disappeared; our fears have been dispelled."[3] But, even after all the defections that have taken place, a letter, dated April 1836, mentions that there are two thousand natives in church-fellowship; that two thirds of the people can read; that a great number have learned to write; and that the schools and chapels are well attended. In the different islands there are thirty-nine stations, thirty-seven schools, seven thousand scholars, and thirty-nine congregations consisting of twenty-two thousand attendants. A letter from one of the missionaries mentions that he had seen Queen Pomare in the midst of a group of little girls, teaching them words of one and two syllables.

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[1] Missionary Chronicle for April 1835, p. 168, Letter of Mr Williams.

[2] See the Evangelical Magazine, and also the Missionary Chronicle for September 1832, p. 407. In the Evangelical Magazine for November 1833, the difficulties of the missionaries are very fairly stated. "The difficulties," it is observed, "attending the progress of the work in which our brethren are engaged have been frequently stated to the friends of the society. These have arisen from the natural indolence and fickleness of the natives, the effects of their former notorious licentiousness, which so many attempts have been made to revive; and the appearance of gross and visionary heresies, whereby a number of individuals, disaffected towards the requirements of the gospel, have sought, by pretended supernatural revelation, to counteract or destroy the effects which the word of God was producing among the people, in elevating the tone of moral feeling, and improving their social character and habits. In recent years, difficulties more formidable than any produced by these causes have arisen from other quarters; the increasing number of ships resorting to the islands for refreshments and traffic, and, with the increase of commerce, consequent profligacy, from the increased intercourse of seamen with the most depraved portions of native society; and the large importations of ardent spirits in English and American vessels, chiefly the latter, consisting of what is denominated New England rum, many vessels conveying this, and, with the exception of fire-arms and ammunition, no other article of barter with which to traffic among the natives. The activity and perseverance manifested in promoting the sale and use of these pernicious drugs, by hawking them about the islands, inducing the chiefs to engage in trade, and the establishment, by foreigners who have left ships touching at the islands, of a number of grog-shops on the shore, have occasioned the missionaries much perplexity and distress. By the retail of ardent spirits, these houses become the greatest pests in the country, the resort of the most abandoned in the islands, and the most indolent and depraved among the crews of the shipping, proving alike seductive and injurious to all within their influence, and exhibiting, in the conduct of foreigners, scenes of outrage and bloodshed unknown amongst the natives since their renunciation of paganism."

[3] Evangelical Magazine for August 1837, p. 395.

One most important benefit which has been conferred upon these islands, and a great step in the progress of improvement, has been the commencement of trade and manufactures. A number of natives have been taught to spin, and to weave the cotton into cloth, to make soap and salt, to prepare tobacco, to manufacture sugar; also a knowledge of rope-making, turnery, carpentry, and the art of working in iron. Some are employed as smiths, others in the preparation of lime, and in the construction of neat and comfortable dwellings, and also in boat and ship-building, in which many of them are adepts.

They have also begun to carry on commerce. A number of small vessels, built by the natives, of from twenty to thirty-five tons burden, are employed in fetching from a group of islands, situated two or three hundred miles eastward, cargoes of pearl-shell, which they dispose of to the English and American traders. The last returns of the trade to Otaheite mention 154 arrivals in 1836 at the port of Honolu, the capital, of which eighty are brigs and schooners belonging to the country, fifty-six to the United States, and seventeen to Great Britain.

The Marquesas.

5. *The Marquesas.*—This cluster of islands was discovered by Alvarode Mendana in 1595, and named by him Las Marquesas de Mendoça, in honour of the viceroy of Peru. Four only are described by Quiros the pilot, under the names of La Dominica, Santa Christina, San Pedro, and La Madalena. The Spaniards anchored in a port of Santa Christina, to which they gave the name of Madre de Dios, well protected from the trade-wind, and which has two excellent streams of fresh water flowing into it. The people are described as being an elegant race; the women in particular as remarkably beautiful, their complexions and general appearance being said to excel those of the women of Lima. Their dress consisted of a cloth made of the leaves of a palm-tree, with which they were covered from the breast downwards; and so civilly disposed were they, that a beautiful native woman seated herself by the side of Donna Isabel, the wife of Mendana, and began to fan her. But the Spaniards, as usual, found means to quarrel with the natives, and to drive them with their fire-arms into the woods.

The produce of the islands was hogs, fowls, fish, cocoanuts, sugar-canes, plantains, and the bread-fruit, which is described for the first time by the writer of this voyage.

Description.

Subsequent discoveries have made us nearly as well acquainted with the Marquesas as with Otaheite. Captain Cook visited them in 1774, and Captain Wilson in 1797. From these we know that they consist of eight in number, besides some smaller islands to the westward, which being seen by an American master of the name of Ingraham, he called them Washington's Islands. They had previously been seen, however, by Marchand in 1789, and may fairly be grouped as part of the Marquesas. The centre of the group may be reckoned in about the latitude of 9. 30. south, and longitude 139. 30. west.

Manners.

The manners, the religious ceremonies, the Morais, and the general appearance of the natives, are so similar to those of Otaheite, that a description of them would amount to little more than a repetition of what has already been said. They have all the good qualities of the natives of that island, and most of their bad ones; but, owing probably to a more restricted communication with strangers, a greater degree of simplicity was observable in their manners, on the first arrival of the missionaries amongst them, than in the people of Otaheite. Scarcely had they anchored in Resolution Bay (Madre de Dios), when two women, though it was dark, swam off to the ship, in the hope of meeting a favourable reception, calling out in a piteous tone, when they found they could not be admitted on board, *Waheené, waheené!* "We are women, we are women." The next morning the visit was repeated, and is thus described in the Missionary Voyage:

"Our first visitors from the shore came early; they were seven beautiful young women, swimming quite naked, except a few green leaves tied round their middle; they kept playing round the ship for three hours, calling *Waheené*, until several of the native men had got on board; one of them, being the chief of the island, requested that his sister might be taken on board, which was complied with. She was of a fair complexion, inclining to a healthy yellow, with a tint of red in her cheek; was rather stout, but possessing such symmetry of features, as did all her companions, that as models for the statuary and painter their equals can seldom be found." Captain Wilson says, that an Otaheitan woman which they had on board was far eclipsed by the Marquesan woman; but she was shocked to see a woman quite naked walking the deck, and threw over her a dress of Otaheitan cloth; but as for the rest of these females, the goats, it seems, soon stripped them of their green leaves, and left them in a state of complete nudity. On shore the women clothe themselves in decent habits.

The Marquesans are so far superior to the Otaheitans, that they sacrifice hogs only to their deities, and never men. Their houses, canoes, their dress, and the cultivation of their land, are at least equal to those of Otaheite, and they have none of those infamous Arreoy societies. Captain Porter of the American frigate Essex, after brutally massacring a number of these people upon the most frivolous pretext, charges them with cannibalism, though, from his own account, there does not appear to be the slightest ground for so injurious an imputation. To all unprejudiced navigators they have appeared as an amiable people, entertaining a great respect for old age, fond of their children instead of murdering them, as in Otaheite and some other islands, and living in peace and harmony with each other, and with their families.

These islands were visited by the missionaries, several of whom have settled amongst the natives. But it does not appear that their labours, though zealously pursued, have hitherto been attended with the desired success. The state of the people, it is said in the Missionary Magazine for April 1837, "is not that of open opposition or enmity against the gospel, but of apathy and unconcern, strengthened by deeply-rooted habits of worldliness and vice;" and the journals of the missionaries entirely agree with this account. It is with difficulty that they procure, at their several stations, a congregation of above eight persons on Sundays; sometimes they amount to twenty, but generally they pay little attention to the instructions of their teacher, and scarcely preserve decorum during the worship, conversing with each other about their ordinary concerns, and pursuing all their worldly occupations after the worship is finished. The missionaries are, however, resolved to persevere in their plans, in the hope that they may, as in the other islands, succeed in time in making an impression on the barbarous natives.[1] The distillation of spirits, which the people had been taught by a native of the Sandwich Islands, proved an additional obstacle to the success of the missionaries, as their eagerness to plunge into this vice shut their ears to all spiritual instruction.

Easter Island.

6. *Easter Island.*—This small island, not thirty miles in length, is only deserving of notice from its solitary position, its great distance from any of the islands of the Pacific, its comparative proximity to the coast of South America, and its being inhabited by a race of men who differ no more from the rest of the Polynesians than they do from

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[1] Missionary Magazine for April, May, August, 1837, p. 195, 231, 395.

one another; having the same language, the same features, the same religious notions, and Morais constructed as they generally are in other islands. On the platforms of the latter are erected shapeless and uncouth masses of stone, carved in imitation of the human bust, with rude faces four or five feet in length, set on trunks of ten or twelve feet in height. Kotzebue, the last visiter to this island, looked, however, in vain for any traces of these statues on the spots where they are described by Cook and La Pérouse.

This island is supposed to have been discovered by the bucaneer Davis, in 1687, although some have contended for the Dutch Admiral Roggewein being the discoverer, and he it was who gave it the name of Paaschen or Easter Island, having first seen it on the day of that feast. Its latitude is 27. 5. south, and longitude 109. 46. west.

It is not remarkably fertile; but few trees are found on it, and no running stream. The natives are very industrious in raising food for their support, which consists chiefly of bananas, taro-roots, sugar-canes, sweet potatoes, and yams. By some navigators they are described as a very savage people, and by others as a mild and amiable race. The fact is, that their conduct has always corresponded with the treatment they received from strange visiters. Thus their decided hostility to Kotzebue, when he attempted to land on the island, was explained on his arrival at the Sandwich Islands. An American, commanding a schooner called the Nancy, from New London, had observed a vast multitude of seals on the shores of the small uninhabited island of Massafuero, to the westward of Juan Fernandez; and thinking it might turn out an excellent speculation, if a small establishment were formed on the island, to carry on the fishing, he set about the means of carrying this project into effect. His own crew was but just sufficient to navigate the vessel, and, there being no anchorage off the island, no part of it could be spared to catch seals. The brutal wretch therefore proceeded to Easter Island, and landing at Cook's Bay, seized and carried off twelve men and ten women to people his new colony. For the first three days they were confined in irons, and were not released till fairly out of sight of land, when the first use they made of their liberty was to jump overboard, choosing rather to perish in the waves than to be carried away they knew not whither, or for what purpose. The women, who were with difficulty restrained from following them, were carried to Massafuero, but what ultimately became of these poor creatures M. Kotzebue does not relate. No wonder, then, that such base and inhuman practices should have driven the natives to acts of hostility against all foreign intruders.

Since this general view of the Polynesian Islands was prepared, every voyager across the Pacific has made the discovery of additional groups of coral islands or reefs, or single islets just emerging above the surface of the ocean. The progressive increase of these wonderful fabrics would seem to require *time* only to choak up the whole Pacific. The reflections made by Kotzebue, on viewing these new creations, are as just as they are natural. "The spot on which I stood filled me with astonishment, and I adored in silent admiration the omnipotence of God, who had given, even to those minute animals, the power to construct such a work. My thoughts were confounded, when I considered the immense series of years that must elapse before such an island can rise from the fathomless abyss of the ocean, and become visible on the surface. At a future period they will assume another shape; all the islands will join and form a circular slip of earth, with a pond or lake in the circle; and this form will again change, as these animals continue building, till they reach the surface, and then the water will one day vanish, and only one great island be visible. It is a strange feeling to walk about on a living island, when all below is actively at work. And to what corner of the earth can we penetrate where human beings are not already to be found? In the remotest regions of the earth, amidst mountains of ice, under the burning sun of the equator, nay, even in the middle of the ocean, on islands which have been formed by animals, they are met with."

But not to islands alone are the operations of these zoophytes confined. Flinders found the coral reefs extending for seven hundred miles along the eastern coast of Australia, and Torres Strait is nearly choked up with them, and must in time become unnavigable. As Captain Fitzroy crossed the Pacific in the Beagle, it is to be hoped that his attention has been drawn to this curious and interesting subject; and that in his forthcoming work, or that of Mr Darwen, who accompanied him, the public will receive additional information respecting these little animals and their operations. (M.)

POLYPHEMUS, a celebrated Cyclops, and king of all the Cyclops in Sicily, was the son of Neptune and Thoosa, the daughter of Phorcys. He is said to have been a monster of great strength, very tall, and with only one eye in the middle of the forehead. He ate human flesh, and kept his flocks on the coasts of Sicily, when Ulysses, on his return from the Trojan war, was driven thither. Ulysses, together with twelve of his companions, visited the coast, and along with them was seized by the Cyclops, who confined them in his cave, and daily devoured two of them. Ulysses would have shared the fate of the rest, had he not intoxicated the Cyclops, and put out his eye with a firebrand when he was asleep. Polyphemus was awakened by the sudden pain, and stopped the entrance of his cave; but Ulysses escaped by creeping between the legs of the rams of the Cyclops, as they were led out to feed on the mountains. Polyphemus became enamoured of Galatea; but his addresses were disregarded, and the nymph shunned his presence. The Cyclops became still more earnest; and when he saw Galatea surrender herself to the pleasures of Acis, he crushed his rival with a piece of a broken rock.

POLYPLECTRON, from the Greek πολυ, *much*, and πλῆκτρον, a musical instrument invented by Dietz about ten years ago, and played upon in the manner of a piano-forte. Its sounds are produced by the friction of numerous narrow slips of leather made to revolve upon a cylinder and over pullies, and brought into contact with the strings by pressing down the finger-keys. The powers of this instrument were highly commended by Prony, Savart, Cherubini, Paer, and others, after they had made trial of it on the 11th of July 1828. According to the touch, firm and *legato*, or light and *staccato*, the quality of the tone varied. The lower sounds and medium ones closely resembled those of the double bass, violoncello, and viola. Dietz had not succeeded in imitating the sounds of a violin. The *orchestrino* of Poulleau, and some other instruments on the same principle, preceded Dietz's polyplectron.

POLYPUS, a species of fresh-water insects. The name of *hydra* was given to them by Linnæus, on account of the property they have of reproducing themselves when cut in pieces, every part soon becoming a perfect animal. Dr Hill called them *biota*, on account of the strong principle of life with which every part of them is endowed. These animals were first discovered by Leeuwenhoeck, who gave some account of them in the Philosophical Transactions for 1703; but their wonderful properties were not thoroughly known till the year 1740, when Mr Trembley began to investigate them. Previously to his discoveries, indeed, Leibnitz and Boerhaave, by reasonings *a priori*, had concluded that animals might be found which would propagate by slips like plants. Their conjectures have been verified.

Marine Polypus is different in form from the fresh-water polypus already described, but is nourished, increases, and may be propagated after the same manner; Mr Ellis having often found, in his inquiries, that small pieces cut off from the living parent, in order to view the several parts more accurately, soon gave indications that they contained not only the principles of life, but likewise the faculty of increasing and multiplying into a numerous issue. It has been proved by Peyssonel, Ellis, Jussieu, Reaumur, Donati, and others, that many of those substances which had formerly been considered by naturalists as marine vegetables or sea-plants, are in reality animal productions; and that they are formed by polypuses of different shapes and sizes, for their habitation, defence, and propagation. To this class may be referred the corals, corallines, keratophyta, eschara, sponges, and alcyonium; nor is it improbable that the more compact bodies, known by the common appellations of star-stones, brain-stones, petrified fungi, and the like, brought from various parts of the East and West Indies, are of the same origin. To this purpose Mr Ellis observes, that, in all the warmer latitudes, the ocean, near the shore, and wherever it is possible to observe, abounds so much with animal life, that no inanimate body can long remain in it unoccupied by some species. In these regions ships' bottoms are soon covered with the habitations of thousands of animals; rocks, stones, and everything lifeless are instantly covered with them; even the branches of living vegetables which hang into the water are immediately loaded with the spawn of different animals, shell-fish of various kinds; and shell-fish themselves, when they become impotent and old, are the basis of new colonies of animals, from whose attacks they can no longer defend themselves.

POLYSEMASIA, from the Greek πολυ and σημασια, a term applied to such intervals and chords in harmony, as produce upon the ear the same effect, although they may differ from each other in notation; for example, ♭B G ♯A G; B D F ♭A, B D ♯E ♯G, &c. Also such chords as, although expressed by the same notes, are yet referrible to different harmonic foundations.

POLYSPERMOUS, from πολυ, *much*, and σπεϱμα, *seed*, in *Botany*, is applied to such plants as have more than four seeds succeeding each flower, without any certain order or number.

POLYSYLLABLE, in *Grammar*, a word consisting of more than three syllables. When a word consists of one, two, or three syllables, it is called a *monosyllable*, a *dissyllable*, or a *trisyllable*.

POLYTHEISM.

Definition.

Polytheism is the doctrine of a plurality of gods, or invisible powers superior to man.

"That there exist beings, one or many, powerful above the human race, is a proposition," says Lord Kames,[1] "universally admitted as true in all ages and among all nations. I boldly call it *universal*, notwithstanding of what is reported of some gross savages; for reports that contradict what is acknowledged to be general among men, require more able vouchers than a few illiterate voyagers. Among many savage tribes there are no words but for objects of external sense; is it surprising that such people are incapable of expressing their religious perceptions, or any perception of internal sense? The conviction that men have of superior powers, in every country where there are words to express it, is so well vouched, that in fair reasoning it ought to be taken for granted among the few tribes where language is deficient."

Source of religious principles traced.

These are judicious observations, of which every man will admit the force who has not some favourite system to build upon the unstable foundation which his lordship overturns. Taking it for granted, then, that our conviction of superior powers has long been universal, the important question is, from what cause it proceeds. The same ingenious author shows, with great strength of reasoning, that the operations of nature and the government of this world, which to us loudly proclaim the existence of a Deity, are not sufficient to account for the universal belief of superior beings amongst savage tribes. He is therefore of opinion that this universality of conviction can spring only from the image of Deity stamped upon the mind of every human being, the ignorant equally with the learned. "Nothing less," he says, "is sufficient; and the original impression which we have of Deity must proceed," he thinks, "from an internal sense, which may be termed the *sense of Deity*."

We have elsewhere expressed our opinion of that philosophy which accounts for every phenomenon in human nature by attributing to it a particular instinct; but to this instinct or sense of Deity, considered as complete evidence, many objections, more than usually powerful, force themselves upon us. All nations, except the Jews, were once polytheists and idolaters. If, therefore, his lordship's hypothesis be admitted, either the doctrine of polytheism must be true theology, or this instinct or sense is of such a nature as, at different periods of the world, to have misled all mankind. All savage tribes are at present polytheists and idolaters; but amongst savages every instinct appears in greater purity and vigour than amongst people polished by arts and sciences; and instinct never mistakes its object. The instinct or primary impression of nature, which gives rise to self-love, affection between the sexes, love of progeny, &c. has in all nations, and in every period of time, a precise and determinate object, which it inflexibly pursues. How then comes it to pass that this particular instinct, which, if real, is surely of as much importance as any other, should have uniformly led those who had no other guide to pursue improper objects, to fall into the grossest errors and the most pernicious practices? To no purpose are we told, that the sense of Deity, like the moral sense, makes no capital figure amongst savages. There is reason to believe that the feeling or perception, which is called the *moral sense*, is not wholly instinctive; but whether it be or not, a single instance cannot be produced in which it multiplies its objects, or makes even a savage express gratitude to a thousand persons for benefits which his prince alone had power to confer.

For these and other reasons which might easily be assigned, we cannot help thinking, that the first religious principles must have been derived from a source different as well from internal sense as from the deductions of reason; from a source which the majority of mankind had early forgotten, and which, when it was banished from their minds, left nothing behind it to prevent the very first principle of religion from being perverted by various accidents or causes, or, in some extraordinary concurrence of circumstances, from being perhaps entirely obliterated. This source of religion every consistent theist must believe to be revelation. Reason, it is acknowledged, could not have introduced savages to the knowledge of God; and we have

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[1] Sketches of the History of Man.

Theism.

just seen that a sense of Deity is an hypothesis clogged with insuperable difficulties. Yet it is undeniable that all mankind have believed in superior invisible powers; and if reason and instinct be set aside, there remains no other origin of this universal belief than primeval revelation, corrupted, indeed, as it passed by oral tradition from father to son, in the course of many generations. It is no slight support to this doctrine, that if there really be a Deity,[1] it is highly presumable that he would reveal himself to the first men; creatures whom he had formed with faculties to adore and to worship him. To other animals the knowledge of a Deity is of no importance; to man it is of the first importance. Were we totally ignorant of a Deity, this world would appear to us a mere chaos. Under the government of a wise and benevolent Deity, chance is excluded; and every event appears to be the result of established laws. Good men submit to whatever happens without repining, knowing that every event is ordered by Divine Providence; they submit with entire resignation, and such resignation is a sovereign balsam for every misfortune or evil in life.

Admitting, then, that the knowledge of Deity was originally derived from revelation, and that the first men professed pure theism, it shall be our business in the present article to trace the rise and progress of polytheism and idolatry; and to ascertain, if we can, the real opinions of the pagan world concerning that multitude of gods with which they filled heaven, earth, and hell. In this inquiry, though we shall have occasion to appeal to the writings of Moses, we shall attribute to them no other authority than what is due to records of the earliest ages, more ancient and authentic than any others that are now extant.

Whether we believe, with the author of the book of Genesis, that all men have descended from the same progenitors, or adopt the hypothesis of modern theorists, that there have been successive creations of men, and that the European derives his origin from one pair, the Asiatic from another, the woolly-headed African from a third, and the copper-coloured American from a fourth, polytheism and idolatry will be seen to have arisen from the same causes, and to have advanced nearly in the same order from one degree of impiety to another. On either supposition, it must be taken for granted, that the original progenitors were instructed by their Creator in the truths of genuine theism; and there is no room to doubt that those truths, simple and sublime as they are, would be conveyed pure from father to son as long as the race lived in one family, and were not spread over a large extent of country. If any credit be due to the records of antiquity, the primeval inhabitants of this globe lived to so great an age, that they must have increased to a very large number long before the death of the common parent; who would of course be the bond of union to the whole society, and whose dictates, especially in what related to the origin of his being and the existence of his Creator, would be listened to with the utmost respect by every individual of his numerous progeny.

ircumstances hich led poly- heism.

Many causes, however, would conspire to dissolve this family, after the death of its ancestor, into separate and independent tribes, of which some would be driven by violence, or would voluntarily wander, to a distance from the rest. From this dispersion great changes would take place in the opinions of some of the tribes respecting the object of their religious worship. A single family, or a small tribe, banished into a desert wilderness, such as the whole earth must then have been, would find employment for all their time in providing the means of subsistence, and in defending themselves from beasts of prey. In such circumstances they would have little leisure for meditation, and being constantly conversant with objects of sense, they would gradually lose the power of meditating upon the spiritual nature of that Being by whom their ancestors had taught them that all things were created. The first wanderers would no doubt retain in tolerable purity their original notions of Deity, and they would certainly endeavour to impress those notions upon their children. But, in circumstances infinitely more favourable to speculation than theirs could have been, the human mind dwells not long upon notions that are purely intellectual. We are so accustomed to sensible objects, and to the ideas of space, extension, and figure, which they are perpetually impressing upon the imagination, that we find it extremely difficult to conceive any being without assigning to him a form and a place. Hence a learned writer[2] has supposed that the earliest generations of men, even those to whom he contends that frequent revelations were vouchsafed, may have been no better than anthropomorphites in their conceptions of the Divine Being.

Origin of Polytheism.

First steps in the progress.

Be this as it may, it is not conceivable but that the members of those first colonies would quickly lose many of the arts and much of the science which perhaps prevailed in the parent state; and that, fatigued with the contemplation of intellectual objects, they would relieve their overstrained faculties, by attributing to the Deity a place of abode, if not a human form. To men totally illiterate, the place fittest for the habitation of the Deity would undoubtedly appear to be the sun, the most beautiful and glorious object of which they could form any idea; an object, too, from which they could not but be sensible that they received the benefits of light and heat, and which experience must soon have taught them to be in a great measure the source of vegetation. The great spirit, therefore, inhabiting the sun, which they would consider as the power of light and heat, was in all probability the first object of idolatrous adoration.

The spirit of light the first god of paganism.

From looking upon the sun as the habitation of their god, they would soon proceed to consider it as his body. Of pure mind entirely separated from matter, men in their circumstances could not long retain the faintest notion; but conscious each of power in himself, and experiencing the effects of power in the sun, they would naturally conceive that luminary to be animated as their bodies were animated. They would feel his influence when above the horizon; they would see him moving from east to west; they would consider him when set as gone to take his repose; and those exertions and intermissions of power being analogous to what they experienced in themselves, they would look upon the sun as a real animal. Thus would the Divinity appear to their untutored minds to be a compound being like man, partly corporeal and partly spiritual; and as soon as they imbibed such notions, though perhaps not before, they may be pronounced to have been absolute idolaters.

The spirit or power of darkness the second.

When men had once got into this train, their gods would multiply upon them with wonderful rapidity. Darkness and cold they could not but perceive to be contrary to light and heat; and not having philosophy enough to distinguish between mere privations and positive effects, they would consider darkness and cold as entities equally real with light and heat, and attribute these different and contrary effects to different and contrary powers. Hence the spirit or power of darkness was in all probability the second god in the pagan calendar; and as they considered the power of light as a benevolent principle, the source of all that is good, they must have looked upon the contrary power of darkness as a malevolent spirit, the source of all that is evil.

Polytheism of the Persian Magi.

This we know from authentic history to have been the belief of the Persian Magi, a very ancient sect, who called their good god Yazdun, and also Ormuzd, and the evil god Ahriman. Considering light as the symbol, or perhaps as the body, of Ormuzd, they always worshipped him before

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[1] See Sketches of the History of Man.

[2] Bishop Law, in his Considerations on the Theory of Religion.

Magianism.

the fire, the source of light, and especially before the sun, the source of the most perfect light; and for the same reason fires were kept continually burning on his altars. That they sometimes addressed prayers to the Evil Principle, we are informed by Plutarch in his Life of Themistocles; but with what particular rites he was worshipped, or where he was supposed to reside, it is not so evident. Certain it is, however, that the worshippers held him in detestation; and when they had occasion to write his name, they always inverted it, to denote the malignity of his nature. The principles of the Magi, though widely distant from pure theism, were much less absurd than those of other idolaters. It does not appear that they ever worshipped their gods through the medium of graven images, or had any other emblems of them than light and darkness. Indeed we are told by Diogenes Laertius and Clemens Alexandrinus, that they condemned all statues and images, allowing fire and water to be the only proper emblems or representatives of their gods: And we learn from Cicero,[1] that at their instigation Xerxes was said to have burned all the temples of Greece, because the builders of those edifices impiously presumed to enclose within walls the gods, to whom all things ought to be open and free, and whose proper temple is the whole world. To these authorities we may add that of all the historians, who agree, that when the creed of the Magi was the religion of the court, the Persian monarchs made war upon images, and upon every emblem of idolatry different from their own.

Tsabaian polytheism.

The Magi, however, were but one sect, and not the largest, of ancient idolaters. The worship of the sun, as the source of light and heat, soon introduced into the calendar of divinities the other heavenly bodies, the moon, the planets, and the fixed stars. Men could not but experience great benefit from those luminaries in the absence of their chief god; and when they had proceeded so far as to admit two divine principles, a good and an evil, it was natural for minds clouded with such prejudices to consider the moon and the stars as benevolent intelligences, sent to oppose the power of darkness whilst their first and greatest divinity was absent or asleep. It was thus, as they imagined, that he maintained a constant superiority over the Evil Principle. Though to astronomers the moon is known to be an opaque body of very small dimensions when compared with a planet or a fixed star, yet to the vulgar eye she appears much more magnificent than either. By those early idolaters she was considered as the divinity second in rank and in power; and whilst the sun was worshipped as the king, she was adored as the queen, of heaven.

The earth, considered as the common mother of all things; the ocean, the waters of which are never at rest; the air, the region of storms and tempests; and indeed all the elements, were gradually added to the number of divinities. Not that mankind in this early age had so far degenerated from the principles of their ancestors as to worship brute matter. If such worship was ever practised, which to us is hardly conceivable, it must have been at a later period, when it was confined to the very lowest of the vulgar, in nations otherwise highly civilized. The polytheists of whom we now treat conceived everything in motion to be animated, and animated by an intelligence powerful in proportion to the magnitude of the body moved.

This sect of idolaters, which remains in some parts of the East to this day, was known by the name of Tsabaians, which they pretended to have derived from a son of Seth; and amongst the books in which their sacred doctrines are contained, they have one which they call the Book of Seth. We need hardly observe, that these are senseless and extravagant fables. The epithet *Tsabaian* is undoubtedly derived from the Hebrew word *Tsaba*, which signifies an host or army; and this class of polytheists was so called, because they worshipped the host of heaven, or the *Tsaba hesemim*, against which Moses so pathetically cautions the people of Israel.[2]

Tsabaism.

Tsabaism arose in Chaldæa.

This species of idolatry is thought to have first prevailed in Chaldæa, and to have been that from which Abraham separated himself, when, at the command of the true God, he "departed from his country, and from his kindred, and from his father's house." But as it nowhere appears that the Chaldæans had fallen into the savage state before they became polytheists and idolaters, and as it is certain that they were not savages at the period of the call of Abraham, their early Tsabaism may be thought inconsistent with the account which we have given of the origin of that species of idolatry. If a great and civilized nation was led to worship the host of heaven, why, it may be asked, should that worship be supposed to have arisen amongst savages? Theories, however plausible, cannot be admitted in opposition to ascertained facts.

True; but we beg leave to reply, that our account of the origin of polytheism is opposed by no fact, because we have not supposed that the worship of the host of heaven arose amongst savages only. That savages, between whom it is impossible to imagine any intercourse to take place, have universally worshipped, as their first and supreme divinities, the sun, moon, and stars, is a fact evinced by every historian and by every traveller; and we have shown how their rude and uncultivated state naturally leads them to that species of idolatry. But there may have been circumstances peculiar to the Chaldæans, which led them likewise to the worship of the heavenly host, even in a state of high civilization. We judge of the philosophy of the ancients by that of ourselves, and imagine that the same refined system of metaphysics was cultivated by them as by the followers of Descartes and Locke. But this is a great mistake; for so gross were the notions of early antiquity, that it may be doubted whether there was a single man, uninspired, who had any notion of mind as a being distinct and entirely separated from matter. From several passages in the books of Moses, we learn, that when in the first ages of the world the Supreme Being condescended to manifest his presence to men, he generally exhibited some sensible emblem of his power and glory, and declared his will from the midst of a preternatural fire. It was thus that he appeared to the Jewish lawgiver himself, when he spoke to him from the midst of a bush; it was by a pillar of cloud and fire that he led the Israelites from Egypt to the Land of Promise; and it was in the midst of smoke, and fire, and thunderings, that the law was delivered from Mount Sinai. That such manifestations of the divine presence would occasionally be made to the descendants of Noah who settled in Chaldæa soon after the Deluge, must appear extremely probable to every one who admits the authority of the Hebrew Scriptures; and he who questions that authority has no right to make the objection to which we now reply, because it is only from the book of Genesis that we know the Chaldæans to have been a civilized people when they fell into idolatry. All histories agree in representing the inhabitants of Chaldæa as at a very early period corrupted by luxury, and sunk in vice. When this happened, we must suppose that the moral governor of the universe would withdraw from them those occasional manifestations of himself, and leave them to their own inventions. In such circumstances, it was not unnatural for a people addicted to the study of astronomy, who had been taught to believe that the Deity frequently appeared to their ancestors in a flame of fire, to consider the sun as the place of

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[1] *De Legibus*, lib. ii. § 10.

[2] Deut. iv. 19.

Tsabaism.

his permanent residence, if not as his body. But when either opinion was firmly established, polytheism would be its inevitable consequence, and the progress of Tsabaism would, in the most polished nation, be such as we have traced it amongst savage tribes.

It passed into Egypt, &c.

From Chaldæa the idolatrous worship of the host of heaven spread itself over all the East, passed into Egypt, and thence found its way into Greece; for Plato affirms,[1] that "the first inhabitants of Greece seemed to him to have worshipped no other gods but the sun, moon, earth, stars, and heavens, as most barbarous nations," continues he, "still do." That Tsabaism, or the worship of the host of heaven, was the first species of idolatry, besides the probability of the thing, and the many allusions to it in sacred Scripture, we have the positive evidence of the most ancient pagan historians of whose writings any part has been transmitted to us. Herodotus,[2] speaking of the religion of the Persians, says that "they worship the sun, moon, and earth, fire, water, and the winds; and this adoration they have all along paid from the beginning." He testifies the same thing of the savage Africans, of whom he affirms,[3] that they all worshipped the sun and moon, and no other divinity. Diodorus Siculus, writing of the Egyptians,[4] tells us that "the first men, looking up to the world above them, and terrified and struck with admiration at the nature of the universe, supposed the sun and the moon to be the principal and eternal gods." And Sanchoniathon the Phœnician, a more ancient writer than any of these, informs us, in the fragment of his history preserved by Eusebius, that "the two first mortals were Æon and Protogonus, and their children Genos and Genea, who inhabited Phœnicia; and when they were scorched with the heat, they lifted up their hands to the sun, whom they believed to be the lord of heaven, and called him *Baalsamen*, the same whom the Greeks call Ζευς."

Statue-worship.

Hitherto those divinities were worshipped in person, or, as Dr Prideaux expresses it, in their *sacella*, or sacred tabernacles; for the votaries of each directed their devotions towards the planet which they supposed to be animated by the particular intelligence whom they meant to adore. But these orbs, by their rising and setting, being as much below the horizon as above it, and their grossly ignorant worshippers not supposing it possible that any intelligence, however divine, could exert its influence except in union with some body, statues or pillars were soon thought of as proper emblems of the absent gods. Sanchoniathon, in the fragment already quoted, informs us, that "*Hyspouranios* and his brother *Ousous*, Phœnician patriarchs, erected two pillars, the one to fire, and the other to air or wind, and worshipped those pillars, pouring out to them libations of the blood of the wild beasts hunted down in the chase." As these early monuments of idolatry were called βαιτυλια, a word evidently derived from the Hebrew *Bethel*, the probability is, that they were altars of loose stones, such as that which was built by Jacob,[5] and from him received the same name. As his was consecrated to the true God, theirs were consecrated to the host of heaven; and the form of consecration seems to have been nothing more than the anointing of the stone or pillar with oil,[6] in the name of the divinity whom it was intended to represent. When this ceremony was performed, the ignorant idolaters, who fancied that their gods could not hear them except when they were visible, supposed that the intelligences by which the sun and planets were animated took possession, in some inexplicable manner, of the consecrated pillars, and were as well pleased with the prayers and praises offered up before those pillars, as with the devotions which were addressed towards the luminaries themselves. Hence Sanchoniathon calls them *animated* or *living stones*, λιθους ἐμψυχους, from the portion of the divine spirit which was believed to reside in them; and as they were dedicated to the host of heaven, they were generally erected upon the tops of mountains, or, in countries which, like Egypt, were low and level, they were elevated to a great height by the labour of men.

Statue-Worship.

The idolatry of high places.

It has been supposed that this practice of raising the pillars on *high places* proceeded from a desire to make the objects of worship conspicuous and magnificent. But we are strongly inclined to believe, that the erectors of βαιτυλια had something further in view, and that they thought of nothing less than to bring the sacred stone or pillar as near as possible to the god whom it represented. But whatever there be in this, we know that the practice itself prevailed universally throughout the East; and that there was nothing which the Jewish legislator more strictly enjoined his people to destroy, than the altars, statues, and pillars erected for idolatrous worship upon mountains and high places. "Ye shall utterly destroy," says he, "all the high places wherein the nations which ye shall possess served their gods, upon the *high mountains*, and upon the *hills*, and under every green tree. And ye shall overthrow their *altars*, and break down their *pillars*, and burn their *groves* with fire."[7]

The mention of *groves* by the Hebrew lawgiver brings to our recollection another species of idolatry, which was perhaps the second in order, as men deviating from the principles of pure theism became more and more entangled in the labyrinths of error. The Chaldæans, Egyptians, and all the eastern nations who believed in a superintending providence, imagined that the government of this world, the care of particular nations, and even the superintendence of groves, rivers, and mountains, in each nation, was committed by the gods to a class of spirits superior to the soul of man, but inferior to those heavenly intelligences which animated the sun, the moon, and the planets. These spirits were by the Greeks called δαιμονες, *dæmons*, and by the Romans *genii*. Timæus the Locrian, who flourished before Plato, speaking of the punishment of wicked men, says,[8] all these things has Nemesis decreed to be executed in the second period, by the ministry of vindictive terrestrial dæmons, who are overseers of human affairs; to which dæmons the Supreme God, the ruler over all, has committed the government and administration of this world, which is made up of gods, men, and animals.

Origin of dæmon-worship.

Concerning the origin of these intermediate beings, scholars and philosophers have framed various hypotheses. The belief of their existence may have been derived from five different sources.

Firstly, it seems to have been impossible for the limited capacities of those men, who could not form a notion of a God divested of a body and a place, to conceive how the influence and agency of such a being could every instant extend to every point of the universe. Hence, as we have seen, they placed the heavenly regions under the government of a multitude of heavenly gods, the sun, the moon, and the stars. But as the nearest of those divinities was at an immense distance from the earth, and as the intelligence animating the earth itself had sufficient employment in regulating the general affairs of the whole globe, a notion insinuated itself into the untutored mind, that these superior governors of universal nature found it necessary, or at least expedient, to employ subordinate intelligences or dæmons, as ministers to execute their behests in the various parts of their widely extended dominions.

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[1] *In Cratylo.*

[2] Lib. i. cap. 131.

[3] Lib. iv. cap. 188.

[4] Lib. i.

[5] Genesis, chap. xxxv.

[6] Hence the proverb of a superstitious man, παντα λιθον λιπαρον προσκυνει, he kisses or adores every anointed stone; which Arnobius calls *lubricatam lapidem, et ex olivi unguine sordidatum.* Stillingfleet's *Origines Sacræ.*

[7] Deut. xii. 23.

[8] *De Anima Mundi*, inter scriptores a T. Gale editos.

Dæmons.

Secondly, such an universal and uninterrupted course of action as was deemed necessary to administer the affairs of the universe, would be judged altogether inconsistent with that state of indolence which, especially in the East, was held an indispensable ingredient in perfect felicity. It was this notion, absurd as it is, which made Epicurus deny the providence, whilst he admitted the existence, of gods. And if it had such an effect upon a philosopher who in the most enlightened ages had many followers, we need not surely wonder if it made untaught idolaters imagine that the governor or governors of the universe had devolved a great part of their trouble on deputies and ministers.

Thirdly, when men came to reflect on the infinite distance between themselves and the gods, they would naturally form a wish that there might somewhere exist a class of intermediate intelligences, whom they might employ as mediators and intercessors with their far-distant divinities. But what men earnestly wish for, they very readily believe. Hence the supposed distance of their gods would, amongst untutored barbarians, prove a fruitful source of intermediate intelligences, more pure and more elevated than human souls.

Fourthly, these three opinions may be denominated popular; but that which we are now to state, wherever it may have prevailed, was the offspring of philosophy. On this earth we perceive a scale of beings rising gradually above each other in perfection, from mere brute matter through the various species of fossils, vegetables, insects, fishes, birds, and beasts, up to man. But the distance between man and God is infinite, and capable of admitting numberless orders of intelligences, all superior to the human soul, and each rising gradually above the other till they reach that point, wherever it may be, at which creation stops. Part of this immense chasm the philosophers perceived to be actually filled by the heavenly bodies; for in philosophical polytheism there was one invisible God, supreme over all these; but still there was left an immense vacuity between the human species and the moon, which was known to be the lowest of the heavenly host; and this they imagined must certainly be occupied by invisible inhabitants of different orders and dispositions, which they called good and evil dæmons.

Fifthly, there is yet another source from which the universal belief of good and evil dæmons may be derived, with perhaps greater probability than from any or all of these. If the Mosaic account of the creation of the world, the peopling of the earth, and the dispersion of mankind, be admitted as true (and a more consistent account has not as yet been given or devised), some knowledge of good and evil angels must necessarily have been transmitted from father to son by the channel of oral tradition. But this tradition would be corrupted at the same time, and in the same manner, with others of greater importance. When the true God was so far mistaken as to be considered, not as the sole governor of the universe, but only as the self-existent power of light and good, the devil would be elevated from the rank of a rebellious created spirit to that of the independent power of darkness and evil; the angels of light would be transformed into good dæmons, and those of darkness into dæmons that are evil. This account of the origin of dæmonology receives no small support from Plato, who derives one branch of it wholly from tradition. "With respect to those dæmons," says he,[1] "who inhabit the space between the earth and the moon, to understand and declare their generation is a task too arduous for my slender abilities. In this case we must credit the report of men of other times, who, according to their own account, were the descendants of the gods, and had, by some means or other, gained exact intelligence of that mystery from their ancestors. We must not question the veracity of the children of the gods, even though they should transgress the bounds of probability, and produce no evidence to support their assertions. We must, I say, notwithstanding, give them credit, because they profess to give a detail of facts with which they are intimately acquainted, and the laws of our country oblige us to believe them."

Dæmons.

Though these dæmons were generally invisible, they were not supposed to be pure disembodied spirits. Proclus, in his commentary upon Plato's *Timæus*, tells us, "that every dæmon superior to human souls consisted of an intellectual mind and an ethereal vehicle." Indeed it is very little probable, that those who gave a body and a place to the Supreme God, should have thought that the inferior orders of his ministers were spirits entirely separated from matter. Plato himself divides the class of dæmons into three orders; and whilst he holds their souls to be particles or emanations from the divine essence, he affirms that the bodies of each order of dæmons are composed of that particular element in which they for the most part reside. "Those of the first and highest order are composed of pure ether; those of the second order consist of grosser air; and dæmons of the third or lowest rank have vehicles extracted from the element of water. Dæmons of the first and second orders are invisible to mankind. The aquatic dæmons, being invested with vehicles of grosser materials, are sometimes visible and sometimes invisible. When they do appear, though faintly observable by the human eye, they strike the beholder with terror and astonishment." Dæmons of this last order were supposed to have passions and affections similar to those of men; and though all nature was full of them, they were believed to have local attachments to mountains, rivers, and groves, where their appearances were most frequent. The reason of these attachments seems to be obvious. Polytheism took its rise in countries scorched by a burning sun; and dæmons by their composition being necessarily subject in some degree to the influence of heat and cold, it was natural to suppose that they, like men, would delight in the shady grove and in the purling stream. Hence the earliest altars of paganism were generally built in the midst of groves, or on the banks of rivers; because it was believed that in such places were assembled multitudes of those intelligences, whose office it was to regulate the affairs of men, and to carry the prayers and oblations of the devout to the far-distant residence of the celestial gods. Hence too are to be derived the mountain and river gods, with the dryads and hamadryads, the satyrs, nymphs, and fauns, which held a place in the creed of ancient paganism, and make so conspicuous a figure in the Greek and Roman poets.

Deification of departed heroes.

These different orders of intelligences, which, though worshipped as gods or demigods, were yet believed to partake of human passions and appetites, led the way to the deification of departed heroes, and other eminent benefactors of the human race. By the philosophers all souls were believed to be emanations from the divinity; but "gratitude and admiration, the warmest and most active affections of our nature, concurred to enlarge the object of religious worship, and to make man regard the inventors of arts and the founders of society as having in them more than a common ray of the divinity. So that god-like benefits, bespeaking as it were a god-like mind, the deceased parent of a people was easily advanced into the rank of a dæmon. When the religious bias was in so good a train, natural affection would have its share in promoting this new mode of adoration. Piety to parents would naturally take the lead, as it was supported by gratitude and admiration, the *primum mobile* of the whole system; and, in those early ages, the natural father of the tribe often happened to be the political father of the people, and the founder of the state. Fondness for the offspring would next have its turn; and a disconsolate father, at the head of a people, would contrive to soothe his grief for the untimely death of a favourite child, and to gratify his pride under the want of succession, by paying divine honours to its memory."[1] "For a father afflicted with untimely mourning, when he had made an image of his child recently taken away, now honoured him as a god, who was then a dead man, and delivered to those that were under him ceremonies and sacrifices."[2] That this was the origin and progress of the worship of departed souls, we have the authority of the famous fragment of Sanchoniathon, already quoted, where the various motives for this species of idolatry are recounted in express words. "After many generations," says he, "came *Chrysor;* and he invented many things useful to civil life, for which, after his decease, he was worshipped as a god. Then flourished *Ouranos* and his sister *Gé*, who deified and offered sacrifices to their father *Hypsistos*, when he had been torn in pieces by wild beasts. Afterwards *Kronos* consecrated *Muth* his son, and was himself consecrated by his subjects."

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[1] *Timæus.*

In the reign of Kronos there flourished a personage of great reputation for wisdom, who by the Egyptians was denominated *Thoth*, by the Phœnicians *Taautos*, and by the Greeks *Hermes*. According to Plutarch, he was a profound politician, and chief counsellor of Osiris, then the king, and afterwards the principal divinity, of Egypt; and we are told by Philo Byblius, the translator of Sanchoniathon, "that it was this Thoth or Hermes who first took the matters of religious worship out of the hands of unskilful men, and brought them into due method and order." His object was to make religion serviceable to the interests of the state. With this view he appointed Osiris and other departed princes to be joined with the stars and worshipped as gods; and being by Kronos made king of Egypt, he was, after his death, worshipped himself as a god by the Egyptians. To this honour, if what is recorded of him be true, he had indeed a better title than most princes; for he is said to have been the inventor of letters, arithmetic, geometry, astronomy, and hieroglyphics, and was therefore one of the greatest benefactors of the human race which any age or country has ever produced.

That the gods of Greece and Rome were derived from Egypt and Phœnicia, is so universally known, that it is needless to multiply quotations in order to prove that the progress of polytheism amongst the Greeks and Romans was the same with that which we have traced in more ancient nations. The following account, given by Hesiod, of the deification of departed heroes, is so just, and in our opinion so beautiful, that we cannot refrain from introducing it in this place.

> The gods who dwell on high Olympus' hill,
> First fram'd a golden race of men, who liv'd
> Under old Saturn's calm auspicious sway.
> Like gods they liv'd, their hearts devoid of care,
> Beyond the reach of pain and piercing woes;
> Th' infirmities of age nor felt nor fear'd.
> Their nerves with youthful vigour strung, their days
> In jocund mirth they past, remote from ills.
> Now when this godlike race was lodg'd in earth,
> By Jove's high will to demigods they rose,
> And airy dæmons, who benign on earth
> Converse, the guides and guardians of mankind.
> In darkness veil'd, they range earth's utmost bound,
> Dispensing wealth to mortals. This reward
> From bounteous Jove awaits illustrious deeds.[3]

National and tutelar gods.

The deification of departed heroes and of statesmen was that which in all probability introduced the universal belief of national and tutelar gods, as well as the practice of worshipping those gods through the medium of statues cut into a human figure. When the founder of a state, or any other public benefactor, was elevated to the rank of a god, as he was believed still to retain human passions and affections, it was extremely natural to suppose that he would regard with a favourable eye that nation for which he had done so much upon earth; that he would oppose its enemies, and protect the laws and institutions which he himself had given it. By indulging the same train of sentiment, each city, and even every family of consequence, found *Lares* and *Penates* amongst their departed ancestors, to whom they paid the warmest adoration, and under whose protection they believed their private affairs to be placed. As those national and household gods were believed to be in their deified state clothed with airy bodies, so those bodies were supposed to retain the form which their grosser bodies had upon earth. The image of a departed friend might perhaps be formed by the hand of sorrowful affection, before the statue or the shrine of a deity was thought of; but when that friend or benefactor became the object of religious adoration, it was natural for his votaries to enliven their devotion by a view of his similitude. Maximus Tyrius tells us,[4] that "there is no race of men, whether barbarian or Grecian, living on the sea-coast or on the continent, wandering in deserts or living in cities, which has not consecrated some kind of symbol or other in honour of the gods." This is certainly true; but there is no good evidence that the first symbols of the gods were statues of men and women. Whilst the sun and other heavenly bodies continued to be the sole objects of religious worship, the symbols consecrated to them were pillars of a conical or pyramidal figure; and if such pillars are ever called graven images by Moses and other ancient writers, it was probably on account of the allegorical figures and characters, or hieroglyphical writing, with which they were inscribed.

Hero-worship engrafted on the planetary.

Hitherto we have considered the souls of departed heroes as holding the rank only of dæmons or demigods; but they generally rose in the scale of divinities, until they dethroned the heavenly bodies, and became themselves the *dii majorum gentium*. This revolution was effected by the combined operation of the prince and the priest; and the first step taken towards it seems to have been the complimenting of their heroes and public benefactors with the name of that being which was most esteemed and worshipped. "Thus a king for his beneficence was called the sun, and a queen for her beauty the moon. Diodorus relates, that Sol first reigned in Egypt, called so from the luminary of that name in the heavens. This will help us to understand an odd passage in the fragment of Sanchoniathon, where it is said that Kronos had seven sons by Rhea, the youngest of whom was a god as soon as born. The meaning probably is, that this youngest son was called after some luminary in the heavens to which they paid divine honours; and these honours came in process of time to be transferred to the terrestrial namesake. The same historian had before told us, that the sons of Genos, mortals like their father, were called by the names of the elements, light, fire, and flame, of which they had discovered the use."

"As this adulation advanced into an established worship, they turned the compliment the other way, and called the planet or luminary after the hero, the better to accustom the people, even in the act of planet-worship, to this new adoration. Diodorus, in the passage already quoted, having told us, that by the first inhabitants of Egypt the sun and moon were supposed to be the principal and eternal gods, adds, that the former was called Osiris, and the

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[1] Warburton's Divine Legation of Moses.

[2] Wisdom of Solomon, xiv. 15.

[3] Εργων και Ἡμερων, lib. i. verse 100, &c.

[4] Dissert. 38.

Hero-Worship.

latter Isis. This was indeed the general practice; for we learn from Macrobius, that the Ammonites called the sun Moloch; the Syrians, Adad; the Arabs, Dionysus; the Assyrians, Belus; the Phœnicians, Saturn: the Carthaginians, Hercules; and the Palmyrians, Elagabalus. Again, by the Phrygians the moon was called Cybele, or the mother of the gods; by the Athenians, Minerva; by the Cyprians, Venus; by the Cretans, Diana; by the Sicilians, Proserpine; by others, Hecate, Bellona, Vesta, Urania, Lucina, &c. Philo Byblius explains this practice. 'It is remarkable,' says he, 'that the ancient idolaters imposed on the elements, and on those parts of nature which they esteemed gods, the names of their kings; for the natural gods which they acknowledged were only the sun, moon, planets, elements, and the like; they being now in the humour of having gods of both classes, the mortal and the immortal.'

"As a further proof that hero-worship was thus superinduced upon the planetary, it is worthy of observation, that the first statues consecrated to the greater hero-gods, or those who were supposed to be supreme, were not of a human form, but conical or pyramidal, like those which, in the earliest ages of idolatry, were dedicated to the sun and planets. Thus the scholiast on the *Vespæ* of Aristophanes tells us, that the statues of Apollo and Bacchus were conic pillars or obelisks; and Pausanias, that the statue of Jupiter Meilichius represented a pyramid; that of the Argive Juno did the same, as appears from a verse of Phoronis quoted by Clemens Alexandrinus;[1] and indeed the practice was universal, as well amongst the early barbarians as amongst the Greeks. But it is well known that the ancients represented the rays of light by pillars of a conical or pyramidal form; and therefore it follows, that when they erected such pillars as representatives of their hero-gods, these latter had succeeded to the titles, rights, and honours of the natural and celestial divinities."[2]

Progress of this revolution in theology.

But though it seems to be certain that hero-worship was thus engrafted on the planetary, and that some of those heroes in process of time supplanted the planets themselves, this was such a revolution in theology as could not have been suddenly effected by the united influence of the prince and the priest. We doubt not the fact that Sol was believed to have reigned in Egypt, and was afterwards worshipped under the name Osiris; but it was surely impossible to persuade any nation, however stupid or prone to idolatry, that a man, whom they remembered discharging the duties of their sovereign and legislator, was the identical sun whom they beheld in the heavens. Osiris, if there was in Egypt a king of that name, may have been deified immediately after his death, and honoured with that worship which was paid to good dæmons; but he must have been dead for ages before any attempt was made to persuade the nation that he was the Supreme God. Even then great address would be requisite to render such an attempt successful. The prince or priest who entered upon it would probably begin with declaring, on the authority of an oracle, that the divine intelligence which animates and governs the sun had descended to earth and animated the person of the renowned legislator; and that, after their laws were framed, and the other purposes served, for which the descent was made, the same intelligence had returned to its original residence and employment amongst the celestials. The possibility of this double transmigration from heaven to earth and from earth to heaven, would without difficulty be admitted in an age when the pre-existence of souls was the universal belief. Having proceeded thus far in the apotheosis of dead men, the next step taken in order to render it in some degree probable that the early founders of states, and inventors of arts, were divine intelligences clothed with human bodies, was to attribute to one such benefactor of mankind the actions of many of the same name. Vossius, who employed much time and great erudition on the subject, has proved, that before the era of the Trojan wars, most kings who were very powerful, or highly renowned for their skill in legislation, were called Jove; and when the actions of all these were attributed to one Jove of Crete, it would be easy for the crafty priest, supported by all the power and influence of the state, to persuade an ignorant and barbarous people, that he whose wisdom and heroic exploits so far surpassed those of ordinary men must have been the Supreme God in human form.

Hero-Worship.

Vices of the pagan gods accounted for.

This short sketch of the progress of polytheism and idolatry will enable the reader to account for many circumstances recorded of the pagan gods of antiquity, which at first view seem very surprising, and which at length brought the whole system into contempt amongst the philosophers of Athens and Rome. The circumstances to which we allude are the immoral characters of those divinities, and the abominable rites with which they were worshipped. Jupiter, Apollo, Mars, and the whole rabble of them, are described by the poets as ravishers of women and notorious adulterers. Hermes or Mercury was a thief, and the god of thieves. Venus was a prostitute, and Bacchus a drunkard. The malice and revenge of Juno were implacable; and so little regard was any of them supposed to pay to the laws of honour and rectitude, that it was a common practice of the Romans, when besieging a town, to evoke the tutelar deity, and to tempt him by a reward to betray his friends and votaries.[3] In a word, they were, in the language of the poet,

> Gods partial, changeful, passionate, unjust,
> Whose attributes were rage, revenge, and lust.

This was the natural consequence of their origin. Having once animated human bodies, and being supposed still to retain human passions and appetites, they were believed, in their state of deification, to feel the same sensual desires which they had felt upon earth, and to pursue the same means for their gratification. As the men could not well attempt to surpass the gods in purity and virtue, they were easily persuaded by artful and profligate priests, that the most acceptable worship which could be rendered to any particular deity was to imitate the example of that deity, and to indulge in the practices over which he presided. Hence the worship of Bacchus was performed during the night by men and women mixing in the dark after intemperate eating and drinking. Hence, too, it was the practice in Cyprus and some other countries to sacrifice to Venus the virginity of young women some days before their marriage, in order, as was pretended, to secure their chastity ever afterwards; and, if Herodotus may be credited, every woman amongst the Babylonians was obliged once in her life to prostitute herself in the temple of the goddess *Mylitte* or Venus, that she might thenceforward be proof against all temptation.

Progress of idolatry.

The progress of polytheism, as far as we have traced it, has been regular; and the enormous error of forsaking the worship of the true God being once admitted, every subsequent step appears to be natural. It would be no difficult task to prove that it has likewise been universal. Sir William Jones, the learned president of the Asiatic Society, discovered such a striking resemblance between the gods of ancient Greece and those of the pagans of Hindustan,[4] as puts it beyond a doubt that those divinities had the same origin. The Ga-

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[1] *Strom.* lib. i.

[2] Warburton's Divine Legation, book iii. sect. 6.

[3] T. Livii, lib. v. c. 21; and Macrob. *Satur.* lib. iii c. 9.

[4] Asiatic Researches, vol. i.

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nesa of the Hindus he has clearly proved to be the Janus of the Greeks and Romans. As the latter was represented with two and sometimes with four faces, as emblems of prudence and circumspection, the former is painted with an elephant's head, the well known symbol amongst the Indians of sagacious discernment. The Saturn of Greece and Rome appears to have been the same personage with the Menu or Satyavrata of Hindustan, whose patronymic is Vaivaswata, or *child of the sun;* a name which sufficiently marks his origin. Amongst the Romans there were many Jupiters, one of whom appears from Ennius to have been nothing more than the firmament personified.

> Aspice hoc sublime candens, quem invocant omnes Jovem.

But this Jupiter had the same attributes with the Indian god of the visible heavens, called Indra or the king, and Divespetir, or the lord of the sky, whose consort is Sachi, and whose weapon is *vajra* or the thunderbolt. Indra is the regent of winds and showers; and though the East is peculiarly under his care, yet his Olympus is the north-pole, allegorically represented as a mountain of gold and gems. With all his power he is considered as a subordinate deity, and far inferior to the Indian triad Brahma, Vishnu, and Mahadeva or Siva, who are three forms of one and the same godhead. The president having traced the resemblance between the idolatry of Rome and India through many other gods, observes, that "we must not be surprised at finding, on a close examination, that the characters of all the pagan deities melt into each other, and at last into one or two; for it seems a well-founded opinion, that the whole crowd of gods and goddesses in ancient Rome, and likewise in Hindustan, mean only the powers of nature, and principally those of the sun, expressed in a variety of ways, and by a multitude of fanciful names."

Nor is it only in Greece, Rome, Egypt, and India, that the progress of idolatry has been from planetary to hero-worship. From every account which modern travellers have given us of the religion of savage nations, it appears that those nations adore, as their first and greatest gods, the sun, moon, and stars; and that such of them as have any other divinities have proceeded in the same road with the celebrated nations of antiquity, from the worship of the heavenly bodies to that of celestial dæmons, and from celestial dæmons to the deification of dead men. It appears, likewise, that they universally believe their hero-gods and demigods to retain the passions, appetites, and propensities of men.

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That the Scandinavians and our Saxon ancestors had the same notions of the gods with the other pagans whose opinions we have stated, is evident from their calling the days of the week by the names of their divinities, and from the forms of the statues by which those divinities were represented. The idol of the Sun, from which Sunday is derived, amongst the Latins *dies Solis*, was placed in a temple, where he was adored and sacrificed to; for they believed that the sun did co-operate with this idol. He was represented like a man half naked, with his face like the sun, holding a burning wheel with both hands on his breast, signifying his course round the world; and by its fiery gleams, the light and heat with which he warms and nourishes all things.

The idol of the Moon, from which comes our Monday, or *dies Lunæ*, anciently *Moonday*, appears strangely singular, being habited in a short coat like a man. Her holding a moon expresses what she is; but the reason of her short coat and long-eared cap is lost in oblivion.

Tuisco, the most ancient and peculiar god of the Germans, represented in his garment of skin, according to their ancient manner of clothing, was, next to the Sun and Moon, the idol of highest rank in the calendar of northern paganism. To him the third day in the week was dedicated; and hence has been derived the name Tuesday, anciently *Tuisday*, called in Latin *dies Martis*, though it must be confessed that Mars does not so much resemble this divinity as he does Odin or Woden.

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Odin or *Woden* was a valiant prince amongst the Saxons. His image was prayed to for victory over their enemies; which, if they obtained, they usually sacrificed to him the prisoners taken in battle. Our Wednesday, anciently *Wodensday*, is derived from his name. The northern histories represent him as the father of Thor, by Friga his wife.

Thor was placed in a large hall, sitting on a bed canopied over, with a crown of gold on his head, surmounted by twelve stars, and holding a sceptre in his right hand. To him was attributed power over both heaven and earth; and, as he was pleased or displeased, he could send thunder, tempests, plagues, earthquakes, or fair and seasonable weather, and cause fertility. From him our Thursday derives its name, anciently *Thorsday*, and amongst the Romans *dies Jovis*, as this idol may be substituted for Jupiter.

Friga represented both sexes, holding a drawn sword in the right hand and a bow in the left; denoting that women as well as men should fight in time of need. She was generally taken for a goddess; and was reputed the giver of peace and plenty, as well as the cause of love and amity. Her day of worship was called by the Saxons *Frigedeag*, now Friday, or *dies Veneris;* but the habit and weapons of this figure have a resemblance to those of Diana rather than Venus.

Seater, or *Crodo*, stood upon the prickly back of a perch. He was thin-visaged and long-haired, with a long beard, bare-headed and bare-footed, carrying in his right hand a pail of water, wherein are fruit and flowers, and holding up a wheel in his left, his coat being tied with a long girdle. His standing on the sharp fins of this fish signified to the Saxons, that by worshipping him they should pass through all dangers unhurt; by his girdle flying both ways was shown the Saxons' freedom; and by the pail with fruit and flowers was denoted that he would nourish the earth. From him, or from the Roman deity Saturn, comes Saturday.

Such were the principal gods of the northern nations. But these people had at the same time inferior deities, who were supposed to have been translated into heaven for their heroic deeds, and whose greatest happiness consisted in drinking ale out of the skulls of their enemies in the Hall of Odin. But the limits prescribed to the present article do not permit us to pursue this subject; nor is it necessary that we should do so. The attentive reader of the article MYTHOLOGY, of the histories given in this work of the various divinities of paganism, and of the different nations by whom those divinities were worshipped, will perceive that the progress of polytheism and idolatry has been uniform over the whole earth.

Animal-worship of the Egyptians.

There is, however, one species of idolatry more wonderful than anything that has yet been mentioned, and of which our readers will certainly expect some account. It is the worship of brutes, reptiles, and vegetables, amongst the Egyptians. To the Greeks and Romans, as well as to us, that superstition appeared so monstrous, that to enumerate every hypothesis, ancient and modern, by which philosophers have endeavoured to account for it, would swell this article beyond all proportion. Animal-worship prevailed at so early a period in Egypt, that the philosophers of antiquity whose writings have descended to us, had little or no advantage over the moderns in pursuing their researches into its origin; and, amongst the modern hypotheses, those of Mosheim and Warburton appear to be as plausible as any that we have seen.[1] The former of these learned writers attributes it wholly to the policy of the prince and the craft of the priest. The latter contends, with much earnestness and ingenuity, that it resulted from the use of hieroglyphical writing. We are strongly inclined to believe that both these causes contributed to the production of so portentous an effect; and that the use of hieroglyphics as sacred symbols, after they were laid aside in civil life, completed that wonderful superstition which the craft of the priest and the policy of the prince had undoubtedly begun.

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[1] There is, however, another hypothesis which is worthy of some attention, if it were only for the learning and ingenuity of its author. The celebrated Cudworth infers, from the writings of Philo and other Platonists of the Alexandrian school, that the an-

We learn from Herodotus,[1] that in his time the number of useful animals in Egypt was so small as to be hardly sufficient for tillage and the other purposes of civil life; whilst serpents and other noxious animals, such as the crocodile, wolf, bear, and hippopotamus, abounded in that country. From this fact Mosheim very naturally concludes,[2] that the founders of society and government in Egypt would by every art endeavour to increase the number of useful animals as the number of inhabitants increased; and that with this view they would make it criminal to kill or even to hurt sheep, cows, oxen, or goats, whilst they would wage perpetual war against the noxious animals and beasts of prey. Such animals as were assisting to them in carrying on this warfare would be justly considered as in a high degree useful to society. Hence the most grievous punishments were decreed against killing, or so much as wounding, the ichneumon and ibis; because the former was looked upon as the instinctive enemy of the crocodile, and the latter of every species of serpents. The learned writer, however, observes, that in Egypt, as in other countries, people would be tempted to sacrifice the good of the public to the gratification of their own appetites, and sometimes even to the indulgence of a momentary caprice. He thinks it was found necessary to strengthen the authority of the laws enacted for the preservation of useful animals by the sanctions of religion; and he says, that with this view the priests declared that certain animals were under the immediate protection of certain gods, that some of those animals had a divine virtue residing in them, and that they could not be killed without the most sacrilegious wickedness, and incurring the highest indignation of the gods. When once the idolatrous Egyptians were persuaded that certain animals were sacred to the immortal gods, and had a divine virtue residing in them, they could not avoid viewing those animals with some degree of veneration; and the priests, taking advantage of the superstition of the people, appointed for each species of sacred animals appropriate rites and ceremonies, which were quickly followed with building shrines and temples, and approaching them with oblations and sacrifices, and other rites of divine adoration.

To corroborate this hypothesis, he observes that, besides the animals sacred over all Egypt, each province and each city had its particular animal to which the inhabitants paid their devotions. This arose from the universal practice amongst idolaters of consecrating to themselves Lares and Penates; and as the animals which were worshipped over the whole kingdom were considered as sacred to the *Dii majorum gentium*, so the animals the worship of which was confined to particular cities or provinces, were sacred to the Lares of those cities and provinces. Hence there was in Upper Egypt a city called Lycopolis, because its inhabitants worshipped the wolf; whilst the inhabitants of Thebes, or Heliopolis, paid their devotions to the eagle, which was probably looked upon as sacred to the Sun. Our author, however, holds it as a fact which will admit of no dispute, that there was not one noxious animal or beast of prey worshipped by the Egyptians till after the conquest of their country by the Persians. That the earliest gods of Egypt were all benevolent beings, he appeals to the testimony of Diodorus Siculus; but he quotes Herodotus and Plutarch as agreeing that the latter Egyptians worshipped an evil principle under the name of Typhon. This Typhon was the inveterate enemy of Osiris, just as Ahriman was of Ormuzd; and therefore he thinks it in the highest degree probable that the Egyptians derived their belief of two self-existent principles, a good and an evil, from their Persian conquerors, amongst whom that opinion had prevailed from the earliest ages.

From whatever source their belief was derived, Typhon was certainly worshipped in Egypt, not with a view of obtaining from him any good, for there was nothing good in his nature, but in hopes of keeping him quiet, and averting much evil. As certain animals had long been sacred to all the benevolent deities, it was natural for a people so besotted with superstition as the Egyptians to consecrate emblems of the same kind to their god Typhon. Hence arose the worship of serpents, crocodiles, bears, and other noxious animals and beasts of prey. It may, indeed, seem at first sight very inconsistent to deify such animals, after they had been in the practice for ages of worshipping others for being their destroyers; but it is to be remembered, that long before the deification of crocodiles, &c. the real origin

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cient Egyptians held the Platonic doctrine of ideas existing from eternity, and constituting, in one of the persons of the godhead, the intelligible and archetypal world. Philo, he observes, did not himself consider those ideas as so many distinct substances and animals, much less as gods; but he mentions others who deified the whole of this intelligible system, as well as its several parts. Hence, when they paid their devotions to the *sensible sun*, they pretended only to worship the divine *idea* or *archetype* of that luminary; and therefore our learned author conceives that the ancient Egyptians, in falling down to bulls, and cows, and crocodiles, meant at first to worship only the divine and eternal *ideas* of those animals. He allows, indeed, that as few could entertain any thoughts at all of those eternal ideas, there were scarcely any who could persuade themselves that the *intelligible system* had so much reality in it as the *sensible things of nature*; and hence he thinks the devotion which was originally paid to the divine ideas had afterwards no higher object than the animals and vegetables of which those ideas were the eternal patterns.

This hypothesis, however, is more ingenious than satisfactory. There is no evidence that the mysterious doctrine of Plato concerning ideas had anywhere been thought of for ages after animal-worship was established in Egypt. Of the state of Egyptian theology at that early period, Philo, and the other philosophers of the Alexandrian school, had no better means of forming a judgment than we have; and they laboured under many Greek prejudices, which must have prevented them from judging with impartiality.

It must be confessed, however, that a pretty close approximation is here made to what seems to us to be the true explanation of the origin of animal-worship. The earliest form of idolatry was Tsabaism, or the worship of the host of heaven. Of this there can be no doubt whatever. But the observation of the sun, moon, and stars preceded the adoration of the heavenly host. Astronomy was the most early cultivated of all the sciences, and traces of the ancient classification still remain to attest the circumstances of its origin. The celestial bodies being first observed in pastoral countries, their groups were, from fancied resemblances to the figures of certain known animals, marked out and distinguished by the names of those animals; and, when they became objects of idolatrous worship, it was under the denominations which had thus been applied to them. In process of time, however, when Tsabaism, from a sublime idolatry, descended to a vulgar and degrading superstition, the sign was mistaken for the thing signified; the emblem was confounded with its archetype; and the animals themselves became the objects of that worship originally intended for the celestial signs or heavenly host, represented and classed in the manner already described. Such appears to us to have been the true origin of animal-worship, at least in Egypt, where almost every sign, emblem, or symbol, has either an astronomical or mythological import; and there can be no doubt that the superstition which excited the ridicule of the Roman satirist was a gross corruption of the earliest form of idolatry known in the world.

[1] Lib. ii. cap. 65.

[2] Cudworth's Intellectual System, cap. iv. No. 158.

of animal-worship was totally forgotten by the people, if they were ever acquainted with it. The crafty priest who wishes to introduce a gainful superstition, must at first employ some plausible reason to delude the multitude; but after the superstition has been long and firmly established, it is obviously his business to keep its origin out of sight.

Such is Mosheim's account of the origin and progress of that species of idolatry which was peculiar to Egypt; and with respect to the rise of animal-worship, it appears perfectly satisfactory. But the Egyptians worshipped several species of vegetables; and it surely could be no part of the policy of wise legislators to preserve them from destruction, as vegetables are useful only as they contribute to animal subsistence. We are, therefore, obliged to call in the aid of Warburton's hypothesis to account for this branch of Egyptian superstition.

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That learned and ingenious author having proved,[1] with great clearness and strength of argument, that hieroglyphical writing preceded the invention of alphabetical characters, and having traced that kind of writing from such rude pictures as those which were in use amongst the Mexicans, through all the different species of curiological, tropical, and symbolical hieroglyphics (see the article HIEROGLYPHICS), shows, by many quotations from ancient authors, that the Egyptian priests wrapped up their theology in the symbolical hieroglyphics, after alphabetical characters had banished from the transactions of civil life a mode of communicating information necessarily obscure. These symbols were the figures of animals and of vegetables, denoting, from some supposed or imaginary analogy, certain attributes of their divinities; and when the vulgar, forgetting this analogy, ceased to understand them as a species of writing, and were yet taught to consider them as sacred, they could not well view them in any other light than as emblems of the divinities whom they adored. But if rude sculptures upon stone could be emblematical of the divinities, it was surely not unnatural to infer, that the living animals and vegetables which those sculptures represented must be emblems of the same divinities more striking and more sacred. Hence, the learned author thinks, arose that wonderful superstition peculiar to the Egyptians, which led them to worship not only animals and vegetables, but also a thousand chimeras of their own creation, such as figures with human bodies, and the heads or feet of brutes, or with the bodies of brutes and the heads and feet of men.

These two hypotheses combined have been thought to account sufficiently for the idolatry of Egypt, monstrous as it was. We are persuaded that, with respect to the origin of animal-worship, Mosheim is in the right;[2] and it was a very easy step indeed for people in so good training to proceed upon the crutches of hieroglyphics to the worship of plants, and those chimeras which, as they never had a real existence in nature, could not have been thought of as emblems of the divinity, had they not been used in that symbolical writing which Warburton so ingeniously attempts to explain.

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To this account of the origin of animal-worship we are fully aware that some objections may occur. Animal-worship, it has been said, was not peculiar to Egypt. The Hindus, it is well known, have a religious veneration for the cow and the alligator; but there is no evidence that in India the number of useful animals was ever so small as to make the interference of the prince and the priest necessary for their preservation; neither does it appear that the Hindus adopted from any other people the worship of a self-existent principle of evil.

To this, however, it may be answered, that there is every reason to believe that animal-worship was introduced into India by a colony of Egyptians at a very remote period. That between these two nations there was an early intercourse, is universally allowed. And although the learned president of the Asiatic Society has laboured to prove, that the Egyptians derived all that wisdom for which they were famed, as well as the rudiments of their religious system, from the natives of Hindustan, he does not appear to us to have laboured with success. To examine his arguments at length would swell this article beyond its due proportion; and we have noticed some of them elsewhere (see the article PHILOLOGY). At present we shall only observe, that Sesostris undoubtedly made an inroad into India, and conquered part of the country, whilst we nowhere read of the Hindus having at any time conquered the kingdom of Egypt. Now, though the victors have sometimes adopted the religion of the vanquished, the contrary has happened so much more frequently, and is in itself a process so much more natural, that this single circumstance affords a very strong presumption that the Egyptian monarch would rather impose his gods upon the Hindus than adopt theirs and carry them back with him to Egypt. Animal-worship might likewise be introduced into Hindustan by those vast colonies of Egyptians who took refuge in that country from the tyranny and oppression of the shepherd kings. That such colonies did settle on some occasion or other in India, seems undeniable, from monuments still remaining in that country, with forms which could hardly have occurred to a native of Asia, though they are very natural as the workmanship of Africans.

We may admit that the Hindus have never adopted from the Persians or Egyptians the worship of an independent principle of evil, and yet dispose of the other part of the objection with very little difficulty. It will be seen by and by, that the Brahmins believe a kind of triad of hypostases in the divine nature, of which one is viewed as the Destroyer, and known by several names, such as Siva and Iswara. When animal-worship was introduced into Hindustan, it was not unnatural to consider the alligator as emblematical of Iswara; and hence in all probability it is that the Hindus believe that a man cannot depart more happily from this world than by falling into the Ganges, and being devoured by one of those sacred animals. Upon the whole, the animal-worship of the Hindus, instead of militating against our account of this monstrous superstition as it prevailed in Egypt, seems to lend no small support to that account, as there was unquestionably an early intercourse between the two nations, and as colonies of Egyptians settled in India.

Polytheists
acknowledged one
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Having thus traced the rise and progress of polytheism and idolatry as they prevailed in the most celebrated nations of antiquity, we now proceed to inquire into the real opinions of those nations concerning the nature of the gods whom they adored. And here it is evident from the writings of Homer, Hesiod, and the other poets, who were the principal theologians amongst the Greeks and Romans, that though heaven, earth, hell, and all the elements, were filled with divinities, there was yet one who, whether called Jove, Osiris, Ormuzd, or by any other title, was considered as supreme over all the rest. "Whence each of the gods

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[1] Divine Legation, book iv. sect. 4.

[2] To prove that it was merely to preserve and increase the breed of useful animals in Egypt, that the prince and the priest first taught the people to consider such animals as sacred, he argues thus: "Hæc ita esse, non ex eo tantum liquet, quod paulo ante observavi, nullas bestias universo Ægyptiorum populo sacras fuisse, præter eas, quæ manifestam regioni utilitatem comparent; sed inde quoque apparet, quod longe major ratio habita fuit famellarum inter animalia, quam marium. Boves diis immolare licebat, vaccas nullo modo. Canes fœminæ contumulabantur, non item mares."

Theogony.

was generated," says Herodotus,[1] "or whether they have all existed from eternity, and what are their forms, is a thing that was not known till very lately; for Hesiod and Homer were, as I suppose, not above four hundred years my seniors; and these were they who introduced the theogony amongst the Greeks, and gave the gods their several names." Now Hesiod,[2] towards the beginning of his Theogony, expressly invokes his muse to celebrate in suitable numbers the generation of the immortal gods who had sprung from the earth, the dark night, the starry heavens, and the salt sea. He calls upon her likewise to say, "in what manner the gods, the earth, the rivers, ocean, stars, and firmament, were generated, and what divine intelligences had sprung from them of benevolent dispositions towards mankind." From this invocation, it is evident that the poet did not consider the gods of Greece as self-existent beings. Neither could he look upon them as creatures; for of creation the ancient Greeks had no conception (see the article METAPHYSICS); but he considered them as emanations coeval with the earth and heavens, from some superior principles; and by the divine intelligences sprung from them, there cannot be a doubt but that he understood benevolent dæmons. The first principles of all things, according to the same Hesiod, were Chaos, and Tartarus, and Love, of which only the last being active, must undoubtedly have been conceived by this father of Grecian polytheism to be the greatest and only self-existing god. This, we say, must undoubtedly have been Hesiod's belief, unless by Tartarus we here understand a self-existent principle of evil; and in that case his creed will be the same with that of the ancient Persians, who, as we have seen, believed in the self-existence of Ahriman as well as of Ormuzd.

Hesiod is supposed to have taken his theology from Orpheus; and it is evident that his doctrine concerning the generation of the gods is the same with that taught in certain verses[3] usually attributed to Orpheus, in which Love and Chaos are thus brought together. "We will first sing," says the poet, "a pleasant and delightful song concerning the ancient Chaos, how the heavens, earth, and seas were formed out of it; as also concerning that all-wise Love, the oldest and self-perfect principle, which actively produced all these things, separating one from another." In the original passage, Love is said to be not only πολυμητις, of much wisdom or sagacity, and therefore a real intelligent substance; but also to be πρεσβυτατος and ἀυτοτελης, the oldest and self-perfect, and therefore a being of superior order to the other divinities, who were generated together with the elements over which they were conceived to preside.

With the theology of Homer our readers of all descriptions are so well acquainted, that we need not swell the article with quotations to prove that the father of epic poetry held Jove to be the father of gods and men. But the doctrine of the poets was the creed of the vulgar Greeks and Romans; and therefore we may conclude that those nations, though they worshipped gods and lords innumerable, admitted but one, or at the most two, self-existent principles, the one good and the other evil.[4] It does not indeed appear that in the system of vulgar paganism the subordinate gods were accountable to their chief for any part of their conduct, except when they transgressed the limits of the provinces assigned them. Venus might conduct the amours of heaven and of earth in whatever manner she pleased; Minerva might communicate or withhold wisdom from any individual with or without reason; and we find, that in Homer's battles the gods were permitted to separate into parties, and to support the Greeks or Trojans, according as they favoured the one or the other nation. Jove indeed sometimes called them to order; but his interference was thought partial, and an instance of tyrannical force rather than of just authority. The vulgar Greeks, therefore, although they admitted but one, or at most two, self-existent principles, did not consider the inferior divinities as mediators between them and the supreme, but as gods to whom their worship was on certain occasions to be ultimately directed.

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Creed of the philosophers.

The creed of the philosophers seems to have been different. Such of them as were theists, and believed in the administration of Providence, admitted of but one god, to whom worship was ultimately due; and they adored the subordinate divinities as his children and ministers, by whom the course of Providence was carried on. With respect to the origin of those divinities, Plato is very explicit, where he tells us,[5] that "when all the gods, both those who move visibly round the heavens, and those who appear to us as often as they please, were generated, that God, who made the whole universe, spoke to them after this manner: Ye gods of gods, of whom I myself am father, attend." Cicero teaches the very same doctrine with Plato concerning the gods;[6] and Maximus Tyrius, who seems to have understood the genius of polytheism as thoroughly as any man, gives us the following clear account of that system as received by the philosophers. "I will now more plainly declare my sense by this similitude: Imagine a great and powerful kingdom or principality, in which all agree freely and with one consent to direct their actions according to the will and command of one supreme king, the oldest and the best; and then suppose the bounds and limits of this empire not to be the river Halys, nor the Hellespont, nor the Meotian Lake, nor the shores of the ocean; but the heavens above and the earth beneath. Here, then, let that great king sit immoveable, prescribing to all his subjects laws, in the observance of which consists their safety and happiness. The partakers of his empire being many, both visible and invisible, are gods; some of them that are nearest and immediately attending on him, are in the highest regal dignity, feasting as it were at the same table; others, again, are their ministers and attendants; and a third sort are inferior to them both: And thus you see how the order and chain of this government descends down by steps and degrees from the Supreme God to the earth and men." In this passage we have a plain acknowledgement of one Supreme God, the sovereign of the universe, and of three inferior orders of gods, who were his ministers in the government of the world; and it is worthy of observation, that the same writer calls these intelligences θεους, θεου παιδας και φιλους, gods, the sons and friends of gods. He likewise affirms, that all ranks of men, and all nations on earth, whether barbarous or civilized, held the same opinions respecting one Supreme Numen, and the generation of the other gods.

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[1] Lib. ii. c. 51.

[2] Vers. 104–112.

[3] *Argonautica*, p. 17, edit. Steph.

[4] Plutarch is commonly supposed, and we think justly, to have been a believer in two self-existent principles, a good and an evil. His own opinion, whatever it was, he declares (*de Iside et Osiride*) to have been most ancient and universal, and derived from theologers and lawgivers, by poets and philosophers. "Though the original author of it be unknown, yet," says he, "it has been so firmly believed everywhere, that traces of it are to be found in the sacrifices and mysteries both of the barbarians and the Greeks. There is a confused mixture of good and evil in everything, and nothing is produced by nature pure. Wherefore it is not one only dispenser of things, who, as it were, out of several vessels, distributes these several liquors of good and evil, mingling them together, and dashing them as he pleases; but there are two distinct and contrary powers or principles in the world, one of them always leading, as it were, to the right hand, but the other tugging the contrary way. For if nothing can be made without a cause, and that which is good cannot be the cause of evil, there must needs be a distinct principle in nature for the production of evil as well as good."

That this is palpable Manicheism appears to us so very evident as to admit of no dispute. It appeared in the same light to the learned Cudworth; but that author labours to prove that Plutarch mistook the sense of Pythagoras, Empedocles, Heraclitus, Anaxagoras, and Plato, when he attributed to them the same opinions which were held by himself. Mosheim, on the other hand, has placed it beyond a doubt, that whatever was Plutarch's belief respecting the origin of evil, and the existence of two independent principles, it was taken implicitly from the writings of Plato. But the chancellor of Göttingen, actuated by the same motives with Cudworth, wishes to persuade his readers that by Plato and Plutarch nothing active was understood by their evil principle, but only that tendency to confusion which was then deemed inseparable from matter. But that something more was meant seems undeniable. For immediately after the words which we have quoted, Plutarch proceeds to affirm that the wisest men declare θεους ἐιναι δυο καθαπερ ἀντιτεχνους, "that there are two gods, as it were, of contrary trades or crafts," of which one is the author of all good and the other of all evil. See Mosheim's edition of Cudworth's Intellectual System, lib. i. cap. 4, § 13.

[5] *Timæus.*

[6] *Tusc. Quest.* lib. i. c. 29, and *De Nat. Deorum*, passim.

"If," says he, "there were a meeting called of all these several professions, a painter, a statuary, a poet, and a philosopher, and all of them were required to declare their sense concerning *the god;* do you think that the painter would say one thing, the statuary another, the poet a third, and the philosopher a fourth? No; nor the Scythian neither, nor the Greek, nor the Hyperborean. In other things we find men speaking very discordantly, all men as it were differing from all. But amidst this war, and contention, and discord, you may find everywhere, throughout the whole world, one uniform law and opinion, that there is ONE GOD, THE KING AND FATHER OF ALL, and many gods, the sons of God, who reign with God. These things both the Greek and the barbarian affirm, both the inhabitants of the continent and of the sea-coast, both the wise and the unwise."[1]

Creed of the Brahmins.

This account of philosophical polytheism receives no small support from the Asiatic Researches of Sir William Jones. "It must always be remembered," says that accomplished scholar, "that the learned Indians, as they are instructed by their own books, acknowledge only one Supreme Being, whom they call *Brahm*, or the Great One, in the neuter gender. They believe his essence to be infinitely removed from the comprehension of any mind but his own; and they suppose him to manifest his power by the operation of his divine spirit, whom they name *Vishnu*, the pervader, and *Nérâyan*, or moving on the waters, both in the masculine gender; whence he is often denominated the *first male*. When they consider the divine power as exerted in creating or giving existence to that which existed not before, they call the deity *Brahma;* when they view him in the light of destroyer, or rather changer of forms, they give him a thousand names, of which Siva, Iswara, and Mahadeva are the most common; and when they consider him as the preserver of created things, they give him the name of Vishnu. As the soul of the world, or the pervading mind, so finely described by Virgil, we see Jove represented by several Roman poets; and with great sublimity by Lucan in the well-known speech of Cato concerning the Ammonian oracle, 'Jupiter is wherever we look, wherever we move.' This is precisely the Indian idea of Vishnu; for since the power of preserving created things by a superintending providence belongs eminently to the godhead, they hold that power to exist transcendently in the preserving member of the triad, whom they suppose to be *everywhere always*, not in substance, but in spirit and energy." This supreme god Brahm, in his triple form, is therefore the only self-existent divinity acknowledged by the philosophical Hindus. The other divinities are all looked upon either as his creatures or his children, and of course are worshipped only with inferior adoration.

Why the philosophers worshipped the inferior divinities.

It was upon this principle of the generation of the gods, and of their acting as ministers to the Supreme Numen, that all the philosophers of Greece, who were not atheists, worshipped many divinities, though they either openly condemned or secretly despised the traditions of the poets respecting the amours and villanies of Jupiter, Venus, Mercury, and the rest of the tribe. It was the same principle sincerely admitted, and not an ill-timed jest, as has been absurdly supposed, that made Socrates, after he had swallowed the poison, request his friend to offer a votive cock for him to Æsculapius.

But a theogony was not peculiar to the Greeks, Romans, and the Hindus; it formed part of every system of polytheism. Even the Egyptians themselves, the grossest of all idolaters, believed in one self-existing God, from whom all their other divinities descended by generation. This appears probable from the writings of Horus Apollo, Jamblicus, Porphyry, and many other ancient authors; but if the inscription on the gates of the temple of Neith, in Sais, as we have it from Plutarch and Proclus, be genuine, it will admit of no doubt. This famous inscription, according to the last of these writers, was to this purpose: "I am whatever is, whatever shall be, and whatever has been. My veil no man has removed. The offspring which I brought forth was the Sun."[2]

The Persian Magi, as we have seen, believed in two self-existent principles, a good and an evil. But if Diogenes Laertius deserves to be credited, they held that fire, earth, and water, which they called gods, were generated of these two. It was observed in the beginning of this article, that the first object of idolatrous worship was probably the sun, and that this species of idolatry took its rise in Chaldæa or Persia. But when it became the practice of eastern monarchs to conceal themselves wholly from their people, the custom, as implying dignity, was supposed to prevail in heaven as well as on earth; and Zoroaster, the reformer of the Persian theology, taught,[3] that "Ormuzd was as far removed from the sun as the sun is removed from the earth." According to this modification of Magianism, the sun was one of the generated gods, and held the office of prime minister or vicegerent to the invisible fountain of light and good. Still, however, a self-existent principle of evil was admitted; but though he could not be destroyed or annihilated by any power, it was believed that he would at last be completely vanquished by Ormuzd and his ministers, and rendered thenceforward incapable of producing any further mischief.

Vulgar polytheists less culpable than the philosophers.

From this short view of polytheism, as we find it delineated by the best writers of antiquity, we think ourselves warranted to conclude that the whole pagan world believed in but one, or at most two, self-existent gods, from whom they conceived all the other divinities to have descended in a manner analogous to human generation. It appears, however, that the vulgar pagans considered each divinity as supreme and unaccountable within his own province, and therefore entitled to worship which rested ultimately in himself. The philosophers, on the other hand, seemed to have viewed the inferior gods as accountable for every part of their conduct to him who was their sire and sovereign, and to have paid to them only that inferior kind of devotion which the church of Rome pays to departed saints. The vulgar pagans were sunk in the grossest ignorance, from which statesmen, priests, and poets, exerted their utmost influence to keep them from emerging; for it was a maxim which, however absurd, was universally received, that "there were many things true in religion,[1] which it was not convenient for the vulgar to know; and some things which, though false, it was yet expedient that they should believe." The polytheism and idolatry of the vulgar, therefore, were their misfortune rather than their fault. But the philosophers were wholly "without excuse;[2] because that when they knew God, they glorified him not as God, neither were thankful, but became vain in their imaginations, and their foolish heart was darkened. Professing themselves wise, they became fools, and worshipped and served the creature more than the Creator, who is God blessed for ever." (H. H. H. H.)

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[1] *Dissert.* i.

[2] Τα ὀντα, και τα ἐσομενα, και τα γεγονοτα, ἐγω εἰμι. Τον ἐμον χιτωνα ουδεις ἀπεκαλυψεν. Ὁν ἐγω καρπων, ἡλιος ἐνενετο. The antiquity of this inscription is admitted by Cudworth, denied by Mosheim, and doubted by Jablonski. The reader who wishes to know their arguments may consult Mosheim's edition of the Intellectual System, and Jablonski's *Pantheon Ægyptiorum.*

[3] Plutarch, *de Iside et Osiride.*

POMBAL, a city of Portugal, in the province of Estremadura, and the corregimiento of Leiria. It stands on a hill, near to which are the striking ruins of an ancient castle. It contains but one church, which is much frequented by pilgrims as well as by inhabitants, on account of a supposed holy image to which miraculous virtue is ascribed. Pombal has 860 houses, with about 4000 inhabitants, some of whom are employed in making hats. The most celebrated, or, according to some, the most profligate, statesman of Portugal, long at the head of the ministry, took his title of marquis from this place.

POMERANIA, a province of Prussia, extending along the southern shore of the Baltic Sea, from long. 12. 29. to 17. 51. It is bounded on the east by West Prussia, on the south by Brandenburg, and on the west by the duchies of Mecklenburg-Schwerin and Mecklenburg-Strelitz. It extends over 12,450 square miles, but in it are included several lakes and extensive estuaries, called *Haffs*, which occupy more than one tenth of the whole surface. Pomerania was an independent duchy until 1637, when, by the death of the reigning prince, it descended to the elector of Brandenburg; but as, during the life of that prince, in the course of the thirty years' war, Sweden had possessed itself of the eastern part of Pomerania, including the island of Rugen and the city of Stralsund, it retained that portion till, by the treaty of 1815, the Swedish territories in Germany were ceded to Prussia, in consideration of that state having guaranteed the cession of Norway to Sweden. It was formerly divided into East and West Pomerania, the river Oder being the line of division between them; but since the whole has been under the Prussian king, it has been formed into three provincial governments, namely, Stettin, Stralsund, and Koslin. By the census of 1817 the population amounted to 689,486, and by that of 1826 it had increased to 846,722. Of these, 16,700 were military, 6700 Catholics, and 4170 Jews; the remainder were Protestants.

The whole province is a continued plain, mostly a sandy soil, covered with heaths, and occasionally with pines, and intermixed with numerous lakes of different dimensions. There are but few elevations of one hundred feet, and only one, near Koslin, which exceeds two hundred feet. The greater portion of the soil is far from fruitful, and barely produces sufficient grain and potatoes for the subsistence of the inhabitants. The chief corn is rye; very little wheat is raised; and the quantity of barley is much less than of oats. There are, however, on the banks of the Oder, and on those of some of its tributary streams, strips of land of such natural fertility as to afford good grass, both for fodder to cattle, and also for making butter and cheese. The manufactures are of the domestic kind, and mostly upon a contracted scale. The chief occupation is spinning flax, in which all females and many males are employed during the long winter evenings. Some coarse woollen cloths are made; and the breweries and distilleries are numerous. On the coast there are several of the town's establishments for building vessels of various descriptions. The climate in winter, though occasionally very cold, may be more properly described as variable, having severe frosts alternating with sudden thaws; but the unexampled increase of the population seems to show that it cannot be an insalubrious district.

POMFRET, JOHN, an English poet, son of the rector of Luton, in Bedfordshire, was born in 1667, and educated at Cambridge; after which he took orders, and was presented to the living of Malden, in Bedfordshire. About 1703 he went to London for institution to a larger and more considerable living; but he was stopped for some time by Compton, then bishop of London, on account of four lines of his poem entitled the Choice.

> And as I near approach'd the verge of life,
> Some kind relation (for I'd have no wife)
> Should take upon him all my worldly care,
> While I did for a better state prepare.

The parenthesis in these lines were so maliciously represented, that the good bishop was made to believe that Pomfret preferred a mistress to a wife. But he was soon convinced that this representation was the mere effect of malice, as Pomfret at that time was actually married. The opposition which his slanderers had made to him, however, produced its effect; for, being thereby obliged to stay in London longer than he intended, he caught the small-pox, and died of this disease at the age of thirty-five.

He published, in 1699, a volume of his poems with a very modest and sensible preface. Two pieces of his were published after his death by his friend Philalethes; one entitled Reason, and written in 1700, when the disputes about the Trinity ran high; and the other *Dies Novissima*, or the Last Epiphany, a Pindaric ode. His versification is not unmusical, but his writings want that force which is necessary to constitute a poet. A dissenting teacher of his name, and who published some rhymes upon spiritual subjects, subjected him to the imputation of fanaticism; but his friend Philalethes has vindicated him from that charge. Pomfret had a very strong tincture of devotion, but no fanaticism, in his composition.

"The Choice," says Dr Johnson, "exhibits a system of life adapted to common notions, and equal to common expectations; such a state as affords plenty and tranquillity, without exclusion of intellectual pleasures. Perhaps no composition in our language has been oftener perused than Pomfret's Choice. In his other poems there is an easy volubility; the pleasure of smooth metre is afforded to the ear, and the mind is not oppressed with ponderous or entangled with intricate sentiment. He pleases many; and he who pleases many must have merit."

POMME, or POMMETTE, in *Heraldry*, is a cross having one or more balls or knobs at each of the ends.

POMMEL, or PUMMEL, in the *Manège*, a piece of brass or other matter at the top and in the middle of the saddle-bow.

POMŒRIUM, in Roman antiquity, was, according to Livy, that space of ground, both within and without the walls, which the augurs, at the first building of cities, solemnly consecrated, and on which no edifices were allowed to be raised. Plutarch gives this account of the ceremony of drawing the pomœrium: "They dug a trench, and threw into it the first-fruits of all things, either good by custom, or necessary by nature; and every man taking a small turf of earth of the country from whence he came, they cast them in promiscuously. Then making this trench their centre, they described the city in a circle round it. After this, the founder, yoking a bull and a cow together, ploughed a deep furrow, with a brazen ploughshare, round the bounds. The attendants took care that all the clods fell inwards, that is, toward the city. This furrow they called *Pomœrium*, and built the wall upon it." In this account Plutarch is to be understood as speaking of Rome.

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[1] Varro apud D. Augustinum *de Civitate Dei.*

[2] Romans, i. 20, 21, 22, 25.

POMPEII, an ancient city of Italy, situated in that part of the country to which the ancients gave the name of Campania. It lies at the bottom of the Gulf of Cumæ, known in modern times as the Bay of Naples, five miles from the volcanic mountain of Vesuvius, and thirteen miles south-east of the city of Naples. Pompeii was in no particular manner distinguished for its magnificence or its historical renown; but the destiny which overtook it, as remarkable as it is happily rare, renders it one of the most interesting spots on the face of the globe. Near the commencement of the Christian era it was overwhelmed by a deluge of ashes, water, and mud, discharged from the neighbouring volcano; and, after lying buried for about seventeen centuries, its streets and houses, with its temples and theatres, have again been laid open to the light of day, and retraversed by the busy foot of man.

Of the early history of Pompeii little is known. It is said to have been founded by Hercules, and that its name is derived from Pompa, in allusion to the pomp with which that hero celebrated his victories whilst awaiting his fleet at the mouth of the river Sarnus, after his reputed conquest of Spain. This refuge in mythology, to which men have betaken themselves in accounting for the origin of Pompeii, is a sufficient proof that the obscurity in which it is hidden is too profound to be penetrated. Strabo, however, asserts that these towns were founded by Pelasgians and Tyrrhenians; and this statement is by no means destitute of plausibility. We may indeed conclude, with some degree of confidence, that the foundations of Pompeii were laid long before those of Rome itself. The early history of the city is nearly as uncertain as the date of its foundation and the etymology of its name. It is first mentioned in the account of the Social or Marsic War, which broke out ninety-one years before the birth of Christ, as one of the towns of Campania that had revolted. It escaped the punishment with which some other places were visited; and the only subsequent event of any moment which is related of it, is a quarrel between its inhabitants and those of Nuceria, now Nocera, in which the latter were worsted.

This transaction occurred A. D. 59. Four years afterwards, Pompeii was almost destroyed by an earthquake, the terrible effects of which are recorded by Seneca. A great part of the town was reduced to ruins; and Herculanum was likewise considerably injured. Similar alarms, the usual presages of an approaching eruption, were repeated, until the memorable 23d of August A. D. 79, when the first recorded volcanic paroxysm of Vesuvius occurred. We are fortunately in possession of a faithful and striking narrative of the event, contained in two letters of Pliny the younger to Tacitus. He was an eye-witness of the catastrophe, and, besides a description of it, he gives an account of the death of his uncle, who fell a victim to his inquiring spirit and humanity.

It was not lava, but showers of stones, cinders, and mud, which overwhelmed Pompeii; pouring down for more than a week, and much of the matter having been deposited in a liquid state. Nor was it by one eruption alone that the cities were covered to their present depth. Successive layers are clearly to be traced, and the lowest bears marks of having been moved, whilst the others are untouched; a plain proof that some time elapsed between their deposition, and that the inhabitants had made excavations in search of their more valuable property. The bed of ashes and stones which covered Pompeii varied in depth from twelve to fourteen feet. Under this it remained for one thousand six hundred and seventy-six years; for although indications of its ruins were observed in 1689, the excavations did not commence till 1755. The disappointment experienced on the failure of the attempt to excavate Herculanum to any extent has thus been compensated; for whilst the thick layers of lava which covered the latter city rendered the undertaking too difficult to be persevered in, the light friable mass which entombed Pompeii was easily removed. The upper stories of the buildings, which were probably composed of wood, were either burned by the red-hot matter which fell upon them, or forced inwards by the weight of the enormous superincumbent mass, or the violence with which it descended. With this exception, we see a beautiful and once flourishing city, just as it existed nearly eighteen centuries ago. The buildings stand as they were originally designed, unviolated by time or fashion; the paintings are as fresh as if they had newly come from the easel; and, in some instances, memorials of a more impressive character bear sad testimony to the suddenness and completeness of the calamity which overwhelmed the city.

Pompeii was originally situated upon the sea-shore, as is proved by shells and sea-sand being found on the side adjoining the Bay of Naples; and it is even said that rings have been discovered close to the ruins, intended, as is supposed, for the mooring of vessels. By the gradual elevation of the coast, it is now at some distance inland; and the river Sarnus, which, it is not improbable, was once capable of receiving the vessels of the ancients, has shrunk to a mere rivulet, and is diverted from its original course. The city stood on an insulated spot formed by the lava which, at some remote period, the action of subterranean fire seems to have thrown up in various directions around the foot of Vesuvius. Thus situated, it combined all the advantages of mercantile convenience with the security of a military station, and the romantic beauty of a spot celebrated in all ages for its surpassing loveliness, and which was a favourite resort of strangers for health or recreation. The city was surrounded by a wall, the whole, or nearly the whole, of which has been traced; and six gates and twelve towers have been counted. Its greatest length is little more than three quarters of a mile, its breadth is less than half a mile, and its circumference is nearly two miles. Its general figure is irregularly oval, and it occupied an area of about one hundred and sixty-one acres. There have been excavated above eighty houses, an immense number of small shops, the public baths, two theatres, two basilicæ, eight temples, the prison, the amphitheatre, and other public buildings, besides fountains and tombs. The streets are paved with large irregular pieces of lava, neatly dovetailed into one another. This pavement had been deeply rutted by the chariot-wheels which formerly rattled over it. In general, the streets are so narrow that they may be crossed at one stride. Where they were of greater breadth, a stepping-stone was placed in the middle, it is supposed for the convenience of foot-passengers. On each side there is a foot-path, along which run curb-stones to prevent the encroachments of the biga or chariot. From the position of the town, and the discoveries made by the excavators, it seems clear that only three principal roads could have led to it. The first, which was on the western side, led to Naples; the second joined the Popilian way at Nola; and the third crossed the Sarnus, and afterwards divided into two branches, of which the principal led to Nocera, and the other to Stabia. The city is generally approached by the first road, because it was the ancient route from Rome to Herculanum, and the chief entrance of Pompeii. The first object of interest met with is the Street of Tombs, now completely excavated, which rises by an easy ascent to the city-gate, called the Gate of Herculanum. The road is flanked by tombs of much beauty and interest, as well as by other buildings, amongst which is a hostelry. We quote the following description of Pompeii, as entered by this gate, from an interesting work on the subject. "On entering, the visiter finds himself in a street running a little east of south, which leads to the Forum. To the right stands a house formerly owned by a musician, to the left a *thermopolium* or shop for hot drinks; beyond is the house of the vestals, beyond this the custom-house, and a little further on, where another street runs into this one from the north, at a very acute angle, stands a public fountain. In the last-named street is a surgeon's house, at least one so named from the quantity of surgical instruments found in it, all made of bronze. On the right or western side of the street by which we entered, the houses are built on the declivity of a rock, sloping down to where the sea formerly came, and are several stories in height. The fountain is about one hundred and fifty yards from the city-gate. About the same distance further on, the street divides into two, the right-hand turning seems a by-street, the left-hand turning conducts you to the Forum. The most important feature in this space is a house called the house of Sallust, or of Actæon, from a painting in it representing that hunter's death. It stands on an area about forty yards square, and is encompassed on three sides by streets, by that, namely, which we have been describing, by another nearly parallel to it, and by a third perpendicular to these two. East of this island of houses is an unexcavated space, beyond which is another broad street, running parallel to the first, the limit of the excavations in this quarter. Between these two are indications of another street, which is cleared out, south of the transverse street. Still further south these streets all terminate in a transverse street. Thus the whole quarter already described is divided by four longitudinal and two transverse streets, into what the Romans called islands, or insulated masses of houses. One of these is entirely occupied by the house of Pansa, which, with its court and garden, is about a hundred yards long by forty wide. The average interval between the western and eastern street is not more than a hundred and fifty yards. The island immediately east of the house of Pansa has three houses of considerable interest, called the house of the tragic poet, from dramatic paintings on the walls; the cloth-dyer's house, from paintings illustrating the processes and utensils of that trade; and the house of the mosaic fountains.

"From the transverse street which bounds these islands on the south, two streets lead to the corners of the Forum; between them are the baths, occupying nearly the whole island. Among other buildings are a milk-shop and gladiatorial school. At the north-east corner of the Forum was the triumphal arch. At the end of the broad eastern street, and higher up in the same street, another triumphal arch is still to be made out, so that this was plainly the way of state into the city. The Forum was distant from the gate of Herculanum about four hundred yards. Near the south-eastern corner two streets enter it, one running to the south, the other to the east. We will follow the former for about eighty yards, when it turns eastward for two hundred yards, and conducts us to the quarter of the theatres. The other street, which runs eastward from the Forum, is of more importance, and is called the Street of the Silversmiths.... The quarter of the theatres comprises a large temple of Hercules, a temple of Isis, a temple of Æsculapius, two theatres, and two spacious porticoes enclosing open areas. On the north and east it is bounded by streets; to the south and west it seems to have been enclosed partly by the town, partly by its own walls. Here the continuous excavation ends, and we must cross nine yards to the amphitheatre, distant from the theatre about five hundred and fifty yards, in the south-east corner of the city, close to the walls, and in an angle formed by them. On the other side are traces of walls, supposed to have belonged to cattle-markets. Near at hand a considerable building, called by the Italians the palace of Giulia Felice, has been excavated and filled up again. A considerable distance to the westward is the first excavation, made near the centre of the city; it is surrounded by vines, which hang in festoons from the poplars on which they are trained; it is small, and appears to have been abandoned on account of the few coins and vessels discovered. From the amphitheatre we return along the Street of Silversmiths towards the Forum; but, before we arrive at the latter, turn up a street running parallel to it. Arriving at the end of it, we turn to the right, and soon reach the triumphal arch of the Forum, having now traversed the whole excavated portion, except a few insignificant streets."

Forum. This account of the general aspect of Pompeii renders it less necessary to give any description of particular places and buildings. The Forum was the focus of business, the resort of pleasure, and the scene of all political and legal contention. Entering at the gate of Herculanum, the main street of the town leads the visiter to the north-west corner. Here he gains admittance by a flight of steps leading downwards through an arch in a brick-wall. Upon entering, the spectator finds himself in a large area surrounded by columns and the ruins of temples, triumphal arches, and other public buildings, the particular uses of which can in general be only conjectured. There are also a number of pedestals, which once supported statues; and around the west, south, and east sides, there runs a Doric colonnade in the Grecian style. At the end by which the place is entered stands a building, called by some the temple of Jupiter, and by others the Senaculum or council-chamber. It is prostyle, and of the Corinthian order, and stands upon an elevated basement, which was ascended by a flight of steps. Those near the columns, which served for ornament, and also for supporting the upper part of the building, run along the whole front of the portico. The interior had been painted; red and black are the prevailing colours. Fragments of a colossal statue, and a sun-dial, were discovered. Near this temple are the ruins of what has been conjectured to have been the granary. Adjacent to this building is the prison, where were found the skeletons of two men, their leg-bones still within the shackles. On the opposite side of the temple of Jupiter stands an edifice, which has been called the Pantheon, from its having had in the centre of its area an altar encircled with twelve pedestals, and which, it is supposed, once supported statues of the aristocracy of Italian mythology. The area is a hundred and twenty feet in length by ninety feet in breadth. To this building are attached numerous cells, in all probability for the accommodation of priests. Near to this building were discovered ninety-three brass coins and statues of Nero and Messalina.

On the northern side of the Pantheon there runs a street named the Street of Dried Fruits, from the quantity of fruits of various kinds preserved in glass vases which have been found in it. Scales, money, and moulds for pastry and bread, were discovered in the shops; and a bronze statue of Fame was also found. On the western side of the Forum are the Basilica, a temple supposed to have been dedicated to Venus, and the granary and prison already noticed. The Basilica, or court of justice, is the largest building in Pompeii. It is of an oblong form, two hundred and twenty feet in length by eighty feet in breadth, and corresponds in some particulars with the ancient description of that building. The temple of Venus is the only remaining building of importance connected with the Forum. It possessed the usual apartments, in one of which was found a painting of Bacchus and Silenus in a state of perfect preservation. In most of the paintings the colours are as vivid as when they were first laid on.

Amongst other objects of interest there is a broad street, which, from various articles of jewellery having been found there, is called the Street of the Silversmiths. On the walls of the shops several inscriptions appear, one of which has been thus translated: "The scribe Issus beseeches Marcus Cerrinius Vatia, the ædile, to patronise him; he is deserving." At the end of this street was discovered a skeleton, supposed to have been that of a priest of Isis. In the hand was a bag of coarse linen, not entirely destroyed, containing three hundred and sixty silver coins, forty-two of copper, and six of gold. Near him were also found various articles belonging to the worship of Isis.

Baths.

The baths of Pompeii were excavated in the year 1824. They surpass all the other buildings of Pompeii in magnificence, decoration, good taste, arrangement, and the state of preservation in which they remain. They occupy a considerable space, and are divided into three separate compartments; one was for fire-places and for the use of servants, another was for the men, and a third for the women. The walls of the *frigidarium* are ornamented with figures, and the apartment is round, and altogether remarkable for its beauty. The basin is twelve feet ten inches in diameter, and two feet nine inches deep, and is entirely lined with white marble. The *tepidarium* is divided into a number of compartments, and has also been highly ornamented. The ceiling is adorned with figures and carvings in stucco. In the bronze frame of the window were four beautiful panes of glass, from which it is evident that windows of glass were in use amongst the ancients. Glass-blowing seems to have been better understood by them than many of the learned are inclined to admit. This is proved by the quantities of bottles, vases, glasses, and other utensils made of the same material, which have been discovered in this subterranean city. The *caldarium*, the third and last description of bath made use of by the Romans, is an apartment in all respects as highly finished and decorated as the others.

Theatres.

Two theatres have been excavated in Pompeii, a large one and a small one; both displaying the remains of considerable magnificence. They are constructed after the usual plan of a Roman theatre, and need not therefore be described here. In the large theatre there must have been sufficient space for five thousand persons. This theatre appears to have been entirely covered with white marble, although only a few fragments remain. The other theatre nearly resembles the one here mentioned, but is much smaller, and appears from an inscription to have been permanently roofed.

Adjoining the theatres there is an edifice which, from the style of its architecture, has been called the Greek temple, or the temple of Hercules. It is supposed by some to be of great antiquity, and is in a very dilapidated state. In this quarter also is situated the temple of Isis. It is also one of the most perfect examples now extant of the parts and disposition of an ancient temple. In one of the rooms was found the skeleton of a priest. Near his remains lay an axe, from which it would appear that he had delayed his departure till the door was choked up with the falling ashes, and so had attempted to force his way through the walls with the hatchet. He had already penetrated through two, but before he could break through the third, death arrested his flight. A number of other skeletons were here found, and also some paintings of the priests of Isis, together with a statue of the deity herself. In this neighbourhood stands the temple of Æsculapius, where were found three terra-cotta statues of Æsculapius, Hygeia, and Priapus. Near this is one of the most interesting buildings discovered in Pompeii, not for its beauty, but for its contents, which prove it to have been the abode of a sculptor. There were found statues, some half finished, others just begun, with blocks of marble, and all the tools required by the artist, as mallets, compasses, chisels, saws, and the like. The amphitheatre, which has been excavated, does not differ from other Roman buildings of the same kind. It was calculated to contain ten thousand persons.

Various utensils found.

In a street which conducts to the Forum, and is called the Street of Fortune, an immense number of utensils have been found. Amongst these were vases, basins with handles, bells, elastic springs, hinges, buckles for harness, a lock, an ink-stand, gold ear-rings, a silver spoon, an oval caldron, a sauce-pan, a mould for pastry, a number of lamps (about one thousand were found at the baths), and three boxes with a slit to admit money, one of which contained coins of Titus Vespasian and other Roman emperors. Here also were found seven glazed plates packed in straw, a pair of scales, and a steelyard. In other parts of the city were discovered fishing-nets, some of them quite entire, and linen with the texture well defined. In the shop of a baker there was found a loaf, still retaining its original form, and with the maker's name stamped upon it. On the counter of an apothecary's shop lay a box of pills, and by the side of it was a small cylindrical roll, evidently waiting to be cut up. This mode of administering medicine, therefore, is of very high antiquity. In various parts of Pompeii have been dug up a number of bronze helmets, greaves, and other warlike furniture; more than one candelabrum, braziers of various sorts, vases, cooking vessels and other kitchen utensils, glass vessels, articles of dress, female ornaments, and other articles of luxury.

Skeletons.

But the relics most calculated to interest our feelings are the remains of the human beings who perished in the great catastrophe. A comparatively small number of skeletons have as yet been brought to light; and hence it is clear that most of the inhabitants had found time to make their escape. Besides those already mentioned, there were discovered in the vaults of a house in the suburbs of Pompeii, the skeletons of seventeen individuals, who appear to have sought in vain an asylum there from the tempest of ashes which poured down from the sky. There was likewise preserved in the same place a perfect cast of a woman, supposed to have been the mistress of the house, with an infant locked in her arms. Her form was imprinted upon the consolidated mass in which she was entombed, but of her body only the bones remained. To these a chain of gold was suspended, and rings with jewels were upon the bones of the fingers. The remains of a soldier were found in a niche, where in all probability he was performing the office of sentinel. His hand still grasped a lance, and the other military accoutrements worn at the time were found beside him or upon his bones.

Architecture and houses.

The architecture of Pompeii is not always in the best taste; yet there is much to be admired in it, both for design and execution. At the same time, except in those quarters where the public buildings were situated, there could have been nothing striking or magnificent in the appearance of the city as a whole. The houses were of small height, and externally gloomy; the lower part being usually a blank wall plastered over, and often painted with different colours, and the upper pierced with small windows to light the apartments on the first floor. Internally there is very little costly decoration to be found, with the exception of mosaic pavements, which are numerous and extremely beautiful; and even in the public buildings marble is of rare occurrence. Its place, however, was not inadequately supplied by a stucco of great beauty, equally adapted to receive paintings or to be modelled into bas-reliefs; and these have been found in great abundance. The paintings are in general in a state of perfect preservation, and have all the freshness of recent finishing. In the Pompeian houses every species of masonry described by Vitruvius may, it is said, be met with; but the cheapest and least durable sorts have been generally preferred; and by far the greater part of the private, and many of the public edifices, are built of bricks, or of the rough masonry which is called *opus incertum*. Hence arises their rapid decay on being exposed to air. Copper, iron, lead, and other metals, have been found employed for the same purposes as those for which we now use them, so that the articles discovered need not be enumerated. Almost all the door-ways are nearly of the same size and form, a little more or less care in the execution of capitals and entablatures making all the difference between them. It is rare in Pompeii to see a whole house set apart for purposes of trade, a portion of it almost invariably furnishing an abode for the owner. The houses of the richer classes were usually surrounded by shops. Throughout the streets numerous signs are to be seen upon the shops, indicative of the trades which were pursued within. One of these represents two men carrying an amphora, and probably served as the sign of a wine-shop. And there is a painting of a boy mounted upon the back of another, and undergoing a process of flagellation; an ominous indication to all idlers that the schoolmaster was at home.

Fountains, sewers, and tombs.

Fountains are very numerous both in the streets and houses of Pompeii, but it is not known from what source or sources the city was supplied with water. But, however obtained, the waters once brought to the city were distributed to its different quarters by conduits of masonry, lead, or baked earthen pipes. Fountains, which appear to have been *jets d'eau*, have been found in several houses; and there is a painting of one representing a broad vase with a jet of water rising from the centre. Of the manner in which the town was drained, and the numberless impurities carried off, little is known satisfactorily; but remains of a considerable sewer, with minor drainages converging to it, have been observed. The tombs line the approach to the city through the gate of Herculanum. They are numerous, and almost all those which have been found are raised upon a platform of masonry above the level of the footway. They are themselves solid, elegant, and in many instances highly ornamented structures.

Manuscripts.

No perfect manuscripts, nothing but mere fragments, have been found at Pompeii. It may be mentioned, that most of the houses have received their names from the paintings on the walls; but some have been designated from persons of rank being present at their excavation, and from other accidental circumstances. (R. R. R.)

POMPEY THE GREAT, CNEIUS POMPEIUS MAGNUS, the renowned rival of Julius Cæsar. Being defeated at the battle of Pharsalia, owing to the defection of his cavalry, Pompey fled by sea to Egypt, where he was basely assassinated by order of Theodotus, prime minister to Ptolemy the younger, then a minor, 48 B.C. See ROME.

POMPEY's Pillar, vulgarly so called, a celebrated column near Alexandria, in Egypt, 114 feet in height, and of which the shaft, composed of a single piece of granite, is ninety feet.

POMPONATIUS, PETER, an eminent Italian philosopher, was born at Mantua in 1462. He was of so small a stature that he was little better than a dwarf; yet he possessed an exalted genius, and was considered as one of the greatest philosophers of the age in which he lived. He taught philosophy with the highest reputation, first at Padua, and afterwards at Bologna. He had frequent disputations with the celebrated Achillini, whose puzzling objections would have confounded him, had it not been for his skill in parrying them by some joke. His book *De Immortalitate Animæ*, published in 1516, made a great noise. He maintained, that the immortality of the soul could not be proved by philosophical reasons; but solemnly declared his belief of it as an article of faith. This scrimp precaution did not, however, save him. Many adversaries rose up against him, who did not scruple to treat him as an atheist; and the monks caused his book, although he wrote several apologies for it, to be burned at Venice. His work upon Incantations was also thought very dangerous. In it he shows that he believed nothing of magic and sorcery; and he lays a prodigious stress on occult virtues in certain men, by which they produced miraculous effects. Of this he gives a great many examples, but his adversaries do not admit them to be true, or free from magic. Paul Jovius says, that he died in 1525, in his grand climacteric. He was three times married, and had but one daughter, to whom he left a large sum of money. He used to apply himself so very intensely to the solution of difficulties, that he frequently forgot to eat, drink, sleep, and perform the ordinary functions of nature.

PONARUM, a town of the south of India, in the Carnatic, fifty-five miles south-west from Pondicherry. Long. 79. 20. E. Lat. 11. 26. N.

PONDAH, a town and celebrated fortress of Hindustan, in the province of Bejapore, which stands at the foot of the Western Ghauts, and commands the most frequented pass into the interior from Goa and Soondah. It was taken by the Mahrattas under Sevajee in 1673; and being afterwards, in 1683, besieged by the Portuguese, it was relieved by Sambajee, who, observing that they had made greater progress in battering the fortifications in ten days, than his father had done in three months, ordered them to be razed. Long. 73. 56. E. Lat. 15. 23. N.

PONDI, a small island in the Eastern Seas, separated from Madura by a channel a mile in width, with a small bay which affords a safe anchorage for shipping. It is well cultivated, and has a pleasant appearance. Long. 114. 23. E. Lat. 6. 57. S.

PONDICHERRY, a city on the sea-coast of the south of India, in the province of the Carnatic, and once the most splendid city in the East. But it has never recovered from the destruction inflicted on it by the British in 1761. It stands on a sandy plain, not far from the sea-shore, which produces only palm-trees, millet, and a few herbs. It was formerly a village, which, with a slip of land about five miles in length, was purchased by the French from the king of Bejapore in 1672. Under their rule it became a populous and thriving settlement. It was taken by the Dutch in 1693, who improved the town and enlarged the fortifications. It was restored at the peace of Ryswick to the French; and in the course of half a century a handsome and regular town was built, the houses in general being two stories high, with flat roofs, and colonnades in front. The town, thus improved and enlarged, became the capital of the French settlements in the East. Having no natural advantages as a commercial town, when the French were expelled from India it fell into decay. When it was occupied by the British in 1761, the fortifications were completely destroyed, and the ditch was filled up by the earth of the glacis. These devastations were also extended, by the animosity of the Madras government, to the buildings, public as well as private; and it is mentioned by Lord Valentia, that the Jesuits' College, and some of the public buildings, still remain, memorials of their resentment. The private houses, however, have been completely repaired, and the same traveller considers Pondicherry as the handsomest town he had seen in India, with the exception of Calcutta. It is better fitted for a maritime station than Madras, as, during the south-west monsoon, the season of naval warfare, it is to the windward, which was found by the French to be of great advantage during the wars of the last century. In the middle of the square are still seen the pillars and other ornaments of a pagoda of black stone richly ornamented with carving. They remain strewed on the ground, no unfit emblem, Lord Valentia adds, of the fallen power of the French in this country. On the 26th of August Pondicherry was besieged by Admiral Boscawen, who was compelled to raise the siege in the following October, after losing about 1000 Europeans. M. Lally landed at this place in 1758, and succeeded Dupleix as governor, when an action was commenced between the British and the French, which ended in the total ruin of the French power in India, and Pondicherry surrendered to Colonel Coote on the 16th of January 1761. At the peace of 1763 this fortress was restored to the French, with the fortifications in a very dilapidated condition. By the skill of the French engineers the fortifications were repaired and considerably strengthened. In 1778 Pondicherry surrendered to Colonel Munro, after an obstinate defence. At the peace of 1783 it again devolved to the French; and on the breaking out of hostilities surrendered to the British on the 23d of August 1793. It was restored at the peace of Amiens, when the population was estimated at 25,000, and the revenue at 40,000 pagodas. Bonaparte sent out as a garrison 1400 European troops, with a large military staff, in the view, it was supposed, of prosecuting schemes of ambition in India; but whatever were his plans, they were frustrated by the short duration of the peace, and Pondicherry was again occupied by the British in 1803. Pondicherry still continues the capital of the French settlements in India, but is no longer considered as a place of consequence, either politically or commercially. The travelling distance from Madras is 100 miles, from Seringapatam 260, from Hyderabad 452, from Delhi 1400, from Calcutta 1130, from Najpoor 773, from Poonah 707. Long. 74. 0. E. Lat. 18. 30. N.

PONDIMARKA, a seaport of Hindustan, in the Northern Circars, and district of Cicacole, which contains a small bay, only capable of receiving small boats. Long 83. 0. E. Lat. 17. 37. N.

PONDONG, a small island in the Eastern Seas, near the south-east coast of Siao. Long. 125. 10. E. Lat. 2. 40. N.

PONIARD, a little pointed sharp-edged dagger, borne in the hand or at the girdle, or hidden in the pocket. The word is formed from the French *poignard*, and that from *poignée*, handful. The poniard was anciently in constant use; but it is now laid aside, except amongst assassins. Sword and poniard were the ancient arms of duellists, and are said to continue so still amongst the Spaniards. The practice of sword and poniard forms part of the exercise taught by the masters of defence.

PONS, St, an arrondissement of the department of Hérault, in France, extending over 488 square miles. It comprises five cantons, and is divided into forty-four communes, containing 40,160 inhabitants. The capital is the city of the same name, usually distinguished as Saint Pons de Thomiers. It is situated in a valley surrounded by lofty mountains, watered by the river St Jean, and contains 5340 inhabitants, who are occupied partly in cotton-spinning and tanning. Long. 2. 53. E. Lat. 43. 32. N.

PONT-A-MOUSSON, a city of France, in the department of the Meurthe, and the arrondissement of Nancy. It is a neat place, situated in a charming valley, through which flows the river Moselle. It is fortified, and contains four churches, 925 houses, and 6680 inhabitants, who carry on the trades of spinning cotton by machinery, and of tanning leather. Long. 5. 57. 1. E. Lat. 48. 54. 19. N.

PONTARLIER, an arrondissement of the department of the Doubs, in France, extending over 531 square miles. It is divided into five cantons, and these into ninety communes, containing 43,100 inhabitants. The capital is the city of the same name, situated in a mountainous district on the banks of the river Doubs. It contains 640 houses, and 4100 inhabitants.

PONT AUDEMER, an arrondissement of the department of the Eure, in France. It is 390 square miles in extent, and comprehends eight cantons, divided into 143 communes, and has a population of 94,650 persons. The capital is a city of the same name, situated on the river Nille. It is surrounded with walls, stands in a fertile spot, and contains 1450 houses, with 5800 inhabitants, who are employed chiefly in making cotton goods. Long. 0. 31. E. Lat. 49. 22. N.

PONT DE BAUX, a city of France, in the department of the Ain, and arrondissement of Bourg. It is situated on the river Reyssouse, is well built, and contains a hospital, a fine corn-hall, 320 houses, and 3050 inhabitants, who carry on a brisk trade in hemp, flax, corn, and wine, by means of the canal, which leads to the Soane. Long. 4. 47. E. Lat. 46. 25. N.

PONTE-CORVO, a city of Italy, in the papal territory, and province of Frosinone, the see of a bishop, and situated on the banks of the river Garigliano. It contains six churches, and, including a small district, 5600 inhabitants. Bonaparte created Bernadotte prince of Ponte-Corvo.

PONTEFRACT, a market and borough town of the west riding of Yorkshire, in the wapentake of Osgoldcross, and 178 miles from London. It is a corporate town, now governed by a mayor, a recorder, four aldermen, and twelve councillors, and it returns two members to the House of Commons. The soil around it is remarkably fertile, and produces abundance of liquorice-roots, from the juice of which the medicine called pomfret-cakes is made. There are still to be seen ruins of an ancient castle, which is remarkable for the bloody tragedies exhibited within its walls. There Thomas earl of Lancaster was beheaded by Edward II. after the battle of Borough Bridge; Richard II. was long confined in it as a prisoner, and is said to have been murdered there; and the Earl of Rivers and Sir Richard Grey were executed there by order of King Richard III. During the civil wars it was held and ably defended by the party of Charles I., but ultimately taken, and soon afterwards demolished. It is now a well-built town, with a fine market-place and elegant market-cross. The church is a large building. The population of the town amounted in 1801 to 3097, in 1811 to 3605, in 1821 to 4447, and in 1831 to 4832; but the parish, containing five other townships, contained at the last census 9254 inhabitants.

PONTEVICO, a city of Austrian Italy, in the delegation of Brescia, and province of Milan. It is situated on the river Oglio, at the place where the Strone falls into it. It is fortified, and has a castle near it. The inhabitants amount to 5268.

PONTIANA, a Dutch settlement, on a river of the same name, on the western coast of the island of Borneo. It carries on a considerable trade. The imports are piece-goods and opium; the exports diamonds, gold-dust, pepper, and birds' nests. It is situated upon a fine navigable river, nearly under the equator. Long. 109. 30. E. Lat. 3. S.

PONTIFEX, Pontiff, or *High Priest*, a person who has the superintendence and direction of divine worship, as the offering of sacrifices and the celebration of other religious solemnities. The Romans had a college of pontiffs, over which was a sovereign pontiff, or *pontifex maximus*, instituted by Numa, whose function it was to prescribe the ceremonies with which each god was to be worshipped, compose the rituals, direct the vestals, and perform the business of augury, until, on some superstitious occasion, he was prohibited intermeddling therewith. The office of the college of pontiffs was to assist the high priest in giving judgment in all causes relating to religion, inquiring into the lives and manners of the inferior priests, and punishing them if they saw occasion to do so. The Jews, too, had their pontiffs; and amongst the Catholics the pope is styled the *sovereign pontiff*.

PONTIFICATE is used to signify the state or dignity of a pontiff or high priest; but by modern writers it is chiefly applied to the reign of a pope.

PONTIVY, an arrondissement of the department of Morbihan, in France, extending over 632 square miles. It is divided into seven cantons and forty-six communes, and has a population of 90,600 persons. The capital is the city of the same name, situated on the river Blavet, and contains 5100 inhabitants, whose chief trade consists in corn.

PONT L'EVEQUE, an arrondissement of the department of Calvados, in France, extending over 301 square miles, containing five cantons and 135 communes, with 64,350 inhabitants. The capital, a city of the same name, is situated on the river Touques, has a good trade, and contains 510 houses, with 2520 inhabitants. Long. 0. 3. E. Lat. 49. 17. N.

PONTOISE, an arrondissement of the department of the Seine and Oise, in France, extending over 478 square miles, divided into seven cantons and 175 communes, with 87,500 inhabitants. The capital is the city of the same name, situated at the junction of the river Biorne with the Oise. It contains 800 houses, and 5400 inhabitants. The church of St Martin's, a fine Gothic structure, forms its most distinguished ornament. It is celebrated for its veal, which is sent to Paris. Long. 12. 1. E. Lat. 49. 3. N.

PONTOON, in *War*, a kind of flat-bottomed boat, the body of which is composed of wood lined without and within with tin. Pontoons serve for the construction of bridges over rivers, to facilitate military operations. The French pontoons, and those of most other powers, are made of copper on the outside; and though these cost more at first, yet they last much longer than those of tin, and, when worn out, the copper sells nearly for as much as it originally cost; whereas when ours are rendered useless, they sell for nothing. Our pontoons are twenty-one feet in length, five feet in breadth, and in depth within two feet 1·5 inches.

PONTOON-*Carriage* is made with two wheels only, and two long side pieces, the fore ends of which are supported by a limber; and it serves to carry the pontoon, boards, cross-timbers, anchors, and every other thing necessary for making a bridge.

PONTOON-*Bridge* consists of pontoons slipped into the water, and placed about five or six feet asunder, each fastened with an anchor when the river has a strong current; or to a strong rope that goes across the river, running through the rings of the pontoons. Each boat has an anchor, cable-baulks, and chests. The baulks are about five or six inches square, and twenty-one feet in length. The chests are boards joined together by wooden bars, about three feet in breadth and twelve feet in length. The baulks are laid across the pontoons at some distance from one another, and the chests upon them are joined close; which in a very short time makes a bridge capable of supporting any weight.

Etymology of the name.

PONTUS, the name of an ancient kingdom of Asia, originally a part of Cappadocia, and which was bounded on the east by Colchis, on the west by the river Halys, on the north by the Euxine Sea, and on the south by Armenia Minor. Some derive the name of Pontus from the neighbouring sea, commonly called by the ancients *Pontus Euxinus*, and others from an early king named Pontus, who imparted his name both to the country and the sea; whilst Bochart deduces it from the Phœnician word *botno*, signifying a filbert, as if that nut had abounded in the country. But this derivation seems to be very far-fetched; and the common opinion that the country derived its name from the sea seems by far the most probable. The kingdom was divided into three parts; the first named *Pontus Galaticus*, extending from the river Halys to the Thermodon; the second, named *Pontus Polemonaicus*, extended from the Thermodon to the borders of *Pontus Cappadocicus;* and this last, extending from Pontus Polemonaicus to Colchis, had Armenia Minor and the upper stream of the Euphrates for its southern boundary.

Artabazes.

It is commonly believed that the original inhabitants of Pontus were descended from Tubal. In process of time, however, they mixed with Cappadocians, Paphlagonians, and other foreign nations, besides many Greek colonies which settled in those parts, and maintained their liberty till the time of Mithridates the Great and Pharnaces. The first king of this country whom we find mentioned in history is Artabazes, who had the crown bestowed on him by Darius Hystaspes.[1] The next was Rhodobates, who reigned in the time of Darius Nothus. After him came Mithridates, who, having refused to pay the usual tribute to the Persians, was defeated by Artaxerxes Mnemon; but a peace was soon afterwards concluded by the mediation of Tissaphernes. Besides this, we hear nothing farther of him, except that he was treacherously taken prisoner by Clearchus, afterwards tyrant of Heraclea, and obliged to pay a large sum for his ransom.

Mithridates I.

Mithridates I. was succeeded by Ariobarzanes, who being appointed by Artaxerxes governor of Lydia, Ionia, and Phrygia, employed the forces that were under his care in extending his own dominions, and subduing those of his natural prince. The king of Persia sent against him Autophrodates; but Ariobarzanes, having prevailed on Agesilaus, and Timothæus the Athenian, to come to his assistance, obliged Autophrodates to retire. He then rewarded Agesilaus with a large sum of money, and bestowed on Timothæus the cities of Sestos and Abydos, which he had lately taken from the Persians. He used his utmost endeavours to reconcile the Lacedæmonians and Thebans; but not being able to bring the latter to any reasonable terms, he assisted the Lacedæmonians with large sums of money. The Athenians showed so much respect for this prince, that they not only made him free of their city, but granted both to him and to his children whatever they asked. He was murdered in the twenty-eighth year of his reign, by one Mithridates, whom authors suppose to have been his son. This happened at the time when Alexander the Great invaded Asia, so that Pontus for a time fell under the power of the Macedonians.

Mithridates II.

In the reign of Antigonus, Mithridates the son of Ariobarzanes shook off the Macedonian yoke. Antigonus having dreamed that he had a field in which gold grew after the manner of corn, and that Mithridates cut it down and carried it into Pontus, began to be very suspicious of his designs, and ordered him to be put to death privately. But Mithridates, having got notice of the king's intention, withdrew into Paphlagonia, attended only by six horsemen. Here, being joined by many others, he possessed himself of Ciniatum, a stronghold situated near Mount Olgasys, whence, as his army continually increased, he made an irruption into Cappadocia; and having driven the commanders of Antigonus from that part which borders upon Pontus, he entered his paternal kingdom, which, in spite of the utmost efforts of Antigonus, he kept possession of for the space of twenty-six years, and transmitted to his posterity.

Under the reigns of Mithridates III. Ariobarzanes II. and Mithridates IV. the immediate successors of Mithridates II., nothing remarkable occurred. But Mithridates V. made war upon the inhabitants of Sinope, a city on the coast of Paphlagonia. He made himself master of all the adjacent places; but finding the whole peninsula on which Sinope itself stood well fortified and garrisoned, not only by the inhabitants, but also by their allies the Rhodians, he abandoned the enterprise. This prince afterwards proved a great friend of the Rhodians, and assisted them with money to repair the losses which they had sustained by an earthquake. He also entered into a strict alliance with Antiochus the Great, who married one of his daughters, named Laodice.

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[1] This country, together with the adjacent provinces, was at different periods under the dominion of the Assyrians, Medes, and Persians; the last of whom divided Cappadocia into satrapies or governments, and bestowed that division which was afterwards called Pontus on one of the ancestors of Mithridates. This regulation was effected in the reign of Darius the son of Hystaspes, and has been regarded as the date of the kingdom.

Pharnaces I.

After the death of Mithridates V., his son Pharnaces I., having attacked the city of Sinope, unexpectedly took it by storm. On this the Rhodians sent ambassadors to Rome, complaining of the behaviour of the king of Pontus; but Pharnaces was so far from being intimidated by their threats, that he invaded the territories of Eumenes, their great ally. The latter sent ambassadors to Rome, and entered into an alliance with Ariarathes king of Cappadocia; Pharnaces, in his turn, also sent ambassadors to Rome, complaining of Eumenes and Ariarathes; and their representations being at variance, some Romans were sent into Asia to inquire into the state of matters. These envoys found Eumenes and his associates willing to accommodate the difference, but Pharnaces in a quite opposite disposition, which they accordingly reported at Rome.

In the mean time a war was commenced between Eumenes and Pharnaces; but the latter, being disappointed of assistance from Seleucus king of Syria, whom the Romans would not permit to join him, was at last forced to sue for peace, which was granted him upon certain conditions. It was stipulated that he should forthwith withdraw his forces from Galatia, and disannul all engagements and alliances with the inhabitants of that country; that he should in like manner evacuate Paphlagonia, and send back such as he had from thence carried into slavery; that he should restore to Ariarathes all the places which he had taken during the war, the hostages of both kings, all their prisoners without ransom, and moreover deliver up to them such of their subjects as from the breaking out of the war had fled to him; that he should restore to Morzias, a petty king in these parts, and to Ariarathes, nine hundred talents which he had seized in the war, and pay down three hundred more to Eumenes as a fine for invading his dominions without provocation. Mithridates, king of Armenia, having in this war joined Pharnaces, was, by the articles of the treaty, obliged to pay three hundred talents to Ariarathes for having assisted his enemy, contrary to an alliance at that time subsisting between them. Soon afterwards Pharnaces died, and left the kingdom to his son Mithridates VI. more weakened by this peace than by the most destructive war. The new king entered into an alliance with the Romans, and proved such a faithful friend that he was rewarded by the senate with Phrygia Major, and honoured with the title of the friend and ally of the people of Rome. After a long and prosperous reign, he was murdered by some of his intimate acquaintance, and was succeeded by his son Mithridates VII. surnamed the Great.

Mithridates the Great.

The new prince, though not exceeding thirteen years of age, began his reign with most inhuman acts of cruelty to his mother and nearest relations. His father, by his last will, had appointed him and his mother joint heirs to the kingdom; but he, claiming the whole, threw her into prison, where she soon died in consequence of the hard usage she had met with. Those to whom the care of his education was committed, observing him to be of a cruel and unruly temper, made various attempts on his life; but could never effect their design, as the king was always on his guard, and armed against all kinds of treachery, without showing the least diffidence.

His extraordinary qualities.

In his youth Mithridates took care to inure himself to hardships, passing whole months in the open air, employed in the exercise of hunting, and often taking his rest amidst the frozen snow. When he came of age, he married his sister named Laodice, by whom he had a son named Pharnaces. After this he took a journey through many different kingdoms of Asia, having nothing less in view than the whole continent. He learned their different languages, of which he is said to have spoken twenty-two; took an estimate of their strength; and, above all, viewed narrowly their strongholds and fortified towns. In this journey he spent three years, during which time, a report being spread abroad that he was dead, his wife Laodice had criminal conversation with one of the lords of her court, by whom she had a son. When her husband returned, she presented him with a poisoned bowl; but Mithridates had accustomed himself to take poison from his infancy, so that it had now no other effect than to hasten the destruction of his wife, which soon afterwards took place, together with all those who had been in any way accessory to her disloyalty and incontinence.

His exploits.

The king now began to carry into effect his schemes of conquest. Nothing could be more unwise than to attack those nations which were immediately under the protection of Rome, and thus provoke that powerful people to fall upon him. Beginning with Paphlagonia, which the Romans had declared a free state, he easily reduced this country, which he divided between himself and Nicomedes king of Bithynia, at that time his ally. The Romans remonstrated; but Mithridates, instead of paying any regard to their remonstrances, invaded Galatia, which was immediately under their protection. This he also reduced, and then turned his eyes to Cappadocia. But as the kingdom of Cappadocia was at that time held by Ariarathes, who was a great favourite of the Romans, and married to the sister of Mithridates, the latter hired an assassin to despatch his brother-in-law, after which he thought he might succeed better in his designs. After the death of Ariarathes, Cappadocia was invaded by Nicomedes king of Bithynia, who drove out the son, and married the widow of Ariarathes. This gave Mithridates a plausible pretence for invading Cappadocia, and driving Nicomedes out of that country. Thus he gained considerable reputation, not only as a warrior, but as a just and good-natured prince; for as it was not known that he had had any hand in the murder of Ariarathes, every one conceived that he had undertaken the war against Nicomedes merely to revenge the quarrel of his nephew, and to restore him to his rights. To keep up the farce a little longer, Mithridates actually withdrew his troops from the country, and left the young prince master of the kingdom. In a short time, however, he began to press the young king of Cappadocia to recall the assassin Gordius, who had murdered his father. But this the king of Cappadocia indignantly refused; and Mithridates, being determined on a quarrel at all events, took the field with an army of eighty thousand foot, ten thousand horse, and six hundred chariots armed with scythes.

Assassination of his own nephew.

With this force he imagined he should carry all before him; but finding the king of Cappadocia ready to oppose him with an army not inferior to his own, he had recourse to treachery; and, inviting his nephew to a conference, stabbed him, in the sight of both armies, with a dagger which he had concealed in the folds of his garment. This barbarous and unexpected piece of treachery had such an effect on the Cappadocians that they threw down their arms, and suffered Mithridates, without opposition, to seize upon all their strongholds. The latter, however, resigned the kingdom to his son, a child of eight years of age, and committed to Gordius the care of the young prince and of the whole kingdom; but the Cappadocians, disdaining to be ruled by an assassin, placed on the throne the brother of Ariarathes, who had kept himself concealed in some part of Asia. His reign, however, was of short duration; for being soon afterwards driven out by Mithridates, the Cappadocians were again reduced. The unhappy prince died of grief; and in him ended the family of Pharnaces, who had ruled Cappadocia from the time of Cyrus the Great.

Nicomedes, king of Bithynia, afraid of Mithridates, and supposing that his own dominions would next fall a prey to the ambitious conqueror, suborned a youth of a comely and

Attempt of Nicomedes king of Bithynia to deceive the Romans.

majestic aspect to pretend that he was a third son of Ariarathes, to repair to Rome, and to demand the kingdom of Cappadocia as his just right. He was received by the senate with the greatest kindness; and Laodice, the wife of Nicomedes, confirmed the deceit by her oath. But in the mean time Mithridates, having obtained intelligence of the plot, sent notice of it to the Romans by Gordius, so that the imposture soon became known at Rome. The consequence was, that the senate commanded Mithridates to relinquish Cappadocia, and enjoined Nicomedes to give up that part of Paphlagonia which he possessed, declaring both these countries free. The Cappadocians protested that they could not live without a king, and were allowed to choose one of their own nation. Mithridates used all his interest in favour of Gordius; but the latter being excluded by the Romans, one named Ariobarzanes was chosen by a majority of votes.

Ariobarzanes.

To enforce this election, Sylla was sent into Cappadocia. He had the character of ambassador, but the real intention of his embassy was to disappoint the ambitious designs of Mithridates. With a handful of forces he defeated a numerous army of Cappadocians and Armenians commanded by Gordius, and settled Ariobarzanes on the throne. But no sooner was Sylla gone than Mithridates stirred up Tigranes king of Armenia against Ariobarzanes, who, without making any resistance, fled to Rome, and Tigranes restored the kingdom to Ariarathes the son of Mithridates. At the same time died the king of Bithynia; and upon his death Mithridates immediately invaded that country, and drove out Nicomedes, the natural son of the deceased king. But the expelled prince fled to Rome, and being assisted by that powerful republic, the king of Pontus was soon obliged to abandon Bithynia and Cappadocia.

War of Mithridates with the Romans.

The Romans having now become exceedingly jealous of the power and ambition of Mithridates, resolved to humble him at any sacrifice. For this purpose they sent ambassadors to the kings of Bithynia and Cappadocia, desiring them to make inroads into the territories of Mithridates, and treat them as they pleased, at the same time assuring them of powerful assistance in case they should have occasion. Ariobarzanes could not by any means be induced to provoke so powerful a neighbour; but Nicomedes being induced to comply, partly by promises and partly by menaces, entered Pontus, where he laid waste whole provinces with fire and sword. Mithridates complained to the Roman legates; but they replied that he had himself been the aggressor, that Nicomedes had only paid him in his own coin, and that they would not allow him to hurt their friend and ally. Upon this Mithridates, having entered Cappadocia with a numerous army, put to flight the united forces of Ariobarzanes and Altinius the Roman legate, thus making himself once more master of that kingdom. In the mean time he sent ambassadors to Rome, complaining of the proceedings of Nicomedes. But his ambassadors met with a very indifferent reception, being enjoined to tell their master that he must either restore the kingdom of Cappadocia to Ariobarzanes, and make peace with Nicomedes, or be accounted an enemy of the Roman people. With this answer they were commanded to depart the city that very day, and told that no more ambassadors could be admitted till their commands were obeyed.

In the mean time both parties prepared for war. The Roman legates in Asia drew together all the forces they could muster in Bithynia; Cappadocia, Paphlagonia, and Galatia; and, being joined by Cassius, governor of Asia, took the field against Mithridates in the year 89 before Christ. They divided their army into several small bodies. Cassius encamped on the confines of Bithynia and Galatia; Manius Aquilius with his division possessed himself of the avenues leading from Pontus into Bithynia; Quintus Oppius secured the entrance into Cappadocia; and the admirals Minucius Rufus and C. Popilius lay with a fleet of three hundred sail at Byzantium, to prevent the enemy from entering the Euxine Sea. Each of the generals had under his command an army of forty thousand men, besides a body of fifty thousand foot and six thousand horse brought to their assistance by Nicomedes.

On the other hand, Mithridates having invited several of the neighbouring nations to join him, collected an army of two hundred and fifty thousand foot, fifty thousand horse, and a hundred and thirty chariots armed with scythes, besides three hundred ships and a hundred galleys. Part of this force he detached against Nicomedes, and utterly defeated him, though much superior in number, whilst obeying the order of Cassius in taking possession of an advantageous post. Another part he detached against Manius Aquilius, whom he also defeated with the loss of ten thousand killed on the spot, and three thousand taken prisoners. On this the other Roman generals abandoned their posts, the fleet also dispersed, and most of the ships were either taken or sunk by the admirals of Mithridates.

The king of Pontus having now resolved to improve the opportunity for driving the Romans entirely out of Asia, overran all Phrygia, Mysia, Asia Proper, Caria, Lycia, Pamphylia, Paphlagonia, and Bithynia, with the rest of the countries which had either belonged to or sided with the Romans, as far as Ionia. He was everywhere received with the greatest demonstrations of joy; the inhabitants flocking to him in white garments, and calling him their father, deliverer, and sole lord of all Asia. What gained him the affections of the people was his kind usage of the prisoners he had taken in the two engagements above mentioned, whom he not only sent home without ransom, but furnished with provisions and money sufficient to defray their expenses by the way. Ambassadors flocked to him from all parts, and amongst these some came from Laodicea on the Lycus, to which the king had promised his protection, provided the people delivered up to him Q. Oppius, governor of Pamphylia, who had fled thither for protection. This request was readily complied with; and Oppius was sent to him in chains, with lictors walking before him in derision of the Roman pride and ostentation. Mithridates was overjoyed to see a Roman general and proconsul in his power; and his joy was soon afterwards increased by the arrival of Manius Aquilius, whom the Lesbians, having revolted against the Romans, sent to him in fetters, together with many other Romans of distinction who had taken shelter amongst them. As Aquilius had been the chief author of the war, Mithridates led him about with him wherever he went, either bound on an ass, or on foot coupled with Bastarnes, a public malefactor, compelling him to proclaim to the crowds who came to see him, that he was Manius Aquilius the Roman legate. When he arrived at Pergamus, he caused Aquilius to be first publicly whipped, then to be put on the rack, and lastly he ordered molten gold to be poured down his throat.

Cruel massacre of the Romans in Asia.

Mithridates being now looked upon as invincible, all the free cities of Asia received him as their sovereign, contributing large sums towards defraying the expenses of the war, by which means he became possessed of treasures which enabled him to keep for years several armies in the field, without levying any taxes upon his subjects. As many Roman citizens were dispersed in the provinces which Mithridates had subdued, he considered these as so many spies, who would not fail to send an account of his proceedings to Rome. For this reason he resolved to cut them off at once by a general massacre; a barbarous policy, which, it is said, had never been heard of till his time, but has since been practised by other nations. He despatched private letters to all the governors and magistrates of the cities where the Romans resided, enjoining them, on pain of death, and the entire destruction of their country, to cause the whole Italian race, women and children not excepted, to be murdered on the thirtieth day from the date of his letters, and to let their bodies remain unburied in the open fields. One moiety of their goods was to be forfeited to the king, and the other bestowed as a reward on the assassins. Whatever slave murdered his master was to receive his liberty, and one half of the debt was to be remitted to the debtor who should kill his creditor. Whoever concealed an Italian, under any pretence whatever, was to be punished with immediate death. On the fatal day, all the gates of the cities being shut, and the avenues guarded by soldiers, the king's orders were proclaimed; which caused an universal horror, not only amongst the unhappy victims themselves, but amongst those who had any feelings of humanity, at seeing themselves obliged either to betray and murder their innocent guests, friends, and relations, or to become liable to a cruel death. However, as most of the Asiatics bore a mortal hatred of the Romans, and were besides animated by the promise of an ample reward, the orders were without delay put into execution. The inhabitants of Ephesus, where Mithridates then resided, dragged such as had taken sanctuary in the temple of Diana from the very statue of the goddess, and put them to the sword. The Pergamenians discharged showers of darts upon them as they embraced the statues in the temple of Æsculapius. At Adramyttium, in Mysia, many were murdered in the water, whilst they were attempting to swim across to the island of Lesbos with their children on their backs. The Caunians, who not long before had been delivered from the yoke of the Rhodians, and restored to their ancient privileges, excelled all others in cruelty. As if they had apostatized from human nature, they took pleasure in tormenting and butchering the innocent children before their mothers' eyes; some of them running distracted, and others dying with grief at a sight which nature could not endure. The Trallians were the only people on the continent who had not the cruelty to imbrue their hands in the blood of the innocent Italians. However, as the king's orders were peremptory, they hired one Theophilus, a Paphlagonian, to despatch the few Romans who lived amongst them; and he, having shut them all up together in the temple of Concord, first cut off their hands as they embraced the statues of the gods, and then hacked them in pieces. Many Romans were saved on the floating islands of Lydia, called *Calaminæ,* where they concealed themselves till such time as they found an opportunity of escaping out of Asia. According to Plutarch and Dion, a hundred and fifty thousand Roman citizens were nevertheless massacred upon that day; but, according to others, only eighty thousand.

Reduction of the island of Cos.

Mithridates having now got rid of those whom he was in dread of on the continent, embarked great part of his forces in order to reduce the islands of the Archipelago. At Cos he was gladly received, and had delivered up to him the young Alexander, son of Alexander king of Egypt, who being driven out of that country, was killed by Charcas, a sea-captain, as he was retiring in a small vessel to Cyprus. With the young prince, they put into the king's hands vast sums of money, besides all the golden vessels and jewels, to an immense value, which his grandmother Cleopatra had for years been amassing. To the young prince Mithridates gave an education suitable for a king's son, but kept the treasures to himself. Here likewise he found eight hundred talents in ready money, which, at the first breaking out of the war, had been deposited by the Jews of Asia, and were designed for the temple of Jerusalem.

Failure of his attempt upon Rhodes.

From Cos Mithridates steered his course for Rhodes, where at that time all the Romans who had escaped the massacre above mentioned found a sanctuary, and, amongst others, L. Cassius the proconsul. The Rhodians, however, being very expert in maritime affairs, Mithridates did not think proper to venture an engagement. As the enemy's fleet advanced, therefore, he retired; but six of the Rhodian ships coming up with twenty-five of his, a sharp action ensued, in which the Rhodians sunk two of the king's ships, and put the rest to flight. In this encounter, though Mithridates had never seen a sea-fight before, he behaved with great intrepidity; but one of the ships of his own squadron falling foul of that which carried him, he was very near being taken prisoner. From this time he abhorred the sea, and took an aversion to the Chians, because the pilot of the ship was a Chian. However, he again appeared before the island; but was forced anew to leave it with disgrace, and to abandon all thoughts of reducing it.

Greece reduced by his generals.

Mithridates now retired into Asia with a design to settle the civil government of the countries which he had conquered, committing the care of the war to his generals. Archelaus, his generalissimo, was sent into Greece with an army of a hundred and twenty thousand men; where, by treachery, he made himself master of Athens, and either put to the sword or sent to Mithridates all those who favoured or were suspected of favouring the Romans. From Athens he despatched parties to reduce the neighbouring castles and the island of Delos, which they accordingly effected; but Orobius, a Roman general, hearing that the enemy kept no guards, and passed their time in carousing and debauchery, fell upon them unexpectedly, and cut off the whole party, except Apellicon the commander.

In the mean time Metrophanes, another of the king's generals, entering Eubœa, laid waste the whole country, directing his rage chiefly against the cities of Demetrias and Magnesia, which refused to open their gates to him. But as he was sailing off with a great booty, Bryttius, the prætor or governor of Macedonia, having come up with him, sunk some of his ships, and took others, putting all the prisoners to the sword. Upon the news of this loss, Mithridates sent his son Ariarathes with a powerful army to invade Macedonia, which he soon reduced, together with the kingdom of Thrace, driving the Romans everywhere before him. The generals whom he sent into other quarters were not less successful; so that Mithridates had, according to Aulus Gellius, twenty-five different nations who paid him homage. The same author adds, that he was skilled in every one of their various languages, and could converse with the natives without an interpreter. Amongst these nations we find the Rhoxani, now the Russians or Muscovites, whom Diophantes, one of the king's generals, brought under subjection, after having slain in an engagement some fifty thousand of the barbarians.

Sylla sent against Mithridates.

During all this time the Romans had been too much occupied with their own domestic quarrels to take such effectual measures as they otherwise would have done for checking the progress of Mithridates. But at last, having received certain advice that the king designed to invade Italy, and that he had even been solicited to do so by some of the revolted Italians, they sent against him Lucius Sylla, who had already given sufficient proofs of his courage, conduct, and experience in war. Sylla had with him only five legions and a few cohorts. But with this inconsiderable force he landed in Attica, and in a short time made himself master of the capital; Archelaus not daring, or, according to others, not caring, to engage him. As Sylla had but a few frigates, he sent Lucullus to the island of Rhodes, with orders to the Rhodians to join him with their fleet. The undertaking was very dangerous, as the king's fleet in a manner covered the sea. However, Lucullus, despising all danger, ventured out, and sailed, without meeting with any accident, to Syria, Egypt, Libya, and Cyprus; whence he returned with such supplies of ships and experienced mariners, as enabled Sylla, after their junction with the Rhodians, to act offensively by sea as well as by land. Archelaus now despatched messengers to Taxiles, who commanded in Thrace and Macedonia, desiring him to join with all his forces; and

Taxiles having obeyed, they mustered an army of a hundred and twenty thousand men. Sylla met them near Cheronæa with only fifteen thousand foot and fifteen hundred horse; but gave them a dreadful overthrow, no fewer than a hundred and ten thousand of the Asiatics having fallen in battle, whilst the Romans lost only a few men.

Victories of Sylla.

This success having excited envy and jealousy against Sylla in Rome, the senate sent Lucius Valerius Flaccus, the consul of that year, with two legions, into Asia; apparently to attack Mithridates on that side, but in reality with private instructions to fall upon Sylla himself, if they found him disaffected to the senate. But as Flaccus was a man of no experience in war, C. Fimbria, a senator of great repute amongst the soldiery, was appointed to attend him in the character of legate and lieutenant-general. Sylla was at that time in Bœotia; but, hearing what had occurred at Rome, he marched with all expedition into Thessaly, designing to encounter Flaccus, who, he expected, was to land in that province. But no sooner had he left Bœotia, than the country was overrun by an army of Asiatics, under command of Dorylaus, the chief favourite of the king. On learning this, Sylla returned into Bœotia, where he gained two signal victories, which put an end to the war in Greece. In the first of these Dorylaus lost a hundred and fifty thousand men according to some authors, or two hundred thousand according to others; and in the next all the remainder. In this last engagement twenty thousand were driven into a river, where they perished to a man; an equal number were pursued into a marsh, and entirely cut off; and the remainder were killed in the heat of the battle, the Romans giving no quarter to men who had treated their fellow-citizens in such a cruel and barbarous manner in Asia. Plutarch tells us, that the marshes were dyed with blood; that the course of the river was stopped by the dead bodies; and that even in his time, that is, near two hundred years afterwards, a great number of bows, helmets, coats of mail, and swords, were found buried in the mud. Archelaus, who had joined Dorylaus with a body of ten thousand men a few days before the battle, lay three days stripped amongst the slain, until he found a small vessel which carried him to Eubœa, where he collected what forces he could, but was never again able to take the field. Indeed Livy tells us, that Archelaus betrayed the king's cause; and Aurelius Victor says that the king's fleet was intercepted by Sylla through the treachery of Archelaus. That there was a good understanding between the two commanders, says the latter, was plain from Sylla's bestowing upon Archelaus ten thousand acres of land near the city of Chalcis in Eubœa. Strabo also informs us, that Archelaus was afterwards greatly esteemed and caressed by Sylla and the senate; but Sylla himself in his Commentaries, and Dio Cassius, endeavour to clear Archelaus from all suspicion of treachery.

Flaccus put to death by Fimbria.

In the mean time, Sylla having given up Bœotia to be plundered by his soldiers, marched into Thessaly, where he took up his winter-quarters, and caused his old ships to be refitted and several new ones built, in order to pass over into Asia in the beginning of the spring, that he might drive from thence not only Mithridates, but also his rival Flaccus, whom the senate, out of opposition to him, had appointed governor of that province. But before he arrived, some differences having arisen between Flaccus and Fimbria, the latter was deprived of his command by the consul. Upon this Fimbria, having gained over the soldiery, made war upon the consul, took him prisoner, put him to death, and assumed the command of all the Roman forces in Asia. In this situation he behaved with the greatest cruelty, insomuch that his name became more odious than even that of Mithridates himself. This hatred the king of Pontus endeavoured to improve to his own advantage; and therefore he commanded his son, also called Mithridates, to join Taxiles, Diophantes, and Menander, three of his most experienced commanders, and to return at the head of a numerous army into Asia; not doubting that the inhabitants, thus harassed by Fimbria, would shake off the Roman yoke when they saw such a powerful army in the field ready to protect them. But Fimbria, distrusting the Asiatics, marched out to meet the enemy, and offered them battle before they entered the province. As the king's army was greatly superior to the Romans in number, the latter suffered severely in the engagement, but held out until night put an end to the contest, when they withdrew to the opposite side of a river, which was at a small distance from the field of battle. Here they designed to intrench themselves; but a violent storm having in the mean time arisen, Fimbria laid hold of that opportunity to repass the river and surprise the enemy, of whom he made such havock, that only the commanders and some few troops of horse escaped. Amongst these was the king's son, who, attended by a few horsemen, got safe to Pergamus, where his father resided. But Fimbria, pursuing him day and night without intermission, entered Pergamus sword in hand; and, hearing that both Mithridates and his son had fled from thence a few hours before, continued his pursuit, and would have taken the king himself, had he not entered Pitane with a considerable body of horse. The place was closely invested by Fimbria; but as he had not ships to blockade it by sea, he sent a messenger to Lucullus, who commanded the Roman navy in Asia, entreating him, as he tendered the welfare of the republic, to make what haste he could to Pitane, and assist him in taking the most inveterate enemy of Rome. But Lucullus, preferring the gratification of a private pique to the good of his country, refused to put to sea; and thus allowed the fleet of Mithridates to carry him in safety to Mitylene.

Peace concluded.

Soon after the king's departure, Fimbria took Pitane by storm, and reduced most of the cities of Asia, particularly Troy, which he also took by assault, putting most of the inhabitants to the sword, because they had sent an embassy to Sylla, offering to submit to him rather than to Fimbria. To add to the misfortunes of Mithridates, his fleet was entirely defeated in two engagements by Lucullus; so that he began to be weary of the war, and therefore desired Archelaus to conclude a peace, upon as honourable terms as he could. The king himself also had afterwards a conference with Sylla, and a peace was concluded in the year 85 before Christ. The terms were, that Mithridates should relinquish all his conquests, and content himself with his paternal dominions, which were confined within the limits of Pontus; that he should immediately resign Bithynia to Nicomedes, and Cappadocia to Ariobarzanes, and release without ransom all the prisoners he had taken during the war; that he should pay to the Romans two thousand, or, as others will have it, three thousand talents, and deliver up to Sylla eighty ships with all their arms and ammunition, besides five hundred archers; and, lastly, that he should not molest such cities or persons as had during the war revolted from him and sided with the Romans.

Sylla, having thus concluded the war with great glory to himself and equal advantage to the republic, turned his army against Fimbria; but the latter, finding himself in no condition to oppose his rival by force, had recourse to treachery, and attempted to get Sylla assassinated. The plot miscarried, however, and Fimbria put an end to his own life. Sylla, having now an uncontrolled power in Asia, declared the Chians, Rhodians, Lycians, Magnesians, and Trojans, free, and friends of the people of Rome, by way of reward for their having sided with the Romans; but on the other cities he imposed heavy fines, condemning them in one year to pay twenty thousand talents, and quartering his soldiers in the houses of those who had shown disaffection to the Romans. Each private man was to receive from his landlord sixteen drachms a day, and each officer fifty; and, besides, both were to be supplied with provisions, not only for themselves, but also for such of their friends as they thought proper to invite. By these impositions most of the people of Asia were reduced to beggary; especially the inhabitants of Ephesus, who, above all others, had shown hatred against the Romans. Having collected immense treasure, Sylla then set sail for Italy; leaving behind him Lucullus in the character of quæstor, and Muræna in that of prætor. The two legions which Fimbria had commanded were given to Muræna, because Sylla suspected them of an inclination to the faction of Marius, whose party he was going to crush at Rome.

The na-ions that ad revolt-d against Mithrida-es crushed y him.

In the mean time Mithridates had no sooner returned into Pontus, than he set about the reduction of those nations which had revolted against him during the war. He began with the Colchians, who immediately submitted, upon condition that Mithridates would give them his son for king. This was complied with; but the old king had thenceforward a jealousy of his son, whom, accordingly, he first imprisoned and then put to death. Soon after this, the king having made great preparations under pretence of reducing the Bosphori, a warlike nation who had revolted against him, the Romans began to be jealous; and their suspicion was further increased by Archelaus, who, having fled to them, assured them that the preparations of Mithridates were not at all designed against the Bosphori. On hearing this, Muræna invaded Pontus without any further provocation. The king reminded him of the articles of peace concluded with Sylla; but Muræna replied that he knew of no such articles; for Sylla had set down nothing in writing, but contented himself with the execution of what had been agreed upon. Having given this answer, the Roman general began to lay waste and plunder the country, without sparing even the treasures or temples consecrated to the gods. Having put all to fire and sword on the frontiers of Pontus towards Cappadocia, he passed the river Halys, and on that side possessed himself, without opposition, of four hundred villages; for Mithridates was unwilling to commit any hostilities before the return of an ambassador whom he had sent to Rome to complain of the conduct of Muræna. At length the ambassador returned, and along with him one Callidius, who, in a public assembly, commanded Muræna to forbear molesting a friend and ally of the Roman people; but afterwards, calling him aside, he had a private conference with him, in which it is supposed, as he brought no decree of the senate, that he encouraged him to pursue the war. Whatever there might be in this, however, it is certain that Muræna still continued to practise the same hostilities, and even made an attempt on Sinope, where the king resided and the royal treasures were deposited. But as the town was well fortified, he was forced to retire with some loss. In the mean time, Mithridates himself taking the field, appeared at the head of a powerful army, drove the Romans out of their camp, and forced them with great slaughter to save themselves by flying across the mountains into Phrygia. This sudden victory again induced many cities to join Mithridates, and gave him an opportunity of once more driving the Romans out of Cappadocia.

lithridates ngages in a ew war ith the omans.

In the mean time, Sylla, having been created dictator at Rome, sent a messenger to Muræna, charging him in his name not to molest Mithridates, whom he had honoured with the title of a friend and ally of Rome. Muræna did not think proper to disregard this message; and therefore immediately abandoned all the places he had seized, whilst Mithridates again renounced Cappadocia, giving his own son as an hostage of his fidelity. Being then at leisure to pursue his other plans, Mithridates fell upon the Bosphori; and, having soon subdued them, appointed Machares, one of his sons, king of the country. But leading his army from thence against the Achæans, a people bordering on the Colchians, and originally descended from the Greeks, who, returning from Troy, had mistaken their way into Greece, and settled there, he was defeated with the loss of three fourths of his men. On his return to Pontus, however, he recruited his army, and made vast preparations to invade them anew; but, in the mean time, hearing of Sylla's death, he came to the imprudent resolution of entering into a second war with the Romans. Having therefore induced his son-in-law, Tigranes, king of Armenia, to invade Cappadocia, he himself entered Paphlagonia at the head of a hundred and twenty thousand infantry disciplined after the Roman manner, sixteen thousand horse, and a hundred chariots armed with scythes. This country readily submitted, after which the king marched into Bithynia, which also submitted without opposition; and the province of Asia followed the example, for these countries, being oppressed with exorbitant taxes, looked upon him as their deliverer. In entering the cities of Asia, he caused M. Marius or Varius, whom Sertorius had sent him from Spain to discipline his troops, walk before him with the ensigns of consular dignity, as if he was the chief magistrate; the king following as one of his attendants. He made several cities free, but at the same time acquainted the inhabitants that they were indebted to Sertorius for their liberty; and thus, by the connivance of that general, many cities revolted from the Romans without knowing that they had done so. But in the mean time, Julius Cæsar, being at that time at Rhodes, whither he had gone to study oratory, and hearing what havock the king's officers had made in the adjacent countries, collected what troops he could, and falling unexpectedly upon them, expelled them from the province of Asia.

Lucullus and Cotta sent against him.

The Roman senate, now finding a war unavoidable, appointed Lucullus to conduct it. The other consul, Cotta, having solicited an employment in this war, was sent with a fleet to guard the Propontis and defend Bithynia. Lucullus having raised one legion in Italy, passed over with it into Asia, where he was joined by four others, two of which, as they had served under Fimbria, proved at first very mutinous and refractory; nor were the others much better disposed, having been immersed in, and demoralised by, Asiatic luxuries. The disciplining of these troops consumed a considerable time, which proved prejudicial to the Roman affairs; for almost all the Asiatics were ready to revolt, and Mithridates was making the greatest preparations. One of his armies was ordered to march into Cappadocia, under the command of Diophantes Matharus, in order to oppose Lucullus if he should attempt to enter Pontus on that side; another, commanded by Mithridates in person, consisted of one hundred and fifty thousand infantry, twelve thousand horse, and a hundred chariots armed with scythes; a third army, commanded by Marius and Eumachus, two generals of great experience in war, was encamped in the neighbourhood of Heraclea in Pontus.

Mithridates at first successful.

The beginning of the war proved favourable to Mithridates. Cotta, being desired by Lucullus to keep his fleet within the harbour, as being inferior to that of Mithridates, resolved to take the first opportunity of fighting the king by land, not doubting of an easy victory. Having for this purpose collected all the forces he could, Cotta despatched his lieutenant, P. Rutilius, with a considerable body, to observe the motions of the enemy. This commander being met by Marius and Eumachus, an engagement ensued, in which the Romans were defeated, and the greater part of them, with their commander, cut in pieces. The same misfortune befell several other officers of distinction sent to oppose Mithridates, who, elated with success, ordered his admiral to sail into the very harbour, and set fire to the Roman fleet. This was accordingly performed without the least opposition from Cotta; and sixty ships were taken, sunk, or burned, on that occasion.

His reverses.

These victories, having increased the rebellious disposition of the Asiatics, induced Lucullus to hasten his march, in order to stop the progress of the enemy. But finding the king's army much more numerous that he expected, he thought proper to decline an engagement. However, several skirmishes happened, in which the Romans had always so much the advantage, that they became impatient for a general engagement. But Lucullus did not at this time choose to run so great a risk; and therefore Mithridates, seeing that he could not force the Romans to a battle, decamped in the night-time, and by day-break reached Cyzicum, an important city, warmly attached to the Romans. Lucullus pursued him; and, falling on his rear, killed ten thousand, and took thirteen thousand prisoners. After this, the Roman general, by a manœuvre, gained an important pass, which enabled him to cut off all communication between the army of Mithridates and the neighbouring country. The king, seeing himself thus in danger of famine, redoubled his efforts to gain the city; but finding that he could not batter down the walls, he resolved to undermine them. In this also he was unsuccessful; the besieged sunk countermines, and had very nearly taken the king himself in one of his own mines. In the mean time, winter coming on, the army of Mithridates was so distressed for want of provisions, that many died of hunger, whilst the survivors were forced to feed on the flesh of their dead companions. The famine was followed by a plague, which destroyed such numbers that Mithridates was obliged to think of a retreat; and even this had become very dangerous. However, he laid hold of the opportunity when Lucullus proceeded to besiege a neighbouring castle, and sent off the greater part of his cavalry in the night, ordering them not to halt till they were out of the reach of the enemy. But Lucullus having got intelligence of their march, suddenly returned, and pursued them so closely that he came up with them as they were passing a river, took six hundred horse, all their beasts of burden, fifteen thousand men, and put the rest to the sword. On his return he fell in with Aristonicus, the king's admiral, whom he took, just as that commander was ready to sail with a large sum of money designed to bribe the Roman army. In the mean time, Mithridates, finding himself reduced to the last extremity, embarked in the night-time with the greater part of the forces, whilst Marius and Eumachus, with thirty thousand men, made the best of their way to Lampsacus. But being closely pursued by the Romans, they were overtaken at the river Æsopus, which at that time was not fordable, from having been swelled by heavy rains. Twenty thousand were killed on the spot; nor would a single man have escaped, had not the Asiatics scattered great quantities of gold and silver in the way, that the march of the Romans might be retarded by their stopping to gather it up. Lucullus on his return entered Cyzicum amidst the acclamations of the citizens, who afterwards instituted public sports in honour of him, which they called *Lucullea*. The city was declared free, and all the privileges, exemptions, and immunities, which were enjoyed by the inhabitants of Rome itself, were bestowed upon the citizens.

Great victory gained by Lucullus.

From Cyzicum, Lucullus marched along the coast of the Hellespont until he came to Troas, where he equipped his fleet, and put to sea in quest of Marius, Alexander, and Dionysius, three of the king's generals, who had a fleet of fifty ships, with ten thousand soldiers on board. Lucullus came up with them near the island of Lemnos, took thirty-two of their ships, and put a great number of their troops to the sword. The day after the engagement the three generals were discovered in a cave, where they had concealed themselves, and dragged from thence to Lucullus, who, after having severely upbraided Marius for fighting against his country, caused him to be put to death. Alexander and Dionysius were reserved for the triumph; but the latter poisoned himself to avoid that disgrace. Lucullus then steered his course for Bithynia, on receiving intelligence that Mithridates had appeared with his fleet upon those coasts. But the king having received notice of his approach, made what haste he could to gain Pontus, and arrived at Heraclea on board a pirate named Selemus, with whom he was obliged to trust himself, his fleet being dispersed by a violent storm, and the ship that carried him cast away.

Further successes of Lucullus.

In the meanwhile Mithridates was no less unfortunate by land than by sea. Triarius, one of the officers of Lucullus, reduced the cities of Apamea, Prusa, Prusias, and Nicæa, and marched thence with all expedition to Nicomedia, where the king himself was, and near which place Cotta lay encamped. But before the two armies could effect a junction, Mithridates escaped, first to Heraclea, which was betrayed to him, and then to Sinope. Nor did Lucullus himself remain all this time inactive. Having reduced all Paphlagonia and Bithynia, he marched into Cappadocia, and joined Cotta and Triarius at Nicomedia, with a design to invade Pontus; but hearing that Heraclea was in the hands of Mithridates, he despatched Cotta to reduce that city. Triarius was ordered to proceed with the fleet to the Hellespont and Propontis, to intercept the king's fleet, which was daily expected from Spain with supplies from Sertorius. Lucullus himself, with the main strength of the army, pursued his march into Pontus. His army was greatly harassed, especially in the narrow passes between Cappadocia and Pontus, by flying parties of the enemy. But the greatest inconvenience was the want of provisions, as the king's troops had laid waste all the country around; insomuch that Lucullus, having lost almost all his beasts of burden, was obliged to take along with the army thirty thousand Galatians, each of them carrying a sack of corn on his back. At last, however, he gained the plains of Pontus, where provisions were so plentiful that an ox was sold for a drachma, and everything else in proportion.

The Roman general having now carried the war into the enemy's country, divided his forces, and at the same time invested a very strong town named Amisus; another called Eupatoria, built by Mithridates, and made the place of his residence; and a third named Themiscyra, situated on the banks of the Thermodon. Eupatoria was soon taken, but Themiscyra made a vigorous resistance, and the townsmen galled the Romans to such a degree, that, not daring to approach the walls openly, they contented themselves with undermining them. But in this, too, they met with no small difficulty, for the enemy countermined, and often engaged them under ground, letting into the mines bears and other wild beasts, with swarms of bees, which obliged them to abandon their works. However, the town was at last obliged to surrender for want of provisions. As for Amisus, Lucullus himself sat down before it. But finding it strongly fortified, and garrisoned with the flower of the king's troops, the Roman general thought proper to reduce it by famine; and on this occasion his countrymen first complained of him as protracting the war for his own advantage.

Mutiny in the army of Mithridates, and flight of the king.

In the mean time, Mithridates having recruited his shattered army, advanced to Cabiræ, a city not far distant from Amisus; and Lucullus, leaving part of the army to continue the siege, marched at the head of the rest to oppose Mithridates. But the king having drawn his cavalry into a general engagement, defeated them with considerable loss, and drove them back to the mountains, through the passes of which Lucullus had lately marched to attack him. This check obliged the Roman general to retire to a rising ground near to the city of Cabiræ, where the enemy could not force him to an engagement. Here provisions beginning to grow scarce, Lucullus sent out strong parties from his army into Cappadocia, the only place whence he could receive supplies. One of these parties entirely defeated Taxiles and Diophantes, two of the king's generals, who had been stationed there to prevent Lucullus from having any communication with the country. The king, on receiving the news of this defeat, resolved to break up his camp and to retire, not doubting that Lucullus would attack him as soon as his forces returned. This resolution he no sooner imparted to his nobles, than they began privately to send away their most valuable property; and when it was discovered by the soldiers, they were so much displeased that they plundered their baggage, and put those who had the care of it to the sword. After this they betook themselves to flight, crowding out of the gates in the utmost confusion. The king hastened to stop their flight; but nobody showing him the least respect, he was carried away by the crowd, and in great danger of being trampled to death. Having with difficulty made his escape, he retired with a small retinue, first to Cabiræ, and then to his son-in-law Tigranes, king of Armenia. Lucullus despatched the best part of his cavalry in pursuit of the fugitives, whilst he himself, with the rest, invested the camp of Mithridates, where those only remained who could not fly with the rest. The camp was easily taken; but most of the soldiers made their escape, whilst the Romans, contrary to their general's orders, were busied in plundering. Lucullus then closely pursued the king, who, being overtaken by a company of Galatians, caused a mule loaded with part of his treasures to be driven in amongst them, by which means he made his escape, whilst they quarrelled about the booty. Mithridates, remembering in his flight that he had left his sisters, wives, and concubines at Pharnacia, despatched an eunuch named Bacchus or Bacchides with orders to put them all to death, lest they should fall into the hands of the enemy; and this cruel order was accordingly obeyed.

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After the flight of Mithridates, the Romans no longer met with any opposition; the king's governors flocking from all parts to place themselves under the protection of the conqueror. Amongst these were the grandfather of Strabo the geographer, whom the king had disobliged by putting to death his cousin-german Tibias, and his son Theophilus. He was a man of such credit, that no sooner had he abandoned the king's party, than fifteen other commanders delivered up to Lucullus the places with which they had been intrusted; and about the same time Triarius, falling in with the king's fleet near the island of Tenedos, obtained a complete victory, having either taken or sunk sixty of the enemy's ships.

During all this time Cotta had been employed without success in besieging Heraclea, which he could never have reduced without the assistance of Triarius. That commander, having defeated the fleet, reduced the town to such distress, that a third part of the garrison died of hunger; upon which the governor, Conacorix, privately agreed with Triarius to deliver up one of the gates to him. This was accordingly done; and the Romans entering, made a terrible slaughter of the helpless inhabitants. But in the mean time Cotta, provoked at seeing himself deprived both of all share of the booty and the honour of reducing a place which he had so long besieged, fell upon his countrymen as they were busied in plundering; a proceeding which would have occasioned a great deal of bloodshed, had not Triarius promised to divide the booty equally. Conacorix, to conceal his treachery, after marching out of Heraclea, seized on two forts belonging to the Romans; and Triarius being sent to recover them, Cotta, in his absence, plundered the city anew, rifled the temples which the other had spared, put all the citizens he could meet with to the sword, and having carried off everything valuable, at last set fire to the city in several places, by which means it was soon reduced to ashes. Cotta then, having no further occasion for his troops, dismissed the auxiliaries, resigned his legions to Lucullus, and put to sea himself in order to return to Rome. But he had scarcely got out of the harbour, when part of his ships, being overloaded with the spoils of the city, sunk; and the others, driven by a violent north wind, were dashed against the shore, which occasioned the loss of a great part of the booty. Upon his return to Rome, however, he was highly applauded by the senate, and honoured with the title of *Ponticus*.

Lucullus, having now reduced Pontus, marched against the Chaldæans, Tibarenians, and inhabitants of Armenia Minor, who voluntarily submitted to him, and put him in possession of all their strongholds. From Armenia he returned to Amisus, which still held out; Callimachus, governor of the place, having harassed the Romans to such a degree, by engines of his own contrivance, that they had given over their assaults, and contented themselves with blocking it up by land, though the garrison was at the same time plentifully supplied with provisions by sea. Lucullus, on his arrival, summoned the city to surrender, offering the inhabitants honourable terms; but these being refused, he made a general assault at the time when he knew that Callimachus used to draw off the greater part of his troops to give them some respite. The Romans applying their scaling ladders, got over the wall before Callimachus could come to the assistance of those whom he had left to guard it; however, by setting the city on fire, he found means in the confusion to make his escape. Lucullus commanded his men to use their utmost endeavours to save the city; but being intent only upon plundering, they regarded nothing except the furniture. At last the fire was extinguished by a violent shower; and Lucullus, having with difficulty restrained his soldiers from committing any further excesses, in some measure repaired the city before he left it, and suffered the inhabitants to enjoy their possessions in peace.

Nothing was now wanting but the captivity of Mithridates himself to put a final period to the war; and therefore Lucullus demanded him from his son-in-law Tigranes. But though that prince could not be prevailed on to see Mithridates on account of his misconduct, he could as little be induced to deliver him up to his enemies. After this refusal, however, he for the first time condescended to see his father-in-law, who had already resided for about a year and eight months in his dominions. In a private conference held by the two kings, it was agreed that Tigranes should march against the Romans, and Mithridates, with ten thousand cavalry, return into Pontus, where he should make what levies he could, and rejoin Tigranes, before Lucullus, who was then employed in the siege of Sinope, could enter Armenia. But Sinope having, in the mean time, surrendered, Lucullus marched with all possible expedition against Tigranes, and having drawn him into a general engagement, entirely defeated him.

Defeats of Tigranes and Mithridates.

Mithridates was marching to his assistance, when he met his son-in-law flying with a small retinue to shelter himself in some remote corner of the kingdom. He encouraged him to raise new forces, not doubting but that another campaign would repair all former losses, provided he would commit to his management everything relating to the war. To this Tigranes acceded, and as he thought his father-in-law more qualified to deal with the Romans than himself, orders were issued for raising a new army, whilst all the Armenians able to bear arms were summoned to meet at the place of the general rendezvous. Out of these Mithridates chose seventy thousand foot and thirty-five thousand horse; and having trained them during the winter, after the Roman discipline, in the beginning of the spring he left part of them with Tigranes, and marched himself with the rest into Pontus, where he recovered many important places, and overcame in a pitched battle M. Fabius, whom Lucullus had appointed governor of that province. Flushed with his success, as soon as the wounds he had received in the engagement suffered him to move, he pursued Fabius, and beseiged him in the city of Cabiræ, whither he had retired; but in the mean time Triarius, who was marching from Asia to join Lucullus, hearing of the distress of the Romans, hastened to their relief, and appearing unexpectedly on the neighbouring hill, struck such terror into the enemy, that they raised the siege, and made the best of their way into Cappadocia. Triarius pursued them, and got so near that the two armies were separated only by a river. Here he halted, with a design to pass the river after he had allowed his men some rest, for they were tired out with long marches. But Mithridates was beforehand with him, and crossing the river on a bridge, where he had placed a strong guard, attacked the Romans with great resolution before they had time to refresh themselves. The battle was bloody, and the event doubtful, till the bridge breaking down with the weight of the multitude that passed, the king's troops who had engaged, relying chiefly upon their numbers, began to lose courage, seeing they could receive no further assistance; and the Romans charging them with fresh vigour, they betook themselves to flight. After this engagement, as winter came on, both armies were glad to retire into winter quarters.

Defeat of Triarius.

During the winter, Mithridates raised new forces; and having received considerable supplies from Tigranes, took the field early in the spring, in hopes of driving the Romans quite out of Pontus, before Lucullus, who had work enough upon his hands in Armenia, could come to their assistance. With this view he marched straight against Triarius and Sornatius, to whom Lucullus had committed the care and defence of that province; and finding them encamped near the city of Gaziursa, he proffered them battle, which they declined. He then set a strong detachment to besiege a castle where the Romans had left all their baggage, hoping they would rather venture an engagement to relieve the place than lose all they had with so much toil and labour obtained during the war. Neither was he disappointed in his hopes; for though Triarius intended to keep close in his camp till the arrival of Lucullus, whom he daily expected, having acquainted him with the danger, the soldiers, hearing that the castle was besieged, declared in a tumultuous manner, that if he did not lead them they would march to the relief of the place without his permission. Triarius being thus forced by his own men to fight, drew out his forces against the king, whose army was three times his number; but whilst they were upon the point of engaging, both armies were forced, by a violent storm, to retire to their respective camps. Triarius having, however, that very day received intelligence of the approach of Lucullus, and fearing he would snatch the victory from his hands, resolved to make a bold push, and next morning by break of day to attack the king in his camp. If he conquered, the glory, he thought, would be entirely his own; if he were overcome, the enemy could reap no great advantage from his victory, Lucullus being at hand with a powerful army. The king was surprised, but putting himself at the head of a few troops of his guards, he sustained the shock of the Romans till the rest of his army came to his relief, and attacked the enemy with such fury, that the Roman infantry were forced to give way, and driven into a morass, where they were surrounded, and great numbers of them cut in pieces.

The cavalry were likewise put to flight, and pursued with great slaughter, till a Roman centurion in the king's service, pitying his countrymen, attempted to kill him. The king's life was saved by his breastplate; but as he received a deep wound in the thigh, he was obliged to discontinue the pursuit himself, and those who were about him caused the retreat to be sounded, which, as it was unexpected, occasioned great confusion in the army. The centurion was immediately cut in pieces; but the Roman horse, getting the start of the enemy, found means to make their escape. Above seven thousand of the Romans were killed in that battle; amongst whom were one hundred and fifty centurions and twenty-four tribunes, the greatest number of officers that had ever before fallen in any engagement. Mithridates being cured of his wound, in order that he might not in future be exposed to such dangers, caused the Romans who served in his army to be formed into one body, as if they were to be sent out on a party; and then ordered them to retire to their tents, where they were all to a man cut in pieces.

The king, however elated with success, yet would not engage Lucullus; but by long marches hastened into Armenia Minor, and encamped on a hill near the town of Talaura, expecting Tigranes, who was advancing with a strong army to join him. Lucullus, in pursuit of Mithridates, marched over the field of battle, leaving those unburied who had fallen in the engagement, which alienated the minds of the soldiery; and they began to be very mutinous, being stirred up by Appius Claudius, whom Lucullus had turned out of his command for his vile behaviour, notwithstanding he was a near connection, Lucullus having married his sister. The discontent that prevailed in the army rose to such a height that Lucullus was obliged to remain in his camp all that summer; the soldiers declaring, in a mutinous manner, that they would not follow him any longer, nor serve under a general who refused to share the booty with them.

Lucullus recalled.

These complaints, and the general discontent which reigned in the army, obliged the senate to recall Lucullus, and appoint Manius Acilius Glabrio, consul of that year, in his room. Glabrio, on arriving in Bithynia, gave notice by public criers to all the cities, that the senate had discharged Lucullus and his army, and confiscated his goods, for protracting the war and refusing to comply with their injunctions. Lucullus was accordingly abandoned by the greater part of his army, and forced to retire into Galatia, not being in a condition to make head against the joint forces of the two kings, who, laying hold of that opportunity, recovered the best part of Pontus, Bithynia, Cappadocia, and Armenia Minor. For although Glabrio had hastened into Pontus, as if he had intended to engage the enemy and rob Lucullus of the victory, yet, upon the first news of the approach of the two kings, he thought fit to retire and leave the country open on all sides to the enemy.

Pompey sent against Mithridates.

When this became known at Rome, a law was enacted there by C. Manilius, a tribune of the people, whereby the management of the war against Mithridates and Tigranes, and likewise the provinces of Cilicia, then under Quintus Marcius, and of Bithynia under Glabrio, were committed to Pompey. By the same law he was continued in that unlimited power by sea, with which he had been invested when he first set out against the pirates of Cilicia. In virtue of this law, Pompey, who had then just ended the war with the Cilician pirates, took upon him the command of the army, and directed the allies of the Roman people to join him with all possible expedition. But before he took the field, he renewed the alliance which Sylla and Lucullus had concluded with Phrahates king of Parthia; and then sent friendly proposals to Mithridates, who at first seemed inclined to give ear to them, and accordingly despatched an ambassador to the Roman army to treat of a peace. Pompey required of him, if he was in earnest, to lay down his arms, and deliver up to him all those who had revolted from the Romans during the war. This demand was no sooner reported abroad in the king's camp, than the deserters, who were very numerous in the king's army, betaking themselves to their arms, threatened to put Mithridates himself to death; and would have occasioned a great disturbance, had not the king appeased the growing tumult, by assuring them that he had sent ambassadors, not to treat of a peace, but only, under pretence of suing for peace, to take a near view of the enemy's strength. He moreover obliged himself, by a solemn oath, in presence of the whole army, never to enter into any treaty of friendship with the Romans, nor to deliver up to them such as had ever served under him.

Pompey finding his proposals rejected, advanced against the king with an army of thirty thousand foot and twenty

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thousand horse, as Plutarch writes, or thirty thousand, all chosen troops, as we read in Appian; for he discharged most of those who had served under Glabrio and Lucullus. As he entered Galatia, he was met by Lucullus, who endeavoured to persuade him to march back, the war being nearly finished, and even deputies sent by the republic to settle the province of Pontus; but not being able to prevail with him, after mutual complaints against each other, they parted; and Pompey removing his camp, commanded the troops that were with Lucullus to join him, except sixteen hundred, whom he left to attend Lucullus in his triumph. Lucullus then set out for Rome, where he was received by the senate with great marks of esteem, most men thinking him highly injured by the authors of the Manilian law. Pompey pursued his march into Pontus; but finding that he could not by any means induce the king to risk a battle, he marched back into Armenia Minor, with a design either to reduce that province, or oblige Mithridates to venture a battle in order to relieve it. Mithridates followed him at some distance, and entering Armenia, encamped over against the Romans, on a hill, where, by intercepting their convoys, he reduced them to such distress that they were obliged to remove to a more convenient place; the king cutting off many in their rear, and harassing them with frequent attacks, till he fell into an ambuscade prepared by Pompey, whose personal courage and prudent conduct on that occasion confirmed the king in his resolution not to hazard a general engagement. The two armies encamped over against each other; Pompey on one hill, and the king on another, near the city of Dastira, in the province of Acisilene, at a small distance from the Euphrates, which divides Cisilene from Armenia Minor.

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sieged.

Here Pompey, seeing he could neither draw the king to a battle, nor force his camp, which was pitched on a steep and craggy mountain, began to block him up with a ditch, which he carried round the bottom of the hill where the king was encamped; and meeting with no opposition, he finished his work, thus cutting off the enemy's communication with the country. Pompey was amazed to see the king thus tamely suffer himself to be shut up, and could not help saying, that he was either a great fool or a great coward; a fool, if he did not apprehend the danger; and a coward, if, being apprised of it, he did not to the utmost of his power endeavour to prevent it. By this ditch, which was one hundred and fifty furlongs in circuit, and defended by many forts raised at small distances from each other, the king was so closely besieged, that he could neither send out parties to forage, nor receive the supplies that came to him from Pontus. He was thus besieged for the space of forty-five or fifty days, and his army reduced to such straits, that, having consumed all their provisions, they were at last forced to live on their dead horses. Mithridates therefore resolved at all events to break through the Roman fortifications; and accordingly, having put to the sword all those who were sick or disabled, that they might not fall into the enemy's hands, he attacked in the dead of the night the Roman guards, and having overpowered them with numbers, got safe into the open fields, and continued his march till night towards Armenia Major, where he was expected by Tigranes.

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Pompey next morning by break of day pursued the enemy with his whole army; and having with difficulty overtaken them, found the king encamped on a hill, to which there was but one ascent, and that guarded by a strong body of infantry. The Romans encamped opposite them; but Pompey, fearing the king would make his escape in the night-time, decamped privately, and taking the same route the enemy were to hold in order to gain Armenia, possessed himself of all the eminences and defiles through which the king was to pass. Mithridates, thinking that Pompey had returned to his former camp, pursued his march, and about the dusk of the evening entered a narrow valley, which was surrounded on all sides by steep hills. On these hills the Romans lay concealed, expecting the signal to fall upon the enemy, and attack them upon all sides at once, whilst they were fatigued by their march, and apparently in great security. Pompey was at first for delaying the attack till the next morning, thinking it not safe to engage in the night-time amongst such steep and craggy mountains; but he was at last prevailed upon, by the earnest prayers and entreaties of all the chief officers of the army, to fall upon the enemy that very night. It was therefore agreed, that in the dead of the night all the trumpets should at once sound the charge, that this signal should be followed by an universal shout of the whole army, and that the soldiers should make what noise they could, by striking their spears against the brass vessels that were used in the camp. The king's army, at this sudden and unexpected noise, which was echoed again by the mountains, imagined at first that the gods themselves were come down from heaven to destroy them; and the Romans charging them on all sides with showers of stones and arrows from the tops of the hills, they took themselves to flight; but finding all the passes beset with strong bodies of horse and foot, they were forced to fly back into the valley, where, for many hours together, they were exposed to the enemy's missiles, without being able, in the confusion, either to attack them or defend themselves. They attempted indeed to make some resistance when the moon rose; but the Romans running down upon them from the hills, did not give them time to form in order, and the place was so narrow that they had not room even to make use of their swords. The king on that occasion lost ten thousand men according to Appian, and forty thousand according to Eutropius and others. On Pompey's side there fell between twenty and thirty private men, and two centurions.

Distress of Mithridates.

Mithridates, at the head of eight hundred horse, broke through the Roman army, and being after this effort abandoned by all the rest, because they were closely pursued by the enemy, he travelled all night, attended by three persons only, viz. his wife or his concubine, Hypsicratia, his daughter Dripetine, and an officer. At day-break he fell in with a body of mercenary cavalry, and three thousand infantry, who were marching to join him. By these he was escorted to the castle of Sinoria, situated on the borders of the two Armenias. As great part of his treasures was lodged here, he rewarded very liberally those who accompanied him in his flight; and taking six thousand talents, withdrew into Armenia. As soon as he passed the borders, he despatched ambassadors to Tigranes, acquainting him of his arrival; but that prince, who was then on the point of concluding a separate peace with the Romans, clapped his ambassadors in irons, pretending that his son Tigranes had, at the instigation of Mithridates, revolted first to the Parthians, and then to the Romans. Mithridates finding himself thus abandoned, even by his son-in-law, left Armenia; and directing his course towards Colchis, which was subject to him, and not as yet invaded by the Romans, passed the Euphrates the fourth day, and got safe into his own territories.

His flight into Scythia, and other countries.

Pompey sent out several parties in pursuit of the king, but remained himself with the main body of the army in the field of battle, where he built a city, calling it, from that remarkable victory, Nicopolis. This city, with the adjoining territory, he bestowed upon such of his soldiers as were old or disabled; and many flocking to it from the neighbouring countries, it in a short time became a very considerable place. This battle was certainly attended with very fatal consequences for Mithridates, who, his army being either entirely cut off or dispersed, was forced to abandon his own dominions, and fly for shelter to the most remote parts of Scythia. Pompey having concluded a peace with Tigranes, and settled the affairs of that kingdom, began his march in pursuit of Mithridates through those countries which are situated near the Caucasus. The barbarous nations through which he passed, chiefly the Albanians and Iberians, attempted to stop his march, but were soon put to flight. The excessive cold and the deep roads, however, obliged him to pass the winter near the river Cyrus. Early in the spring he pursued his march; but meeting with great opposition from the Iberians, a warlike nation, and entirely devoted to Mithridates, most part of the summer was spent in reducing them to subjection. In the mean time, Mithridates, who had wintered at Dioscurias, on the isthmus between the Euxine and Caspian Seas, and had there been joined by such of his troops as had made their escape from the late unfortunate battle, continued his flight through the countries of the Achæans, Zygians, Heniochians, Cercetans, Moschians, and Colchians. Of these nations some received him kindly, and even entered into alliance with him; whilst he was forced to fight his way through others with the sword.

Pompey's further conquests.

Pompey took the same route, directing his course by the stars, especially in the northern parts of Scythia, and even carrying with him a supply of water for the army in the vast deserts through which he marched. He spent two years in warring with these nations, and was often in danger of losing both his life and his army. But at last he overcame them all; and believing Mithridates, of whom he could obtain no account, to be dead, he marched back into Armenia Minor, where he allowed some rest to his soldiers, who were quite worn out with the hardships they had endured in the expedition. Having refreshed his army, he marched into Pontus to reduce some strongholds which were still garrisoned by the king's troops. Whilst he was at Aspis in Pontus, many of the king's concubines were brought to him; but he sent them all home to their parents, without offering them the least injury, and thereby gained the affections of the chief lords of Pontus, whose daughters they were. The strong castle of Symphori was delivered up to him by Stratonix, one of the king's concubines, upon no other terms than that he would spare her son Xiphares, who was with the king, in case he should fall into his hands. She likewise discovered to him treasures hidden under ground, which he, with great generosity, bestowed upon her, reserving for himself only some vessels to set off his triumph. Having taken another fort, called the *New Castle*, hitherto regarded as impregnable, he found in it great store of gold, silver, and other valuable things, which he afterwards consecrated to Jupiter Capitolinus. Here, in looking over the king's manuscripts, he came to discover where the rest of his treasures were concealed, what troops he could raise and maintain, and what sums were yearly paid him by his subjects and tributaries, so that he could form a true estimate of his whole power and wealth. Amongst other manuscripts, he found some books of physic, written by Mithridates himself, which he commanded Lenæas, a learned grammarian, to translate into Latin.

Mithridates appears again at the head of an army.

Pompey having thus reduced all Pontus, marched into Syria with a design to recover that kingdom, and, passing through Arabia, to penetrate as far as the Red Sea. But whilst he was employed in this expedition, accounts were brought him that Mithridates, whom he believed to be dead, had appeared unexpectedly in Pontus at the head of a considerable army, and surprised Panticapæum, a famous emporium at the mouth of the Euxine Sea. All this time he had lain concealed in the territories of a Scythian prince, adjoining to the Palus Mœotis; but hearing that Pompey had left Pontus, and was engaged in other wars, he ventured out of his hiding-place, resolved either to recover his paternal kingdom, or perish in the attempt. He returned privately into Pontus, and managed matters there so dexterously that the Roman garrisons knew nothing of his arrival till he appeared with a considerable army in the field. He advanced first to the castle of Symphori; and understanding that Stratonix had delivered it up to Pompey, on condition that he would save the life of her son in case he should take him prisoner, the king immediately caused the youth, who was in his army, to be put to death, and his body to be left unburied; Stratonix beholding from the walls the cruel and unnatural murder, for he was her son by Mithridates, and had served him with great fidelity. At the same time he sent ambassadors to Pompey to treat of a peace, offering to pay a yearly tribute to the republic, upon condition of being restored to his kingdom. Pompey replied, that he would hearken to no proposals whatsoever, unless the king came to treat with him in person, as Tigranes had done. But this Mithridates looked upon as nowise consistent with his dignity, and therefore, laying aside all thoughts of an accommodation, he began to make what preparations he could for renewing the war.

Recovers several places.

He summoned all his subjects who were able to bear arms to meet at an appointed place; and having chosen out of the whole multitude sixty cohorts, each consisting of a hundred men, he incorporated them with the regular troops that were already on foot. Being now in a condition to act offensively, for Pompey had left but a small number of troops in Pontus, he possessed himself of Phanagorium, Chersonesus, Theodosia, Nymphæum, and several other important places. But, in the mean time, Castor, whom Mithridates had appointed governor of Phanagorium, falling out with Tripho, one of the king's favourite eunuchs, killed him, and, dreading the king's resentment, stirred up the inhabitants to a revolt. By this means Phanagorium was again lost; but the castle, which was defended by four of the king's sons, Artaphernes, Darius, Xerxes, and Oxathres, held out for some time. The king hastened to their relief; but the castle being set on fire by the rebels, they were forced to surrender to Castor before his arrival. These four sons, with one of the king's daughters, by name Cleopatra, Castor sent to the Romans; and fortifying himself in the town, persuaded most of the neighbouring cities, which were oppressed with heavy taxes, and greatly harassed by the king's collectors, to join in the rebellion.

Discontent of his subjects.

Mithridates finding that he could neither rely upon the soldiery, most of whom were forced into the service, nor on his other subjects, who were dissatisfied by reason of the exorbitant taxes, sent ambassadors to invite the princes of Scythia to come to his relief, and with them his daughters, to be bestowed in marriage on such as showed themselves most inclined to assist him. But as the ambassadors he employed on this occasion were eunuchs, a race of men no less abhorred by the army than favoured by the king, over whom they had a great ascendant, especially in his old age, the soldiers who were sent to attend them on their journey put them all to the sword as soon as they were out of the king's reach, and delivered his daughters up to the Romans. Mithridates, finding himself thus deprived of his children, betrayed by his army, and forsaken even by those on whom he chiefly relied, could not yet be induced to submit to the Romans, though Pompey promised him honourable conditions, provided he came to treat with him in person.

His design of invading Italy.

In this desperate condition he left no stone unturned to stir up the princes of Asia against the Romans, especially the Parthians; but finding them awed by the great opinion they all had of Pompey, he had recourse at last to the European Gauls, whom he understood to be at war with the Romans; and having sent some of his trusty friends to engage them in his favour, taking leave of his own kingdom, he began his long march, designing to pass through Bosphorus Cimmerius, Scythia, and Pannonia, and, joining the Gauls, to pass the Alps, and invade Italy. This design was no sooner known in the army, than the soldiers openly began to complain and mutiny; exaggerating the boldness of the attempt, the length of the march, and the insurmountable difficulties which must necessarily attend such a desperate enterprise. The chief commanders did all that lay in their power to divert him from it; representing to him, that if he was not able to cope with the Romans in his own kingdom, much less would he be a match for them in Italy or Gaul, where they could daily receive new supplies; whereas he would lose the greater part of his army in so long and difficult a march, and the rest, perhaps, in the first engagement, without any possibility of repairing the loss. But all was to no purpose. They found him so unalterably fixed in his resolution, that he caused those to be put to death who with most warmth remonstrated against it, not sparing even his own son Exipodras, for dropping some unguarded expressions on that occasion. Thus they were forced to let him pursue his own measures, until they found a more proper opportunity to oppose them, which soon afterwards presented itself, as they were encamped at Bosphorus Cimmerius, on their march into Scythia.

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Here Pharnaces, the king's favourite son, whom he had appointed to succeed him, observing the general discontent that reigned in the army, began to entertain thoughts of placing the crown on his own head; and not doubting but the soldiery would stand by him, if he declared against the intended expedition into Italy, openly protested amongst the Roman deserters, who were a considerable part of the army, that if they would follow him he would return into Pontus. The Romans, who were well apprised of the danger that attended such an undertaking, and had most of all exclaimed against it, promised to support him to the utmost of their power, and even encouraged him to assume the title of king, a title which his father seemed determined to hold till he had destroyed, by his rash and desperate attempts, himself, his friends, and his army. Pharnaces, finding he could depend upon the Romans, engaged the same night most of the principal commanders in his party, and by their means the greater part of the soldiery. It was agreed, that next morning by break of day all those who had declared in his favour should appear in arms, and with a loud shout proclaim Pharnaces king. This was accordingly done, and the shout returned even by those persons whom Pharnaces had not thought proper to let into the secret. The king, who had taken up his quarters in the city, being awakened by the noise, sent out some of his domestics to ascertain what had happened in the army. Neither did the officers or soldiers dissemble the matter, but boldly answered, that they had chosen a young king instead of an old dotard governed by eunuchs.

Hereupon Mithridates, mounting on horseback, and attended by his guards, went out to appease the tumult; but his guards forsaking him, and his horse being killed under him, he was obliged to fly back into the city, whence he sent several of his attendants one after another to desire of his son a safe-conduct for himself and his friends. But as none of the messengers returned, some being slain, and others siding with the new king, Mithridates endeavoured to move his son to compassion, by signifying to him from the walls the distressed condition to which he was reduced by a son whom he had favoured above the rest of his children; but finding him nowise affected by this speech, turning to the gods, he besecched them with many tears to make his son know one day by experience the grief and agony which a father must feel in seeing his love and tenderness requited with such base and monstrous ingratitude. Having thus spoken, he thanked in a very obliging manner those who had stood by him to the last, and exhorted them to make their submission to the new king on the best terms they could procure; adding, that as for himself, he was determined not to outlive the rebellion of a son whom he had always distinguished with particular marks of paternal affection.

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After this, he withdrew into the apartment of his wives and concubines, where he first took poison himself, and then presented it to them, and to his favourite daughters Mithridatis and Nissa, who not long before had been betrothed to the kings of Egypt and Cyprus. To the women it proved immediate death; but on the king, who from his infancy had inured his constitution to poisonous potions, it had so slow an operation, that he was forced, through fear of falling into the rebels' hands, to recur to his sword. Neither did the wound, as he was greatly weakened by the poison, prove mortal; so that the rebels, having in the mean time stormed the town, and broken into the house, found the king wallowing in his blood, but still alive, and in his senses. Pharnaces, hearing this, sent some of those that were about him to dress his wounds, with a design to deliver him up to the Romans, and thereby ingratiate himself with Pompey. But, in the mean time, a Gaul, who had served in the army, by name Bitætus, or Bithocus, entering the king's room in quest of booty, and being touched with compassion at seeing him forsaken by all his friends, and struggling on the bare ground in the agonies of death, drawing his sword, put an end to his misery, and thus prevented the insults which he apprehended if he should fall alive into his son's hands. The barbarian, when he first saw the king, is said to have been so awed by the majesty of his countenance, that, forgetful of his booty, he fled out of the room; but being called back, and earnestly entreated by the dying prince to put an end to his misery, he summoned all his courage to perform that office, which he did with a trembling hand; and immediately retired without touching anything that belonged to the king, though the hope of a rich booty was the only motive that had led him thither.

Excessive joy of the Romans at his death.

Pompey, who was at that time engaged in a war with the Jews, received the first notice of the death of Mithridates, as he was on his march to Jerusalem. The messenger who brought the joyful tidings was sent by Pharnaces, and appeared unexpectedly before Pompey with the branch of a laurel, as was customary on the like occasions, twisted round the head of his javelin. When he heard what had happened at Panticapæum, he was so impatient to impart it to the soldiery, that he could not even wait until they had raised him a mount of turf from which to address the army, according to the custom of the camp, but ordered those who were beside him to form a kind of mount with their saddles; and from thence he acquainted the soldiery that Mithridates had laid violent hands on himself, and that his son Pharnaces was ready to acknowledge the kingdom as a gift of the people of Rome, or resign it if they were unwilling he should reign. This news was received with joyful shouts by the whole army, and the day solemnized with feasts and sacrifices throughout the camp, as if in Mithridates alone all the enemies of the republic had expired. Pompey despatched without delay a messenger with letters to the senate, acquainting them with the death of Mithridates, and the submission of his son Pharnaces. When his letters were read, the senators were so overjoyed, that, at the proposal of Cicero, then consul, they appointed twelve days for returning due thanks to the gods, who had delivered them from such an insulting and powerful enemy: and the tribunes of the people enacted a law, by which Pompey, in consideration of his eminent service in the Mithridatic war, was to wear a crown of laurel, with the triumphal gown at the Circensian games, and a purple gown at the scenical shows.

Submissive embassy of Pharnaces.

Pharnaces, when he heard of his father's death, caused his body to be preserved in brine, proposing to present it to Pompey, who had promised to return into Pontus after the reduction of Judæa, and there settle matters to his satisfaction. Accordingly, the latter, having taken the city and temple of Jerusalem, set out with two legions for Pontus; and on his arrival at Sinope, he was there met by ambassadors from Pharnaces, acquainting him that their master had forborne assuming the title of king till his will and pleasure were known; that he put both himself and the kingdom entirely into his hands; and that he was willing to attend him at any time or place which he might think fit to appoint. The same ambassadors delivered up to Pompey those who had taken Manius Aquilius the Roman legate, whom Mithridates had put to a cruel death; all the prisoners, hostages, and deserters, whether Romans, Greeks, or barbarians; and the body of Mithridates, with his rich apparel and arms, which were greatly admired by Pompey and the other Romans. Both soldiers and officers flocked to see the king's body; but Pompey declined that sight, saying that all enmity between that great prince and the people of Rome had ended with his life, and, returning the body to the ambassadors, caused it to be interred with the utmost pomp and magnificence amongst his ancestors in the burying-place of the kings of Pontus, the Roman commander defraying all the charges of the ceremony. With the body Pompey restored his wearing apparel and armour; but the scabbard of his sword, which cost four hundred talents, was stolen by Rublius, a Roman, and sold to Ariarathes king of Cappadocia; and his cap or turban, which was a curious piece of workmanship, was privately taken by one Caius, who presented it to Faustus the son of Sylla, in whose house it was kept, and shown for many years afterwards amongst the rarities which Sylla had brought out of Asia.

The kingdom of Bosphorus bestowed on Pharnaces.

Pompey bestowed the kingdom of Bosphorus on Pharnaces, and honoured him with the title of friend and ally of the people of Rome. Pharnaces, being thus acknowledged king of Bosphorus, sent orders to all the garrisons of Pontus to submit themselves, delivering up the castles and treasures with which they had been intrusted, to Pompey, who by that means amassed an immense booty. In the city of Talaura, which Mithridates used to call his wardrobe, he found two thousand cups of onyx set in gold, with such store of gold and silver vessels, of costly furniture, of saddles, bridles, and trappings, set with jewels and precious stones, that the Roman commissaries spent thirty days in taking an inventory of the whole. Nor was this all. In another castle he found three large tables with nine salvers of massive gold, enriched with precious stones to an inestimable amount; the statues of Minerva, Mars, and Apollo, of pure gold and most curious workmanship; and a pair of gaming-tables of two precious stones, three feet broad and four feet long, on which was a moon of gold weighing thirty pounds, with their pieces, all of the same precious stone. In a fort situated amongst the mountains, were also delivered up to him the king's statue of massive gold, eight cubits high, his throne and sceptre, and the bed of Darius the son of Hystaspes. Most of these treasures had been transmitted to him from his ancestors, chiefly from Darius king of Persia; some belonged to the Ptolemies of Egypt, and had been deposited by Cleopatra in the hands of the Coans, who delivered them to Mithridates; and great part of them had been collected by the king himself, who was very fond of rich and stately furniture.

Pompey having thus got entire possession of Pontus, and reduced it to the form of a Roman province, marched into Asia properly so called; and having wintered at Ephesus, he early in the spring set out for Italy with a fleet of seven hundred ships. As he brought over his army with him, the senate was under no small apprehension lest he should make himself absolute, and rule without control. But he had no sooner landed at Brundusium, than he disbanded the army, without waiting for any decree either of the senate or people; a proceeding which neither his friends nor his enemies had expected. His triumph lasted two whole days; and although he was attended in his triumphal chariot by three hundred and twenty-four captives of distinction, amongst whom were five sons and two daughters of Mithridates, yet he would not suffer any of them to be put to death, as had been done by others, but sent them all back, except such as were of royal extraction, to their respective countries, and even supplied them with money to defray the charges of their journey. After his triumph, he delivered into the treasury twenty thousand talents, though, at the disbanding of the army, he had divided sixteen thousand talents amongst the tribunes and centurions, two thousand sestertia amongst the quæstors, and had given to each soldier fifty sestertia.

Quarrel of Pharnaces with the Romans.

Pompey had no sooner left Asia, than Pharnaces fell unexpectedly upon the Phanagorenses, a people of Bosphorus, whom Pompey had declared free, because they had been the first to revolt against his father Mithridates, and by their example had induced others to abandon the king's party. Pharnaces besieged their chief city Phanagoria, and kept them blockaded till, for want of provisions, they were forced to sally out, and put all to the issue of a battle; and this proving unsuccessful, they delivered up themselves and the city to the conqueror. Some years afterwards, when the civil war broke out between Cæsar and Pompey, he laid hold of that opportunity to recover the provinces which his father had formerly possessed; and, having raised a considerable army, overran Pontus, Colchis, Bithynia, Armenia, and the kingdom of Moschis, where, as Strabo observes, he plundered the temple of the goddess Leucothea. He took the strong and important city of Sinope, but failed to reduce Amisus. In the mean time, Cæsar, having vanquished Pompey and his party, appointed Cn. Domitius Calvinus governor of Asia, enjoining him to make war upon Pharnaces with the legions which were quartered in that province. Domitius immediately despatched ambassadors to Pharnaces, commanding him to withdraw his troops from Armenia and Cappadocia. The king returned for answer, that he was willing to abandon Cappadocia; but as to the kingdom of Armenia Minor, it was part of his hereditary dominions, and therefore he would not resign it till he had an opportunity of laying his pretensions before Cæsar himself, whom he was ready to obey in all things. Hereupon Domitius, drawing together all the forces he could collect, marched into Cappadocia, which he recovered without opposition, Pharnaces having abandoned it to make a stand in Armenia, which lay nearer his own dominions. Domitius pursued him thither, and having overtaken him near Nicopolis, found his army drawn up in battle array, and the king ready to come to an engagement.

Romans defeated.

As Domitius did not decline the combat, both armies advanced, and the king, at the head of a chosen body of men, fell upon the left wing of the Romans, consisting mostly of raw and undisciplined Asiatics; and having with little difficulty put them to flight, he penetrated to the centre, where the thirty-fifth legion, after a faint resistance, gave ground, and, retiring to the neighbouring mountains, left their allies to shift for themselves. The latter were all cut off, and Domitius, with the remains of his scattered army, marched back into Cappadocia, and thence, winter being now at hand, into the province of Asia. The king, elated with this victory, and hearing that Cæsar, with the flower of the Roman forces, was engaged in the siege of Alexandria, appointed Asander governor of Bosphorus, and marched into Cappadocia in pursuit of Domitius, with a design of invading Asia, and recovering all the provinces which had once been subdued by his father. Bithynia and Cappadocia readily submitted; but Armenia the Lesser, which was held by Dejotarus, made so vigorous a resistance that he was forced to abandon the enterprise, lest the Romans should in the mean time strengthen themselves in Asia, whither he was in haste to march, in hopes of meeting there with the same success as his father Mithridates had done. But before he reached that province, he was informed that Asander had revolted, in hopes of gaining the favour of the Romans, and obtaining from them the kingdom of Bosphorus for himself. At the same time, he received intelligence that Cæsar, having at last reduced Alexandria, and settled the affairs of Syria, was marching into Armenia.

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Pharnaces, being not a little dismayed at this news, immediately despatched ambassadors to sue for peace, hoping that Cæsar, who was hastening into Italy with a design to pass into Africa, would willingly listen to any proposals of a pacific nature. Cæsar courteously entertained the ambassadors; and though he did not intend to agree to their conditions, yet, that he might come upon Pharnaces unawares, he showed himself very desirous of entering into a treaty of peace. But nevertheless he pursued his march with all possible expedition; and, arriving on the confines of Pontus, ordered all the troops that were quartered in the neighbouring provinces to join him; having brought from Alexandria only one legion, namely, the sixth, and that consisting of only a thousand men. Besides this veteran legion, he found at the place of general rendezvous three others, but all of them very indifferently armed, and worse disciplined. With these forces, however, such as they were, he advanced against Pharnaces, who being greatly frightened at his approach, by reason of the success which had attended him in all his expeditions, again despatched ambassadors with a crown of gold, offering him his daughter in marriage, and promising to do whatever he should require. The ambassadors took care to let him know, that their master, though highly obliged to Pompey, yet had never been prevailed upon to send him any supplies during the civil war, as had been done by Dejotarus, king of Armenia the Lesser, whom he had honoured with his friendship. Cæsar returned for answer, that he was willing to conclude a peace with Pharnaces, provided he retired without delay from Pontus, restored all the captives and hostages, whether Romans or their allies, and give back the goods of the Roman citizens and publicans which he had seized since he first took up arms. He added, that as to his not sending supplies to Pompey, they ought rather to have concealed such an ungrateful proceeding of their master, than alleged it as any merit, since the forsaking of one to whom he was indebted for his crown bespoke him a man of mean, selfish, and unworthy principles.

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Pharnaces, on the return of his ambassadors, acquainted Cæsar that he agreed to the conditions; but finding that Cæsar's affairs called him into Italy, he required a longer period of time for the performance of what was stipulated between them, starting daily new difficulties, in hopes that Cæsar would in the mean time be obliged to depart, and leave the affairs of Pontus in the same posture in which he had found them. Cæsar, disgusted at these evasions, and unable any longer to brook the king's deceitful behaviour, determined to put himself at the head of his army, and attack the enemy in his camp when he least expected it. Accordingly, having marched out in the night, he came by break of day in sight of the king's army; and uttering these words, "Shall this treacherous parricide go unpunished?" broke into the camp at the head of a thousand horse. The king's chariots, which were armed with scythes, caused some small disorder amongst Cæsar's horse; but in the mean time the rest of his army coming up, he put the enemy to flight, and obtained a complete victory. This battle was fought near the place where Mithridates had routed with great slaughter the Roman army under the command of Triarius. Most of the king's army were either taken or cut in pieces; but Pharnaces himself had the good luck to make his escape whilst the Romans were occupied in plundering the camp. This victory was so quickly decided, that Cæsar, in a letter to his friend Anitius, at Rome, expressed it in three words; "I came, I saw, I conquered." He ever afterwards used to call Pompey a fortunate rather than a great commander, since he had gained his chief glory in the Mithridatic war, fighting with so cowardly an enemy. He divided amongst his soldiers the rich booty and the spoils of the camp; and because Mithridates had erected a trophy near that place as a monument of his victory over Triarius, which, as it was consecrated to the gods, Cæsar did not think lawful to pull down, he set up another over against it, to transmit to posterity his victory over Pharnaces. After this victory he recovered and restored to the allies of the Roman people all the places which Pharnaces had made himself master of during the war, declared Amisus a free city, and appointed Mithridates Pergamenus king of Bosphorus instead of Pharnaces.

Death of Pharnaces.

Having thus settled the affairs of Pontus, he set sail for Italy, leaving Domitius Calvinus to pursue the war against Pharnaces if he should again appear in the field. After the battle, Pharnaces had retired to Sinope with a thousand horse, where he was quickly besieged by Domitius, to whom he surrendered the town, upon no other condition than that he should be suffered to retire into Bosphorus with the small body that attended him. This Domitius willingly granted, but caused all the king's horses to be killed, since he had asked a safe conduct only for his horsemen. With these and a band of Scythians and Sarmatians he attempted to recover the kingdom of Bosphorus; but being met between Theodocia and Panticapæum, both which cities he had reduced, by Asander, who was still in possession of the kingdom, a sharp engagement ensued, in which the king's men, not being used to fight on foot, were put to flight, and Pharnaces himself, who remained alone in the field, was surrounded by the enemy, and cut in pieces, after having reigned in Bosphorus Cimmerius, the kingdom which Pompey had bestowed upon him, fifteen or sixteen years.

Pontus again made a kingdom by Antony.

Upon the death of Pharnaces the kingdom of Pontus was again reduced into the form of a province, and so continued till the triumvirate of Antony, who, after the battle of Philippi, conferred it upon Darius the son of Pharnaces, for his services during the civil war. He continued faithful to the Romans, but during his reign performed nothing worth mentioning.

Polemon.

Darius was succeeded in the kingdom by Polemon, who was likewise preferred to that honour by Mark Antony. He was the son of Zeno, an orator of Laodicea, and greatly favoured by Antony. From him that part of Pontus which borders on Cappadocia derived the name of *Polemonaicus.* He attended Mark Antony in his expedition against the Parthians; and being taken prisoner in the unsuccessful battle fought by Statianus, he was sent by the king of the Medes, an ally of the Parthians, to conclude a peace with the Romans. In this embassy he acquitted himself so well that Antony added the kingdom of Armenia to his other dominions. In the war between Antony and Augustus he joined the former; but after the battle of Actium he was received into favour by the latter; and being sent by Agrippa against Scribonius, who, upon the death of Asander had usurped the kingdom of Bosphorus, he overcame him, and reduced the kingdom of Colchis, which was bestowed upon him by Agrippa, who likewise honoured him with the title of "friend and ally of the people of Rome." He afterwards waged war with the neighbouring barbarians refusing to live in subjection to the Romans; but was overcome, taken, and put to death, by the Aspungitani, a people bordering on the Palus Mœotis.

Polemon II.

Upon his death, his son Polemon II. was by the Emperor Caligula raised to the throne of Bosphorus and Pontus. But the emperor obliged him to exchange the kingdom of Bosphorus for part of Cilicia; and Nero, with his consent, reduced that part of Pontus which he enjoyed into the form of a province. He fell in love with Berenice, daughter of Agrippa, king of Judæa; and in order to marry her he embraced the Jewish religion. But as she soon became tired of his riotous way of living, and returned to her father, so he renounced his new religion, and again embraced the superstitions of paganism. Polemon dying without issue, the ancient kingdom of Pontus was parcelled out into several provinces, and added to those of Bithynia, Galatia, and Cappadocia, that part of it only which was called *Pontus Polemonaicus* retaining the dignity of a distinct and separate province. During the civil discords between Vespasian and Vitellius, Anicetus, first a slave, afterwards freedman of Polemon, and lastly commander of the royal navy, took up arms with the design of rescuing the kingdom from the Roman yoke; and, being joined by great multitudes drawn together by the prospect of spoil, overran the country, and possessed himself of Trapesund, a city founded by the Grecians on the utmost confines of Pontus. Here he cut in pieces a cohort formed of the inhabitants, but which had been formerly invested with the privilege of Roman citizens. He likewise burned the fleet, and, Mucianus having called to Byzantium most of the Roman galleys, swept the seas. Hereupon Vespasian, who at that time was in Syria, sent Verdius Gemnius into Pontus with a chosen body of auxiliaries from the legions. The latter having assailed the enemy whilst they were in disorder, and roaming about in pursuit of prey, drove them into their vessels; then with some galleys chased Anicetus into the mouth of the river Chobus, where he thought himself safe under the protection of Sedochus, king of the Lazians, whose alliance he had purchased by large sums and rich presents. Sedochus at first refused to deliver him up to the Romans; but was soon prevailed upon, partly by threats, and partly by presents, to surrender both him and all the other fugitives who had taken sanctuary in his dominions. Thus ended that servile war; and the kingdom of Pontus continued to be a province of the empire till the time of David and Alexis Comnenus, who being driven from Constantinople by the French and the Venetians in the year 1204, under the command of Baldwin earl of Flanders, settled, the one at Heraclea, and the other at Trebisond. The troubles which arose amongst the Latins gave Alexis Comnenus an opportunity of erecting here a new empire, which comprehended great part of Pontus, and was known by the name of the Empire of Trebisond. The Comneni held it about 250 years, till the time of Mahommed II. who carried David Comnenus, the last emperor of Trebisond, prisoner to Constantinople, in the year 1462, with all his family, and subjected his empire to that of Constantinople.

PONTYPOOL, a market-town of the county of Monmouth, in the parish of Trevethan, and hundred of Abergavenny, 150 miles from London. It is situated at the foot of a range of hills profusely rich in coal and iron. It was formerly celebrated for its japan ware; but that trade has been in some degree superseded by similar manufactures at Birmingham, whilst the trade in iron and coal has vastly extended, and increased the population within the last forty years. The population of the whole parish amounted in 1801 to 1472, in 1811 to 2423, in 1821 to 3931, and in 1831 to 10,280.

PONZA, or PONTIA, is the name of a small island of the Tuscan Sea, well known as the place to which many illustrious Romans were banished. It is situated on the coast of Italy, near Terracina, and in the neighbourhood of other small islands or rocks. All these islands were visited by Sir William Hamilton in the year 1785; and an account of his journey is given in a letter to Sir Joseph Banks, which appeared in the Philosophical Transactions (vol. lxxvi. p. 365). Sir William arrived at Ponza on the 20th of August; and, according to his account, it is situated about thirty miles from Ventotienne. On the 21st he went round it in a boat. Its length is about five miles, but its breadth is nowhere above half a mile, and in some places not more than five hundred feet. It is surrounded by a multitude of detached rocks, some of them very high, and most of them composed of a compact lava. There are many irregularly-formed basalts, but none in large columns. In some places they have a reddish tinge, from iron ochre, are very small, and irregularly laid over one another. Some stand perpendicularly, others obliquely, and some lie horizontally. The rocks themselves in which these masses are found are lava of the same nature with the basalts. At first sight they appear like the ruins of ancient Roman brick or tile buildings. One rock is composed of large spherical basalts, and in other places our author found the lava inclined to take the like spherical form, though on a much smaller scale, some of the former basalts being nearly two feet in diameter. All these rocks, in our author's opinion, have been detached by the sea from this island, which is entirely composed of volcanic matter, lavas, and tufas of various qualities and colours, as green, yellow, black, and white. Some of these matters are more compact in their texture than others; and in some parts great tracts seem to have undergone similar operations, which still subsist at a spot called the Pisciarelli, on the outside of the Solfatara, near Puzzoli, and where a hot sulphureous vitriolic acid vapour converts all which it penetrates, whether lavas, tufas, volcanic ashes, or pumice-stones, into a pure clay, mostly white, or with a tint of red, blue, green, or yellow.

In one part of this island there is a sort of tufa remarkably good for the purpose of building. It is as hard as Bath-stone, and nearly of the same colour, without any mixture of lava or pumice-stone, which usually abounds in the tufas of Naples, Baiæ, and Puzzoli.

The island of Palmarole, which is about four miles from Ponza, is not much more than a mile in circumference. It is composed of the same volcanic matter, and probably was once a part of Ponza; but, in our author's opinion, it looks as if the island of Zannone, which lies about the same distance from Ponza, was once likewise a part of the same; for many rocks of lava rise above water in a line between the two last-mentioned islands, and the water there is much more shallow than in the Gulf of Terracina.

Zannone is much larger and higher than Palmarole, and the half of it next the continent is composed of a limestone similar to that of the Apennines near it, whilst the other half is composed of lavas and tufas, resembling in every other respect the soil of the islands just described. Neither Palmarole nor Zannone are inhabited; but the latter furnishes abundance of brushwood for the use of the inhabitants of Ponza, whose number, including the garrison, amounts to near 1700. The uninhabited island of St Stefano in like manner furnishes wood for the people of Ventotienne. It is probable that all these islands and rocks may in time be levelled by the action of the sea. Ponza, in its present state, is the mere skeleton of a volcanic island; little more than its hard or vitrified parts remaining, and these seem to be slowly and gradually mouldering away. The governor of the castle of Ponza, who had resided there fifty-three years, informed our author that the island was still subject to earthquakes; that there had been one violent shock there about four years before, and that the most violent one he ever felt was on the very day and at the very hour when Lisbon was destroyed. Two houses out of three which were then on the island were thrown down. "This," says our author, "seems to prove that the volcanic matter which gave birth to these islands is not exhausted."

POOGUL, a small town of Hindustan, in the province of Mooltan and district of Bikaneer, in the midst of a sandy desert. It has several brackish wells, and some reservoirs of good rain-water vaulted over with brick, from the sale of which to travellers parched with thirst the inhabitants derive a precarious income. They also rear camels and a few goats. It is twenty-four miles north-west of Bikaneer.

POOL, a seaport of the county of Dorset, within the hundred of Cogdean, and a county of itself, 106 miles from London. It is situated on a peninsula stretching into a large estuary at the mouth of the river Froome; and vessels drawing sixteen feet water can approach the quays. The mouth of the estuary is defended by a castle on the island of Browsea; and near it, in Studland Bay, as well as in Swanage Bay, there is good anchorage. The chief pursuits are the fishery and the trade with Newfoundland, that give occupation to more than 200 sail of vessels, which repair to that island and load with salted cod and other fish, a few for England, but mostly for the ports of Spain, Portugal, and the Mediterranean; and the latter return with the productions of the several countries where they sell their fish. There is, besides, a considerable coasting trade, especially for coals; and within the estuary and under the port, at a place called Russell's Quay, the greater part of the best pipe-clay, which is dug near it, is shipped for the use of the manufacturers of china and pottery in Staffordshire. It must have been a considerable port in the time of the Romans, as one of their roads may be traced from Winchester to Pool. The town is incorporated, and is governed by a mayor, who is an admiral within the port, and holds an admiralty court, a recorder, sheriffs, and aldermen, together with eighteen councillors. Till of late years one of the judges on the western circuit went to Pool to try criminals, but they are now tried at Dorchester. The town returns two members to parliament. The markets are held on Monday and Thursday. The old part of the town is ill built, but many houses recently erected are good. The population amounted in 1801 to 4761, in 1811 to 4816, in 1821 to 6390, and in 1831 to 6459.

POOLE, Matthew, a very learned writer in the seventeenth century, was born at York in 1624. He was educated at Emmanuel College, Cambridge, and afterwards incorporated in the university of Oxford. He succeeded Dr Anthony Tuckney in the rectory of St Michael de Quern, in London, about 1648. In 1658 he set on foot a project for maintaining youths of great parts at the universities, and was honoured with the approbation of the heads of houses in both of them. He solicited the affair with so much vigour, that in a short time L.900 per annum was procured for that purpose; but this design was laid aside at the Restoration. In 1662 he was ejected from his living for nonconformity. He was ten years employed in composing his *Synopsis Criticorum;* and, besides this great work, he published several other pieces. When Titus Oates's depositions concerning the popish plot were printed, our author found his name in the list of those who were to be cut off, so that he was obliged to retire to Holland, where he died in 1679, leaving behind him the character of a very able critic and casuist.

POONAH, a city of Hindustan, in the province of Bejapore, and capital of the peshwa, the chief of the Mahratta state. Situated about thirty miles to the east of the Ghauts, it is an open and defenceless town, covering little more than two square miles, and indifferently built, so that it has rather the appearance of a large village than that of a town. It has long and narrow streets, and the houses are indifferently built; the better sort are raised with large blocks of granite to the height of about fourteen feet, after which the superstructure is composed of timber frames, with slight brick-walls. The ordinary houses are only one story high, with tiled roofs. The lime which cements the bricks and tiles is so bad, that the rain washes away any building that does not depend on timber for its support. There is an ancient palace or castle, in which the peshwa's brother and other members of the family reside; it is surrounded by high and thick brick walls, with round towers at the angles, and has only one entrance through a pointed arch. Here the peshwa assembles the Brahmins, to whom he gives alms at the great feast when the rainy season terminates, and who are accustomed on this occasion to beg their way to Poonah from all parts of India. The family of the peshwa have, besides the castle, a modern house for their own residence in another part of the town. In 1809 the peshwa made arrangements for the erection of a palace, to be built by British architects. Poonah was, in the flourishing period of the Mahratta power, a great place of rendezvous for the different independent chiefs, with their numerous followers, in order to consult on the general interests of the confederacy, and, when at war, to settle the plan of operations. These meetings were held about the middle of October, at the end of the rainy season, and were sometimes attended by 400,000 or 500,000 people, who were encamped in the surrounding plain, and were well supplied with every necessary, such as wood, grain, and fodder, which were brought down the rivers. The inhabitants are well provided from extensive markets; and in one long street a great variety of articles are displayed, such as mirrors, globes, lamps, &c. The slaughter of kine is prohibited; and poultry is never reared or eaten except by the very lowest castes. The streets are named after mythological personages, with the addition of *warry*, which is equivalent to street. Poonah is situated at the confluence of the Moota with the Moola River, their union forming the Mootamoola, which runs into the Beemah; the latter river forms a junction with the Krishna, and, during the rainy season, a journey by water may be effected from within seventy-five miles' distance of the western coast of India to the Bay of Bengal. The Moola washes the city on the north side, where it is two hundred yards in breadth, and in the dry season very shallow. In one of the suburbs, called the Sungum, situated on the opposite side of the Moota River, about two miles from the city, the British ambassador with his suite resides, and other British subjects. The cantonments for the subsidiary force are also in this vicinity. Mythological excavations are found to the eastward of the city, but greatly inferior to those of Elora and Elephanta. The practice of sacrificing the widow along with the deceased husband was common at Poonah, and this cruel and barbarous rite was performed at the confluence of the Moota and Moola Rivers, held sacred by the Hindus, and close to the British residency. The burning of widows is now declared a crime by the British government, and is prevented by the interference of the civil power; so that these enormities under the name of religion can no longer be practised under the eye of the British authorities. The population of Poonah is estimated at 100,000, on the most moderate computation.

The first notice of Poonah occurs in the early part of the seventeenth century, when it was included in the jaghire or estate of Thahjee, father of the famous Sevajee, who built the palace there for his own residence. In 1740 the office and the power of the peshwa was usurped by Bajeerow, who having confined his master Ram Rajah to the fortress of Sattara, fixed his residence at Poonah, and died there in 1759. The dignity was transmitted to his grandson Madhoorow, who died in 1772, and was succeeded by his son Narrain Row, who was murdered by his uncle Ragoba; and shortly afterwards a posthumous child of the deceased was placed on the throne. He died in 1795, and the elder of the two sons of Ragoba, named Bageerow, succeeded. During these disputes Scindia and Holkar interfered, and seized the sovereignty. A treaty was in consequence concluded between the peshwa and the British, who re-established his authority; and this good understanding continued for nearly fifteen years. But in 1817, the peshwa, anxious to emancipate himself from the bondage of the British yoke, entered into the hostile combination which was then formed amongst the native powers for the assertion of their independence. As the contest ended in the triumph of the British armies, the peshwa was compelled to fly, and, after a contest of nearly two years, he at last consented to resign his office, and to retire on a pension to Benares. A descendant of Ram Rajah was raised to the nominal dignity of the peshwa, now become a mere pageant, and a pensioner on the British, on condition of his residing at Sattara; and a British resident, denominated a commissioner, is now stationed at Poonah. The travelling distance from Bombay is 98 miles, from Hyderabad 387, from Oojain 442, from Nagpoor 486, from Delhi 913, and from Calcutta by Nagpoor 1208 miles. Long. 74. E. Lat. 18. 30. N.

POONAKHA, a town of Northern Hindustan, in the province of Bootan, and situated on the Chantchieu River. It is the winter residence of the Deb rajah, and the warmest part of Bootan, and is therefore selected for the cultivation of exotics. The palace is adorned with a handsome gilt canopy. Long. 89. 45. E. Lat. 27. 56. N.

POONAR, a town and district of Hindustan, in the province of Berar, and territory of the nizam. The district is mountainous and woody, and is situated between the twenty-first and twenty-second degrees of north latitude. The town is seventy-five miles south from Gluckpoor. Long. 78. 13. E. Lat. 20. 9. N.

POONDY, a seaport town of Hindustan, in the province of the Northern Circars, and district of Cicacole, situated on a small river capable of being entered by boats, which thereby escape the surf so dangerous along this coast. Long. 84. 27. E. Lat. 18. 40. N.

POOR, in law, an appellation given to all those who are in such a low and mean condition that they either are or may become a burden to the parish.

POORBUNDER, a town of Hindustan, on the south-west coast of the Gujerat peninsula. An agreement was concluded in 1808, between the Bombay government and the Rana Sertanjee and Coer Hallajee of Poorbunder, not to connive at any act of piracy committed by any person under their authority. Long. 69. 50. E. Lat. 21. 37. N.

POOR KNIGHTS, a cluster of islands in the Southern Pacific Ocean, near the north-eastern coast of New Zealand. Long. 174. 42. E. Lat. 35. 30. S.

POOR-LAWS.

Until very recently, the great interest felt in the body of laws comprehended under the above title, was derived from the consciousness of the danger with which the manner of their administration in England threatened the property of the rich, and the morality of the whole people. As the law continues fundamentally the same as it was before the adoption of an improved administration, that source of interest in these institutions remains; but the present sense of security renders possible a calmer and more dispassionate examination of their merits and demerits than could previously to the year 1834 have been made by the most candid persons acquainted with the rapid progress of the evils of the system.

Origin and objects of poor-laws.

It was generally, and is now frequently, assumed by English writers, that a legal system of compulsory relief to the poor was peculiar to the polity of England. No assumption could be less justified by the facts, as will presently be shown. Wherever inquiry has been made, it has been found that the same objects as were sought by the institution in England have been sought by means which more strictly resemble those adopted in England, in proportion as the condition of the community resembles that of England in the complexity of its social relations, and the progress of its legal polity.

So general an adoption of analogous institutions amongst independent communities was, of course, not fortuitous, nor the mere result of imitation; and these institutions are everywhere of too distinct and recent an origin to be traceable to any of the primitive laws or customs of those people who have descended from one common race.

On the contrary, it was the development of the like evils in the progress of the civilization of each country which suggested the adoption of the like remedy. The evils, which were sufficient to induce nations to try a remedy so obviously fraught with great dangers both to the givers and to the receivers, and requiring sacrifices so immediate and so incapable of disguise, appear to have been at least as pressing elsewhere as in England. The description of these evils shows that they were and must be of universal prevalence, and that they have their origin in the constitution of mankind, and not in any such incidents as the dissolution of monasteries, or in any other local or temporary incident.

There never was a time or place in which there were not to be found men anxious to avoid labour, and yet to live in ease and enjoyment. There never was a time in which other men were not, from their sympathy, from their superstition, and from their fears, ready with their bounty to assist the necessitous, and liable to be imposed upon and intimidated, according as the beggar was crafty or bold. No community is so poor as not to suffer in some degree from the existence of a body of idle and worthless persons, subsisting profligately on the benevolence, the folly, or the fears of its members.

And as the condition of the people is found to improve, as progress is made in the arts and commodities of life, there is, of course, found a greater disparity in the condition of the people, and destitution more violently contrasted with opulence. Such a state of things, whilst it increases the means at the disposal of the benevolent and fortunate, increases the sympathy with the unfortunate, or those who appear to be so, and at the same time presents wealth in such masses as to serve as a temptation to those who may prefer to live by fraud or violence. Mendicancy and depredation, which are nearly impossible where a population is scattered, and its moveable wealth in small quantity, become easy in the contrary state of things.

It is accordingly found, in the progress of the civilization of every country, that a period arrives when beggary in its many forms, and with its whole train of consequences, appears in an alarming extent, usually even professed by large fraternities having some character of organization; sometimes connected by religious profession, like palmers, pilgrims, and various orders of mendicant friars, faquirs, dervishes; sometimes connected by supposed identity of race, as the people known throughout the continent of Europe, and largely in Asia, as Zingari, Gypseys, Bohemians: these, with the unfortunate and dissolute of all classes, find a means of living by practising various arts of amusement, and more frequently by operating on the superstitious credulity, and often on the fears, of the more wealthy and industrious part of the community. All accounts of such a state of things, wherever it may have prevailed, agree in showing that predatory habits almost invariably accompany, where occasion offers, the habit of mendicancy.

Great as were the evils obviously connected with the existence of such a mass of idlers, impostors, and depredators, there were not wanting motives to the other classes to perpetuate and increase the evil. Individual benevolence, even where accompanied by intelligence and prudence, although its objects may be immediately selected from the really unfortunate, would not withhold its indirect aid to this bad effect, its respectable example seducing many to imitate the act, without using the due precautions.

But a much greater share of the effect must always be attributed to the incautious benevolence of the great mass of those who have the power to give. It requires great knowledge and sagacity to distinguish the cases in which alms can be given without directly encouraging idleness, or

Origin and Object.

some worse vice; and to direct these qualities effectively to each application would, in the state of things described, require an amount of industry, and an expenditure of time, seldom or never possible. The ignorance and indolence, therefore, of the benevolent, afford the largest encouragements to the idle. Other influences are not wanting, especially ostentation and the love of popularity, which, where many live in idleness, never fail to create dependents and retainers to the full extent of the power or the will to maintain them. Superstition, too, has in all times enforced alms-giving as a virtue, and, operating upon the consciences of great criminals, has throughout the world created and endowed the largest and most magnificent of the so-called charities.

In the above description will be recognised a state of things partially exemplified, either in one set of its details or in another, in every country in Europe, more especially in those in which, like Spain, Naples, the Sardinian states, Ireland, and other countries, no public or well-controlled and systematic provision for the poor has been established.[1]

These observations will be well instanced in England during the progress of the institutions of which a description is about to be given.

CHAPTER I.

GENERAL OBJECTIONS TO PUBLIC RELIEF AND TO PRIVATE ALMS-GIVING.

The fact was adverted to in the beginning of this article, that the existing state of the poor-laws enables us to take a more dispassionate view of the abstract merits and defects of a system of public relief than was formerly possible.

Hitherto the question has been embarrassed by the consciousness of the evils which we were suffering, and of those towards which we were visibly making a rapid progress. On the other hand, the evils of general mendicancy, and the other painful and dangerous circumstances which are everywhere found to prevail where a public law of relief has not been established, are so little known in England, from whence our poor-laws have long excluded them, that little of the good really derived from our poor-laws was acknowledged, whilst the whole of their positive mischief was so apparent as to form almost alone the matter of every discussion of the merits of the system.

Alms-giving.

Before great accumulations of moveable wealth have taken place in any community, depredation to any large extent is scarcely possible, and mendicancy as a trade cannot be followed in such a community, especially where its population is widely scattered. Alms-giving, in the usual sense of the term, does not exist; but its place is often supplied by hospitality to the stranger and traveller, and by the readiness to share with friends or relatives the means of enjoyment which individuals may possess. But in countries where comparatively great accumulations of wealth have taken place, and where poor-laws have not been introduced, or where, as in Ireland, they have not taken root, alms-giving and begging are either avowedly permitted or connived at. And, for reasons hereafter to be shown, the alternative of a regulated system of *public relief*, or the practical permission, whether avowed or not, to solicit *private alms*, appears inevitable.

Objections to Public Relief, &c. Poor-laws.

It would be an evasion of the question to compare a well-devised system of poor-laws with a system in which alms-giving was to be substituted. It is necessary, in order to do full justice to the comparison, to assume a system of poor-laws fraught with all the evils known to be derivable from such a system, and administered with a degree of laxity not less than that of which we have had a practical experience. A system of public relief may be bad in principle, and yet judiciously administered; or it may be good in its principle, and ill administered. For the present purpose, a system shall be assumed, bad in its principle and bad in its administration.

Operation of a bad poor-law.

In this view, the law may give a claim to all persons not having means of independent subsistence, to be relieved, without subjecting the claimant to any harsh or disagreeable condition. Such a claim, though never in fact countenanced by the law, was practically allowed for above a quarter of a century in many parts of England. A law of this kind would obviously render all those who by their exertions could at the utmost earn but a bare subsistence, averse to industry, which in such a case would be a sacrifice of ease without any increased advantage. If present industry were rendered useless, so would thrift and forethought become a folly, an abandonment of present enjoyment without an object. Every present indulgence which the law allowed would wisely be enjoyed; good moral habits and bodily skill would have little merit if the law should place those with them and those without them in the enjoyment of the like benefits. What appears desirable for a man's advantage, it is a virtue in him to do also for his progeny. The paupers' children would be themselves paupers, and the law would present to them every inducement to beget other paupers, and no inducement to refrain. Such we have seen the English pauper, slothful, thoughtless but of his parish pay, sometimes living to see three generations of his progeny paupers, like to or worse than himself.[2]

But the idle pauper cannot be supported except from those funds which must otherwise employ and reward the industrious. Every pauper, for his support, consumes that which would maintain or nearly maintain an industrious labourer; with this difference, that the consumption of the pauper is never repaid, whilst the value of the labourer's consumption is always reproduced with a profit, which again affords the means of employing other industry. The pauper, therefore, is constantly drawing those above him into his own rank. The misfortune of those reluctantly becoming paupers produces a sympathy which extends to the voluntary pauper, and the unfortunate and the idle become less and less distinguishable.

If the law increases its bounty with the number of the paupers' offspring, all these evils are aggravated and accelerated. If the law, like the English bastardy law, renders the reward for having a bastard child greater than the allowance to a legitimate child, another source of immorality is opened, female virtue is at a disadvantage, and unchastity, becoming a source of profit, becomes respectable.[3]

If the law takes the yet more insidious course of providing relief to those who live partly by regular industry, the evils described are enormously increased. In this way the whole industrious population may be destroyed, almost without rendering the recipients conscious of their degradation. In this way the forethought of the industrious man becomes of as little value to him as it is to the pauper, and the whole of the restraints on population are destroyed in the great bulk of the people.

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[1] For a very ample detail of the state of mendicancy and vagrancy of private and public charitable institutions, in the chief countries of Europe and in the United States, the reader is referred to the Appendix (F) of Foreign Communications made to the Poor-Law Commissioners, 1835, and especially to the interesting abstract of and comment upon these communications by Nassau W. Senior, Esq. entitled, "A Statement of the Provision for the Poor, and of the Condition of the Labouring Classes, in a considerable portion of America and Europe;" 8vo, Fellowes, 1835.

[2] See Extracts from evidence received by the Commissioners of Inquiry: "We have cases of three generations of paupers," p. 204. See at p. 218 an amusing instance of three generations of the same stock contemporaneously relieved, at the rate of L.100 per year, by a parish; see also pp. 220, 226, 358.

[3] See Extracts from the information received by the Commissioners of Inquiry into the Poor-Laws. A clergyman in Cumberland speaks thus of the practice of that county: "A very different description of women have of late years become the mothers of bastard

But relief to his workman is in fact for the moment relief to the master; the public undertaking a portion of the maintenance of the servant, saves to that extent the wages of the employer. The corruption of the system thus reaches the master as well as the labourer, and each is equally induced, by his immediate interest, to secure and continue to himself his portion of the benefit, unless we presume them to be more provident than the law itself.

That such bad principles might be involved in a poor-law, is undoubted; for although the English law never, either in letter or spirit, contained all these elements together, yet it at one period or another in succession contained them all, and a loose and in some measure a corrupt administration gave, for a long time, prevalence to all their influences together.

Evils of a bad administration of the poor-law.

This brings into view the evils of a bad administration of the law. Suppose its execution intrusted to officers who must, in a majority of cases, be necessarily ignorant of its complicate objects, being ignorant of the common rudiments of education;[1] and let such officers be in no way distinguished by their interests being made to accord with the interests of the community in a good administration; the obvious consequence must be such as we have seen in England, that the best portions of the law must be badly administered, whilst the bad parts, by such instruments, can scarcely be expected to have these evils softened by a good administration. But a certain consequence would be, that those whose interests were identical with the welfare of the community, would be reluctant to serve the office, which would thus be left to others who could best employ its provisions to their own advantage. Thus in England the overseer was generally found, even when zealous in the discharge of his duty, blindly giving effect to the most pernicious part of the system. When merely weak, without being corrupt, we find him a tool in the hands of those whose object it was to procure labour at a low price, at the expense of the other rate-payers, and at the peril of the gradual though certain deterioration of the labourer and his posterity. Such an overseer was also subject, as a matter of course, to the cajolery or intimidation of the pauper, to the seduction of popularity, readily to be got by the expenditure in mis-called charity of other people's contributions. But the natural operation of the system was to find or to make its officers corrupt, as it was natural that that class of men should be readiest to execrate the officer, whose circumstances best allowed them to avail themselves, for their own advantage, of the law. In England we found that the more pauperized the district, the more certainly was the overseer an employer of pauper labour, or a supplier to the paupers, on his private account, of the objects of their daily consumption, or the owner of the habitations in which they lived, and for which the parish guaranteed a certain and exorbitant rent.

Even these evils might be aggravated by parcelling the country out into districts too small to allow of the procuring of the necessary means even of an economical administration. In England, few parishes or townships were large enough to afford a workhouse or to contract for the supply of the articles of consumption for the poor. Many were so small, that the cost of purchasing small books of account was considered as an extravagance.

We have another important example of the way in which the administration could be carried to the extreme of badness; namely, by the provision of a control which could by its nature operate only to enforce an improvident administration, and which should have no authority to check it. England, again, affords us an example of such a device in the authority of the justices of the peace. The justice was enabled to enforce the giving of relief where the overseer from any motive had refused it; but the justice of the peace had no authority to interfere when the overseer was profligately allowing relief.

Effects of such a poor-law.

The effects of such a system, then, would inevitably be the same as we have witnessed in England. Such have been, perhaps, too indiscriminately attributed to poor-laws generally. These effects were, in a former article in this publication, very distinctly and ably described and elucidated. They were described, first, as a disturbance of the natural course of population, which they increased without reference to the means of support; and, indeed, in the inverse direction, inasmuch as every addition to the number of the non-productive or the partially productive paupers diminished the means of living of the other portions of the community. Secondly, as increasing the very pauperism which it was their object to relieve. Thirdly, as productive of improvidence in the poor, who saw no worse consequence of a dissolute and idle life, than an eventual reliance, in common with millions of their fellow-subjects, upon the parish for their support in sickness or old age, or in the visitation of those calamities against which it is the task of prudence to provide. A fourth effect, much dwelt upon, was the misapprehension caused by these institutions as to the real cause of poverty and distress, and the operation of this misapprehension in producing a discontented spirit in those who encourage the notion that they have a right to relief, but entertain no equally definite notion of their duty to provide for themselves. The fifth evil was the encouragement which the system, as administered, was found to give to every species of immorality: idleness in the day, encouraging depredation, poaching, and smuggling by night, facilitating the resort to the beer-shop again by day: particularly the law of bastardy was observed to be rapidly destroying the virtue of the females, and, by producing ill-assorted marriages, the whole of those domestic virtues, both of parents and children, which depend mainly on a happy home. And it was also remarked, that the law of settlement had a large effect in lowering the character of all who claimed a maintenance from the parish; it being notorious that the most steady, industrious, and moral workmen, upon whom the employer can place his surest reliance, are those who do not legally belong to the parish in which they are living.

Such is the description of an extensive system of poor-laws, framed on a bad principle, and badly administered; and such are their observed effects.

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children. Formerly it was confined to the daughters of cottagers, and girls employed in farm-husbandry; but of late *very respectable farmers' daughters* have been in that situation, and have applied to have their offspring taken care of by the parish." (Captain Pringle's Report, p. 404.) The next extract is from the evidence of an overseer in the same county. "We at this time, in our parish, are supporting two bastard children, whose *mothers have landed property of their own*, and would not marry the fathers of their children." (*Ibid.*) "The daughters of some *farmers, and even landowners*, have bastard children. These farmers and landowners, and children with them, regularly kept back their poor-rate, to meet the parish allowance for their daughter's bastard." (*Ibid.*) "Captain Pringle states, that in the neighbourhood of Carlisle, it was not unusual for the daughters of small farmers, or statesmen as they are here called (men farming their own property), to have bastard children, and to come to the parish for allowance." (*Ibid.* p. 403.)

[1] See as to the illiterateness, general ignorance, and inefficiency of overseers, the volume of Extracts before cited, at the passages referred to in the index, under the title "Overseers."

But it does not thence follow, that a poor-law well devised and well administered should find no place in the polity of a nation.

There appear to be at least two resources besides that of adopting bad principles in such a law, or adopting a bad constitution of officers for its administration. The first resource is to exclude such an institution altogether.

lternative f alms-iving.

Some few countries taking their place by common estimation amongst civilized nations, have made no public provision for the poor. Ireland was practically, before the session of 1837–1838, without such a provision. England was in the same condition until the reign of Elizabeth. In all such countries rigorous enactments exist against mendicancy, but everywhere such enactments are defeated by the common co-operation of the whole people. It will be seen, that in England the most ferocious penal enactments were repeated, with every variation that ingenuity could devise, for the purpose of suppressing mendicancy and vagrancy; and yet at every stage of legislation it is avowed that the evil was still increasing. Ireland had, up to the time of Henry VIII. the English laws in this respect; and the sanguinary laws of Henry VIII. are still the laws of Ireland. Until this day, a criminal who evades conviction for some greater offence is occasionally transported under the vagrancy laws; in all other cases the public opinion revolts against the application of the penalty; and the law, though in the statute-book, is without effect.

It appears a preposterous expectation, that any people will generally sympathise or co-operate with the law which, whilst it leaves the unfortunate to perish, pretends to render mendicancy a crime. So common is the sentiment against such an attempt, that many systems of jurisprudence avowedly admit necessity, or the extreme danger of perishing for want, as a legal excuse for some offences, and as a palliation of any offence directly incited by the pressure of such necessity. There appears, therefore, no means of preventing mendicancy, but by a recognised provision of public relief.

Mendicancy is often expressly permitted by law; sometimes it is allowed to particular classes of persons, as discharged soldiers and sailors and their families, poor students, discharged prisoners, and such like. Sometimes a limit is assigned to begging, a given route on the way homewards, or a given district in which a party may have been born or may have become otherwise domiciled. Even in England, both these kinds of license and restriction have, till within these few years, formed part of our statute-law, and both species are still leading features in the law of Ireland. The effect of such restrictions has nearly everywhere been the same as in our own country, viz. to give authority to mendicancy, without in any way operating to diminish it.

endican-compar-with uperism.

Let us now examine the effects of mendicancy, whether permitted by the law or not; comparing it throughout with the operation of a bad system of poor-laws. In the *first* place, it, like pauperism, destroys industry, but the mendicant is wholly and entirely idle, with no one responsible to see him set to work, and, being for the most part unknown to those who relieve him, is under no necessity even to affect, like the pauper, a readiness to work. The mendicant's progeny is like himself in this respect, except that, being early bred to the parent's habits, industry becomes nearly impossible to them; whilst the occupation of both is such, that even on the supposition that an inclination to adopt a life of industry should be excited, few occupations could be found to which they would be fitted, and still fewer employers who would engage them. In respect of the influences upon *industry*, therefore, the individual mendicant is under worse influences than the individual pauper relieved by the *worst* system of poor-laws. So with respect to the general *morality* of the mendicant. The pauper is under some restraints, owing to his being settled amongst neighbours upon whose good opinion he is at least in some measure dependent; he must be known to the officers of his parish, and by this alone is kept in contact with and in fear of the law. The local sphere for the exercise of his vices is one of narrow limits. These restraints keep the pauper under considerable subjection, both to law and to opinion. But no such restraints operate upon the mendicant. No irregularity of conduct, no vice, can exclude him more from general society than his daily mode of life already does; even if, amongst his fellows, any vice should be recognised as sufficiently repulsive to exclude him from their companionship, their unsettled life renders it impossible that the reputation or the knowledge of his odious qualities could very closely attend him. Add to this absence of restraint the positive encouragement given by their more various and adventurous life, the zest with which its frauds and its darings are performed, and the glory with which they are recounted; these accompaniments have rendered the beggar's life popular, as the subject of romance, and occasionally as the object of imitation amongst even the better educated and more fortunate members of society. A pauper was never yet, as the beggar often is, the romantic hero of a ballad or a legend. Here, again, the influences on the individual mendicant are more pernicious than those on the pauper.

The same disadvantageous comparison exists when we consider the unlimited opportunities afforded by the mendicant's mode of life for every species of petty theft and depredation, habits which appear invariably to accompany that of vagrancy.

Extent of mendicancy.

In England we have a difficulty in conceiving the extent to which the habits of mendicancy may be carried on, and the varieties in its practice. It would be comparatively a small evil that a few mendicants should be found to be preeminently vicious characters; and this evil would bear no comparison with the evil of a pauperism spread as widely as that formerly in England. But some estimate may be formed of the extent to which mendicancy may be carried where there are no poor-laws, by a reference to the state of Ireland, in which it is represented that, in a population of eight millions, not less than 200,000 habitual mendicants and vagrants exist, and where this number is annually reinforced by the accession of the wives and families of those labourers who have left their homes in search of work elsewhere, and which are represented, in the evidence collected by the Commissioners of Poor-Laws Inquiry in Ireland, to exceed a million of persons.

The evil of mendicancy, therefore, may even bear a comparison in the extent and number of those practising it, with the evil of pauperism even under a bad poor-law.

Distributors of alms and of relief.

Now, let the operation upon the distributors in both cases be compared. No regular machinery is devised for the supply of the mendicant, but he is let loose upon the whole of society, to procure his living by every means by which the sympathies, the virtues, the follies, the weaknesses, or the vices of man may be attacked. Though much of the relief given to the mendicant is prompted by the benevolence of the giver, much also has its origin in sympathies falsely excited; in folly, and especially in the vanity and ostentation of him who dispenses the alms. Much, too, of the alms given to mendicants, in alms-giving countries, is given with the object of acquiring power over a disorderly and reckless class. In all countries, in times of commotion, we have seen this class unscrupulous instruments in the hands of those who, by their largesses, or by the exciting of expectations, had attached a large number of these classes. An example is seen in Spain, where the merit chiefly professed by the distributors of the alms of enormous charities is that of relieving the wants of armies of mendicants.

No instrument in the hands of ambitious and designing persons has ever been found more effective than that of retaining large classes of ready-formed mendicants, and of

Objections to Public Relief, &c.

bringing the poorer classes, under specious names, as near as possible to the condition of receivers of alms.

The effects upon the distributors has been equally to the disadvantage of the practice of alms-giving, inasmuch as the appointment of officers to administer the public fund has not been, and cannot be conceived to be, as pernicious as the innumerable institutions and fraternities of idle men brought together for the purpose chiefly of distributing alms. A portion of this operation may be seen and appreciated in the comparison between an ordinary overseer and the trustees who usually have distribution of private charities, the masses of which in England and Wales are shown by the Reports of the Commissioners of Charity to have been diverted from their proposed objects for the benefit of those who had the control in their hands.

Another advantage which a system of poor-laws has over alms-giving is this: Poor-laws are subject to the control of the legislature. Their evils, as discovered, may one by one be pruned away by the power which has created the whole institution; and they can also, at the will of the legislature, if such should appear to be an advisable course, be at any time totally abolished. Mendicancy, on the other hand, and alms-giving, are beyond the effective control of the law. Where once established by habit, no interference of the legislature can effectively modify them, no prohibition of the legislature can abrogate them. The sole corrective appears to be a retreat from private alms, by the adoption of a system of public relief as a means of discountenancing the mendicant's claim.

Thus far have been compared bad poor-laws with mendicancy; and it has been attempted to show that, even in this comparison, private alms-giving is exposed to disadvantages greater than those attached to a system of public relief. The comparison thus far with poor-laws has, as an abstract question, become unfair, because it seems possible, and recent experience appears to confirm the conclusion, that a poor-law may be so devised and so administered as to take away all plea for guilt founded upon absolute necessity; to diminish no man's present motives to labour, and bring up his offspring to industry; to offer the least possible inducements to improvidence, so far as improvidence is involved in neglecting to make accumulations against old age and other calamities. This appears to be rendered possible by the administration of such relief that those capable of working would reject it, as less desirable than independent industry in the time of their health and vigour, and less desirable than provisions secured by prudence for their old age.

CHAPTER II.

HISTORY OF ENGLISH POOR-LAWS TILL THE YEAR 1834.

The most authentic accounts, at least those which prove most incontestibly the prevalence of the habits of mendicancy and vagrancy in England, and give the best evidence of the extent to which their evils were recognised, may be found in the expressions of our early statutes.

It will not be possible to give a detailed description, either of the contents of the series of our statutes, or of their effects. The number of statutes passed for the suppression of vagrancy, mendicancy, and idleness, and for the relief of the poor, amount at the least to a hundred and eighty-seven; those now in force, commencing with the statute 43 Elizabeth, and including only the modifications of that law, amount to a hundred and eighteen, and contain matter of itself about equal to four average volumes of the statutes at large. None, therefore, but the most salient points in the legislation of the last four centuries and a half will be adverted to in the following summary of the progress of legislation upon these subjects.

History of English Poor-Laws.

We first find indications of a general relaxation of the industry of our population in the reign of Richard II. Civil discord had unquestionably its effect in producing the result; but a change in the habits of the population had been produced by the increase of commerce and of communication with other countries, and a large accession had at this time been made to the disposable wealth of the community. The large system of vagabondage, sanctified by the name of pilgrimage, of which the expeditions known as the Crusades were the most salient instance, had begotten a spirit of restlessness and idleness in Europe, infecting even our insular population. It was not so much the habit of beggary, as the desire of change and restlessness of life, that the statute of the 12th Richard II. chap. 7, passed in the year 1388, was intended to repress. This statute, though entirely directed against habits characterized in that day as vagabondage, scarcely recognises beggary as an habitual pursuit. Its main provisions are confined to the object of restraining labourers from changing their abodes. It prohibits any labourer from departing from the hundred, rape, wapentake, city, or borough, where he is dwelling, without a testimonial showing reasonable cause for his going, to be issued under the authority of the justices of peace. Any labourer found wandering without such letter is to be put in the stocks till he find surety to return to the town from whence he came. So far are its enactments from affording any evidence that able-bodied persons of either sex exercised by choice to any large extent the trade of mendicancy, that the only other class besides labourers which it recognises are the impotent. As to impotent persons, it provides that they are to remain in the towns in which they be dwelling at the time of the act; or if the inhabitants are unable or unwilling to support them, they are to withdraw to other towns within the hundred, rape, or wapentake, or to the towns where they were born, and there abide during their lives.

Restraint of vagrancy,

From the earliest periods, but from this time especially, begging was an offence; yet the chief enactments of the two succeeding centuries are rather confined to the object of restraining the movements of labourers than to the restraining of able-bodied beggars. The provisions of the 11th Henry VII. chap. 2, however, require beggars not able to work to go to the hundred where last they dwelt, or were best known, or born, without begging out of the hundred. The 19th Henry VII. chap. 12, passed eight years afterwards (in 1504), requires them to go to the town, city, or hundred where they were born, or to the place where they last abode for the space of three years, without begging out of the said city, town, hundred, or place.

of begging.

The legislation affecting the classes of poor least able to provide for themselves, had thus far been entirely restrictive, and contained that element of the poor-laws by which they are connected with police, almost to as great an extent as is to be found in our most recent institutions. They also indirectly contain a complete settlement law; for, by confining the labourers, but especially the impotent poor and beggars, to the places in which they dwelt at the time of the act being passed, or in which they had been born, or to the places of their last abode, they directly settled such persons on the places thus defined, and rendered the districts chargeable with the burden, at least to the extent to which the endowments of the church and the benevolence of individuals could be applied to the purpose. At length, especially after all the revenues of the church were diverted from the purpose of maintaining the poor, legislation becomes of a severe penal character, and is more immediately directed against those who practise mendicancy as a trade, viz. "able-bodied, sturdy, and valiant beggars." At the same time, the distinction becomes more apparent

Settlement law.

between the impotent poor and those whom the legislature evidently regarded as voluntary poor, and whom the law now subjects to heavy and even sanguinary penalties. The 22d Henry VII. chap. 12, passed in the year 1531, directs the justices to assign to the impotent poor a limit within which they are to beg. An impotent person begging out of his limit is to be imprisoned for two days and nights in the stocks, fed on bread and water, and then sworn to return to the place in which he was authorized to beg. An able-bodied beggar is to be whipped, and sworn to return to the place where he was born, or last dwelt for the space of three years, and there put himself to labour.

mpul- y relief.

Thus far restrictions upon vagrancy, whether originating in misfortune or idleness, or more serious vice, had proved unavailable. The evil had not been repressed; it had evidently increased, and at length drove the legislature to the adoption, not only of severer penalties, according to the old policy, but of a new expedient.

With imperfect machinery for giving effect to its intentions, without security that where its intention was carried into effect evils greater than those against which it was intended to provide might not arise, a system was now created which, in all its policy, is identical with that which now exists in England, and is about to be introduced into Ireland. The means employed, and not the policy itself, alone distinguish the legislation of the two periods. In the first place, beggary and vagrancy are still to be repressed, but no one is to be driven, by absolute destitution, to an infraction of the law; all excuse is to be taken away from the beggar. In the next place, the sympathy of the community with the law is to be secured by a provision at the public expense against the evil consequences of individual destitution. In the last place, the compulsory provision thus made by the community is to be protected by compelling those capable of exertion, and seeking to avail themselves of it, to accept it subject to the condition of working for the maintenance thus secured to them; a condition obviously intended to be as hard or harder than that upon which the independent man obtains his own support, and rendering the alternative of independent industry preferable to that of dependence on the public charity.[1]

The 27th Henry VIII. chap. 25, passed in the year 1536, recites the act last mentioned, and adds, that no provision is made for the support of the impotent, nor for the setting and keeping in work of valiant beggars; and then enacts, that the land-officers of every city, shire, town, and parish, to which such poor creatures or sturdy vagabonds shall repair, in obedience to that act, shall most charitably receive the same, and shall keep the same poor people by way of voluntary and charitable alms, within the respective cities, shires, towns, hundreds, hamlets, and parishes, by their discretion, so that none of them, of very necessity, shall be compelled to beg openly, and shall compel the said sturdy vagabonds and valiant beggars to be kept to continual labour, in such wise as they may get their own living by the continual labour of their own hands, on pain that every parish making default shall forfeit twenty shillings a month. Alms-giving otherwise than to these common boxes, or common gatherings, or to fellow-parishioners, or prisoners, is prohibited on forfeiture of ten times the amount given. A sturdy beggar is to be whipped the first time, his right ear cropped the second time; and if he again offend, he is to be sent to the next jail till the quarter-sessions, and there to be indicted for wandering, loitering, and idleness; and if convicted, *shall suffer execution of death as a felon*, and an enemy of the commonwealth.

As far as the policy of the succeeding legislation is concerned, its intention appears to be fully expressed by the terms of this statute. In all the succeeding period, we find a very large variety of means adopted for the purpose still of giving effect to the same policy; sometimes an increase of severity, even beyond the rigour of this statute, against the beggar and vagrant; sometimes an improved machinery for succouring the impotent, especially for the assessment and levying of the funds, and for producing an effective responsibility in the officers charged with this duty; and eventually a more comprehensive system devised for effectuating the whole of the objects clearly contemplated by the statute of Henry, without the adoption of any other than those objects, but intended merely to prevent the evils resulting from the defective means and instruments previously employed for their attainment.

Accordingly we find in the statutes of the reign of Edward V. "the foolish pity and mercy of them which should have seen to the execution of the goodly laws before enacted, and the perverse nature and long-accustomed idleness of persons long given to loitering," inveighed against in the usual declamatory manner of preambles of that period; but we find indications of the growth of a conviction that the excessive penalties of the previous legislation had defeated the operation of the law. The enactments against vagrancy are therefore rendered somewhat milder; an able-bodied poor person who does not apply himself to some honest labour, or offer to serve, though only for meat and drink, if nothing more is to be obtained, shall be taken for a vagabond, branded on the shoulder with the letter V, and adjudged a slave for two years to any person who shall demand him, to be fed on bread and water and refuse meat, and caused to work by beating and chaining, or otherwise. If he run away within that period, he is to be branded on the cheek with the letter S, and *adjudged a slave for life*; if he run away again, he is to suffer *death as a felon*. If no one demand such loiterer, the place where he is born is to keep him as a slave, and is to see him set to work; and if it fail in this, it is to be mulcted in a penalty, a city forfeiting five pounds, a borough forty shillings.

Removals.

By this statute the old settlement law had ingrafted on it a law of removal. The taking surety of the impotent poor, that they would repair to the places where they were born, or had dwelt for the last three years, had been found ineffectual; the officers were therefore directed to convey the impotent poor on horseback, in cart, chariot, or otherwise, to the next constable, and so from constable to constable, till they be brought to the place where they were born, or most conversant for the space of three years, there to be kept and nourished of alms.

Gradual improvements were introduced in the detail by several successive statutes. The 3d and 4th Edward VI. provides for the keeping of a book in every city, corporate town, and parish, containing the names of householders, and of the impotent poor. It makes some approach to a special organization of officers for the objects. The minister and churchwardens are to appoint collectors of alms; the alms, however, are voluntary, except to the extent to which they can be enforced by the exhortation of the minister and bishop; it being provided, that if any one able to further this charitable work do obstinately and frowardly refuse to give, or do discourage others, the minister and church-

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[1] With regard to the erroneous impression until recently prevalent in England, that poor-laws were institutions peculiar to this country, it is important to observe, that the system of law for repression of mendicancy and relief of the poor here described, was a direct and palpable imitation of a continental institution. Six years before the enactment of the 27th Henry VIII. (that is, in the year 1530), the magistrates of Ypres, in Belgium, enacted a set of regulations, which, as stated by Mr Hallam, manifestly form the model which was followed a few years afterwards by the legislature of this country. The regulations in question appear to have been adopted in the adjacent provinces of the Netherlands, under the sanction of an edict of Charles V. See a paper by Mr Hallam in the first volume of the Transactions of the Statistical Society.

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wardens are to exhort him gently. If he will not be so persuaded, the bishop is to send for him to induce and persuade him by charitable ways and means, and so, according to his discretion, to take order for the reformation thereof. These provisions being made, beggary is still prohibited, upon the pains limited in the previous statutes.

Compulsory tax.

As might be expected, the gentle askings of the collectors, and the exhortations of the minister, the charitable ways and means of the bishop, appear to have been without effect in persuading the parishioners to intrust to the collectors the distribution of their alms. We find, therefore, twelve years afterwards (5th Elizabeth, chap. 3, passed in 1563), an attempt made to give additional effect to these provisions, by enabling the bishop to bind any person to appear at the next sessions, if his froward and wilful mind should obstinately refuse to give weekly relief to the poor according to his ability. Here the justices are to come in to the aid of the bishop, and are charitably and gently to persuade and move the said obstinate person to extend his charity. If he will not be persuaded, the justices with the churchwardens may tax the obstinate person according to their discretion; and on his refusal to pay, the justices, on the complaint of the churchwardens, are to commit him to jail until he does pay the sum taxed, and arrears. Thus was created a compulsory tax, though at first only as an alternative where voluntary contributions were refused.

The important statute, 14th Elizabeth, represents in its recitals, that "all parts of this realm of England and Wales be presently with rogues, vagabonds, and sturdy beggars exceedingly pestered, by means whereof daily happeneth in the same realm horrible murders, thefts, and other great outrage." The sense of these evils seems to have dictated a resort to a new variety of punishments; all persons defined in the act as rogues and vagabonds, or sturdy beggars, are for the first offence to be grievously whipped and burned to the gristle of the right ear with a hot iron, of the compass of an inch about; for the second, they are to be deemed felons; for the third, to suffer death as felons, without benefit of clergy. But now chiefly is to be observed the improvements in assessing the burthen; the justices having power to settle the poor for their abidings, and to set down what portion the weekly charge towards the relief and sustentation of the poor people would amount unto, and that done, shall by their good discretions tax and assess all the inhabitants dwelling within the divisions limited for the settling of the poor.

License to beg.

This statute contained, like some of its predecessors, an enactment giving a limited license for begging, provided that the poor people ask relief of victualling only in the same parish where they do dwell, so the same be at the time and in the manner directed by the churchwardens and overseers of the poor. This license has been extended, modified, and restrained, but still kept in existence, especially in the case of discharged soldiers and prisoners, up to recent times.

43 Eliz. cap. 2.

So far we have seen the gradual accumulation of all the elements contained in the poor-laws up to the time of the last amendment in the system made in the reign of the late King William IV. The statute which permanently fixed all these elements in one system was passed in the last year of the reign of Elizabeth, the celebrated statute the 43d Elizabeth, chap. 2. In this statute we find extreme severity abandoned, and its place supplied with a reasonable test of destitution of such as may be presumed to be voluntary beggars or idlers. The able-bodied, married or unmarried, are to be set to work; children may be apprenticed; only the "lame, impotent, old, blind, and such others among them, being poor and not able to work," are to have "necessary relief," without being set to work. For the latter class of poor, habitations may be provided at the expense of the parish, on the waste or common; and for the support of these, but not of any who are able to work, natural relations, that is, father, mother, grandfather, grandmother, and children, may be compelled to contribute.

The voluntary contribution, and the co-operation of the minister and bishop, are abandoned. A tax upon the inhabitants, and upon the occupiers of property, strictly defined, and upon the parson or vicar, is directed to be levied in every parish; effectual means are given for the assessment, collection, and levy of the tax; for appeal for remedy against its unjust assessment; for the contribution of adjoining parishes and hundreds, where the means of the single parish failed; above all, a special authority is created for giving effect to the provisions of the law. Overseers, not less than two, nor more than four, are to be appointed in every parish yearly, in Easter week, to act with the churchwardens, subject to the orders of the justices, and liable to penalties for neglect of their office.

Such was the system in operation for above two centuries and a quarter, from 1601 to 1834, without material modification: its whole provisions were extended in the reign of Charles II. to town-lands; the law of settlement was also extended and refined, in the same and subsequent reigns; and the provision for setting the able-bodied to work was rendered more effectual by the 9th George I. chap. 7, which enabled every parish to provide a workhouse, or, if too small or too poor, to combine with others for the purpose of maintaining a workhouse, and which rendered the offer of relief in a workhouse a sufficient bar to the claim to any other relief.

Diminutio of vagrancy.

These statutes, aided by all those other causes which operated upon the morals and the general prosperity of the people, had produced the effect intended by their authors; and whatever may have been the portion attributable to any of the several causes in operation, the result unquestionably was, that vagabondage and idleness were found in the last half of the last century to prevail in England to a less extent than in any of the larger states of Europe, with the single exception of Holland. As the extremity of the evil had formerly produced severity in the law, so the disappearance of the evil produced a disastrous relaxation in the restrictions of which the experience and prudence of the previous times had discovered the necessity.

Relaxatio of the law

About the middle of the last century, there began to be indicated in the acts of the legislature a growing opinion, that the severity of the tests applied to the recipients of public charity required to be diminished. In the 7th year of the reign of George III., guardians were especially appointed in the city of London, the city of Westminster, the bills of mortality, the liberties of the Tower, not with any administrative or executive powers, but "to guard against the dangerous consequences which may arise from the false parsimony, negligence, inadvertency, or the annual change of parish officers." These guardians were to protect the poor children of the metropolitan districts to which the act applied, by visiting the places in which they were kept, reporting on their condition, and calling on the assistance of the magistracy where it might seem necessary.

Throughout the whole of the reign of George III. the example thus set was followed by constantly succeeding and increasing relaxations of the rigour of the old law; some of the most conspicuous instances of which are to be found in Gilbert's act, passed in the twenty-second year of that reign, 1782, which, instead of rendering the workhouse a means of testing voluntary pauperism, by employing the able-bodied, thereby deterring them from habits of pauperism, by rendering their state less eligible than one of independence, reverses this principle entirely. It confines the use of the workhouse to that of a mere receptacle for the aged, impotent, and infant poor; and provides, that the able-bodied shall not be required to enter it; and proceeds to the absurd extent in favour of the able-bodied pauper, of com-

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pelling the guardians appointed under the act to find work near their own houses, for all applicants able and professing to be willing to work, but unable to get employment; and to make up any supposed deficiency of wages out of the poor-rates.

The evils of able-bodied pauperism were now proceeding with alarming rapidity. The consummation of the false policy of the legislature during this reign was attained in East's act, 55 Geo. III. chap. 137 (passed 1815). It consists of a complete abrogation of almost all the salutary portions of the 9th Geo. I. chap. 7. The relief was no longer required to be received in the workhouse, it was to be *paid* to any poor person or persons at his or her or their home or homes, house or houses. Justices were empowered to order this relief for any time they might be pleased to define, not exceeding three months; and two justices might make subsequent orders for relief for a period not exceeding six months. The preambles and recitals in this statute consist, as might have been anticipated from the previous course of legislation, of descriptions of the grossest disorders on the part of those maintained by the public charity.

The insolence and general demoralization of the pauper, the most alarming deterioration in the industry of the labouring classes, especially the agricultural labourers of the south of England, the unscrupulous interference of the employers with the wages and the mode of remuneration of the employed, were abundantly shown by the committees of both houses of parliament, appointed to inquire into the progress of the poor-laws, especially by that appointed on the motion of Mr Sturges Bourne (in 1817), and upon the report of which the act known as Sturges Bourne's act, passed in the last year but one of this reign (the 59th Geo. III. c. 12), was founded. This act does not entirely abandon the views which dictated the dangerous provisions of East's act. Generally, however, it was a salutary measure, providing for the election of bodies of persons called select vestries, who were to supersede the overseers, and, in some measure, the justices, more effectually to avoid the evils consequent upon the administration being intrusted to annual and unpaid officers. It made provision also for the performance of the overseers' duties, by paid and permanent assistant overseers.

From the end of George III.'s reign to the year 1834, though legislative changes were not unfrequent, they were confined to matters of detail, involving neither the abandonment nor the adoption of any important principle.

CHAPTER III.

EFFECTS OF POOR-LAWS IN ENGLAND.

Commission of Inquiry.

fects of evious gislation.

In the course of the foregoing description of some of the principal statutes, the useful or injurious principles involved in them have been shortly referred to; the effects operated by the working out of those principles have been less remarked upon. In the main, the *good effects* had consisted in reclaiming from a vagrant and profligate course of life a large proportion of the population. The settlement laws especially had been instrumental in this; for we find that the creation of the claim to relief from the parish funds had so far attracted the idle and dissolute from the practice of common begging, that, in the reign of Charles II., after a period of great commotions, when many disbanded soldiers and sailors, and others, who, in a period of turmoil, are either forced upon or voluntarily resort to an unsettled life, had much swelled the mass of those who in previous times would have been found in the ranks of sturdy and valiant beggars, the same order of people were now found to be systematic though rapacious paupers, making the parish fund the means of levying their contributions on society.

neficial fects.

Operation.

We find in a statute of Charles II. in the second year of the Restoration (13 and 14 Car. II. cap. 12), a multifarious law of settlement created, upon reasons thus expressed in the recital: "Whereas, by reason of some defects in the law, poor people are not restrained from going from one parish to another, and therefore *do endeavour to settle themselves in those parishes where there is the best stock*, the largest commons or wastes to build cottages, and the most woods for them to burn and destroy; and when they have consumed it, then to another parish; and at last become rogues and vagabonds, to the great discouragement of parishioners to provide stocks, where it is liable to be devoured by strangers." From this period the whole of the efforts of the legislation are incessantly made to prevent the too easy settling of the poor upon the parish; but they all equally prove that settled pauperism had more and more taken the place of vagrant mendicancy.

If to the poor-laws can be attributed this good effect, they must also necessarily have the credit of preventing that train of evils which follows upon the existence of a large mass of mendicants and vagrants in any community. The corruption, the demoralization, the inevitable bodily misery, to the mendicant himself, his connections, and his offspring; the extortion, depredation, and the more violent crime which such a class have almost unlimited opportunity and frequent temptation to commit; next the deterioration in the feelings and habits of those whom circumstances may bring in contact with them; the refuge which they afford to all who are inclined or tempted to fall off from the more steady and respectable occupations of life, many of whom are even tempted by the mere spirit of adventure to become recruits; add to these the alarm and practical annoyance, which renders the industry and morality of all other classes less a security for enjoyment; and we have some idea of the train of evils the prevention of which was cut off when vagrancy on the great scale was at length, in England, successfully suppressed, though to be replaced in a great measure by voluntary and resolute pauperism.

Injurious effects.

The *bad effects*, as they arose in detail, usually led to the successive modifications which we find the law in its progress undergoing from time to time. Many of the evils temporarily and partially felt might even now be described with advantage, and as warnings to future legislators; but generally their interest would at present be greater to the historian and antiquary than in a practical point of view. At no period had these laws attained such an influence on the interests of the community of England and Wales, as about the years 1831 and 1832, when the effects of the whole system had reached a greater height than had ever yet been attained.

In these years many of the anticipations of those who had seen the evil tendency of the poor-laws, and had prophesied that the results of the system must be disastrous, were realized in such a way as to produce a conviction in the most supine, that either a remedy must be applied, or a wide-spread ruin be submitted to. In an article in this work, written in the year 1823, by one of the most humane and enlightened men who had ever given their attention to the subject, it was shown that a crisis was impending, and could not be far removed; that, as the law then stood, the poor-rates were increasing in the same ratio in which the prudence and forethought of the receivers of relief were being destroyed. It was shown, that "whenever the charge upon the land in support of those who do not add enough to the annual produce of the country to support themselves is so great that the land can be no longer cultivated with profit, then of course it will be thrown up." In 1832 was seen the phenomenon of whole parishes of fertile land being abandoned, "the landlords giving up their rents, the farmers their tenancy, the clergyman his glebe and the tithes." We find the paupers assembled and refusing to accept of the offer

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of the whole land of the parish, avowing that "they liked the present system better."[1]

In the article referred to, it had been shown that the system then in operation was fraught with the danger of discontented turbulence. "Every one is brought up with the belief that the state is bound to provide him with employment and support. When, therefore, the employment assigned him is such as he does not approve, and the recompense awarded him falls below his expectations (and when the employment is a loss to the public, the recompense must often be below even reasonable expectations), he becomes an irritated and uneasy subject; and, unless he is restrained by the fear of detection, or by the better influence of moral principles, he vents his spleen by any mischief that is in his power, and the burning of stackyards, or the destruction of machinery, results from an unsatisfactory interview with the overseer, or an ineffectual appeal to the bench of magistrates."

In the winter of 1831–1832 we find the practical exemplification of these remarks. In a period of great general prosperity, we find that portion of England in which the poor-laws had had their greatest operation, and in which by much the largest expenditure of poor-rates had been made, the scene of daily riot and nightly incendiarism; and we discover a state of things which, in the sober language of statistics, is thus described: "Of ninety-three parishes in four ill-administered counties, the population is 113,147, and the expenditure L.81,978, or fourteen and fivepence per head; and of eighty parishes in three well-administered counties, the population is 105,728, and the expenditure L.30,820, or five and ninepence per head; and those counties in which the expenditure is large are those in which the industry and skill of the labourers are passing away, the connection between the master and servant has become precarious, the unmarried are defrauded of their fair earnings, and riots and incendiarism have prevailed. The three counties in which it is comparatively small are those in which scarcely any instance of fire or tumult appears to have occurred; in which mutual attachment exists between the workman and his employer; in which wages depend not on marriage, but on ability, and the diligence and skill of the labourers are unimpaired or increased."

The danger had become too real to be neglected if a remedy could be found; but parliamentary inquiries, both in the upper and lower house, had repeatedly taken place comparatively without result, the largest effect produced by any committee of either house being that of the committee appointed in 1817, which in the year 1819 produced Sturges Bourne's act; an act, as events proved, almost wholly unproductive of effect in checking the course of pauperism.

An effort of another kind was now felt to be necessary, and was accordingly made. A Commission of Inquiry was appointed, consisting of individuals remarkable alike for their interest in the subject and their knowledge of its principles and details; its powers, though only those of ordinary commissioners of inquiry, far exceeding, for useful purposes, those of a parliamentary committee. Its labours were continued incessantly for two years, uninterrupted by the vacation or recess. Nor were these confined alone to the examination of witnesses summoned from different parts of the country. The commission were enabled to examine the locality itself, the documentary evidence, the living witnesses, and the actual operation of the system on the spot, and this by the members of their own body, as well as by assistant-commissioners appointed to visit and examine all parts of the country, some of whom extended their inquiries into Scotland, France, Flanders, and Guernsey, whilst

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they also collected a vast mass of interesting evidence from our ambassadors and diplomatic agents in different countries of Europe and America.

The result was a scrutinizing and minute inquiry; which was followed by the suggestion of amendments in the law, the practical deductions from the experience, yet so systematic, that their operation could be calculated almost with certainty, and which were, therefore, proportionally to be relied upon. As the success in inquiring had been great, so was the confidence of the legislature readily given; and the most important statute upon the subject passed since the statute of Elizabeth was carried through both houses by large and confident majorities.

A description of the evils found in operation at the time of the inquiry, of the remedies proposed for those evils, and of the enactments actually adopted, will afford the most complete and consistent view of the present system of English poor-laws. The statement of the operation of the previous law, and of the remedies proposed, will be condensed from the Report of the Commissioners of Inquiry; that of the enactments passed, from the Act for the Amendment and better Administration of the Laws relating to the Poor in England and Wales, being 4 and 5 William IV. cap. 76.

The poor entitled to relief consist, *first*, of those who are impotent through old age or bodily infirmity, through infancy, through accident, or through mental infirmity; and, *secondly*, of the able-bodied poor.

I.—RELIEF OF THE ABLE-BODIED.

It was in the relief of the able-bodied that the greatest pecuniary expenditure, and, above all, that the greatest moral evils, were incurred. The relief granted was in a great measure unconditional; in many districts it had superseded the necessity of practising even the thrift and husbandry necessary in expending the funds placed at the pauper's disposal.

The great source of abuse was found to be the out-door relief afforded to the able-bodied on their own account, or on that of their families. This was given either in kind or in money.

1. *Out-Door Relief of the Able-Bodied in Kind.*

The out-door relief of the able-bodied, when given in kind, was found to consist rarely of food, rather less unfrequently of fuel, and still less unfrequently of clothes, particularly shoes; but its most usual form was that of relieving the applicants, either wholly or partially, from the expense of obtaining house-room. This last mode of relief was extensively prevalent, and productive of important consequences, both direct and indirect.

Partial relief from the expense of obtaining house-room was given, or professed to be given, whenever the occupant of a cottage or an apartment was exempted on the ground of poverty from the payment of rates. In a great number of cases the labourer, if a parishioner, was not only exempted from rates, but his rent was paid out of the parish funds.

2. *Out-Door Relief of the Able-Bodied in Money.*

The out-door relief afforded in money to the able-bodied on their own account or on that of their families was found to be still more prevalent. This was generally effected by one or other of the five following expedients, which may be concisely designated as, first, relief without labour; secondly, the allowance system; thirdly, the roundsman system; fourthly, parish employment; and, fifthly, the labour-rate system.

Relief without Labour.—By the parish giving to those who were or professed to be without employment, a daily or a weekly sum, without requiring from the applicant any labour.

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[1] See, as to the parish of Cholesbury in Berkshire, the Report from his Majesty's Commissioners for Inquiring into the Administration and Practical Operation of the Poor-Laws, 8vo Fellowes, 1834. See also instances in Warwickshire, in Mr Villiers's Report, in Appendix (A).

Sometimes relief, to an amount insufficient for a complete subsistence, was afforded, without imposing any further condition than that the applicant should shift, as it was called, for himself, and give the parish no further trouble. In a still greater number of instances the relief was found to have been given on the plea that the applicant had not been able to obtain work, that he had lost a day or a longer period, and was entitled, therefore, to receive from the unlimited resources of the parish what he had not been able to obtain from a private employer.

Allowance.—By the parish allowing to labourers who were employed by individuals, *relief in aid of wages.*

In some places allowance was found to have been given only occasionally, or to meet occasional wants; to buy, for instance, a coat or a pair of shoes, or to pay the rent of a cottage or an apartment. In others, it was considered that a weekly sum, or more frequently the value of a certain quantity of flour or bread, was to be received by each member of a family.

The latter practice was found to have been sometimes matured into a system, forming the law of a whole district, sanctioned and enforced by the magistrates, and promulgated in the form of local statutes.[1] The allowance fixed by these scales was usually called *bread-money.* Of this kind of relief it was observed, that

"No attention was paid to either the character of the applicant or the causes of his distress. In fact, he was considered as entitled to it without pleading any distress.

"The *bread-money* was hardly looked upon by the labourers in the light of parish relief. They considered it as much their right as the wages they received from their employers, and, in their own minds, made a wide distinction between 'taking their *bread-money*' and 'going on the parish.'"

It was further to be observed, that even in those parishes in which the amount of allowance was supposed to depend upon that of the applicant's earnings, the inquiry as to the amount of those earnings was never carried back further than the current or the previous week or fortnight. The consequence was, that many of those who at particular periods of the year received wages far exceeding the average amount of the earnings of the most industrious labourer, received also large allowances from the parish.[2]

Again, there were other parishes in which no sort of inquiry whatever was made respecting earnings; but the birth of a child endowed the parent with an allowance, whatever might have been his previous income.[3] It was to be observed, also, that under the *scale system* a child was very soon considered as an independent claimant for relief, and entitled to it, though residing with his parents, and though they might have been at full work on high wages.[4]

The Roundsman System.—By the parish paying the occupiers of property to employ the applicants for relief at a rate of wages fixed by the parish, and depending not on the services but on the wants of the applicants, the employer being repaid out of the poor-rate all that he had advanced in wages beyond a certain sum. This was the house-row, or roundsman, or billet, or ticket, or stem, system.

According to this plan, the parish in general made some agreement with a farmer to sell to him the labour of one or more paupers at a certain price, and paid to the pauper out of the parish funds the difference between that price and the allowance which the scale, according to the price of bread and the number of his family, awarded to him. It had received the name of the billet or ticket system, from a ticket signed by the overseer, which the pauper in general carried to the farmer as a warrant for his being employed, and took back to the overseer, signed by the farmer, as a proof that he had fulfilled the conditions of relief. In other cases the parish contracted with some individual to have some work performed for him by the paupers at a given price, the parish paying the paupers. In many places the roundsman system was effected by means of an auction.[5]

Parish Employment.—By the parish employing and paying the applicants for relief.

The 43d Elizabeth does not authorize relief to be afforded to any but the impotent, except in return for work. And

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[1] "*Town of Cambridge.*—The churchwardens and overseers of the poor are requested to regulate the incomes of such persons as may apply to them for relief or employment, according to the price of fine bread, namely,

"A single woman, the price of...3½ quartern loaves per week.
"A single man........................4½ ... ditto.
"A man and his wife................8 ... ditto.
"A man and his wife and one child...9½ quartern loaves per week.
"Ditto ditto and two children......11 ... ditto.
"Ditto ditto and three ditto.........13 ... ditto.

"Man, wife, four children and upwards, at the price of 2½ quartern loaves per head per week.

"It will be necessary to add to the above income in all cases of sickness or other kind of distress, and particularly of such persons or families who deserve encouragement by their good behaviour, whom parish-officers should mark both by commendation and reward.

"By order of the magistrates assembled at the town-hall, Cambridge,—A CHEVELL, clerk to the magistrates.—*Nov.* 27, 1829." (Report, p. 22.)

[2] Mr Bishop found a parish in the Bedford Level, in which a recently drained tract of fertile land requires more labour than the settled inhabitants can provide, and the average yearly earnings of a labourer's family are from L.60 to L.70; but during a frost, and generally from November to March, almost every labourer comes on the parish. When they commented on these facts in their conversation with a resident magistrate, his answer was, "Why, what are we to do? they spend it all, and then come and say they are starving; and you must relieve them." "In our vestry," says Mr Russell, "which meets every Monday, the calculation is confined to the earnings of the past fortnight. No further retrospect is ever taken either for or against the claimant. In some parishes I believe the account is settled once a week instead of once a fortnight." Sometimes the inquiry does not go back even to the beginning of the week at the end of which the claim is made. (*Ibid.* p. 29.)

[3] In the northern division of Devonshire, says Mr Villiers, "The practice of granting allowance for children is so general and confirmed, that the pauper is in the habit of giving formal notice to the overseer of the pregnancy of his wife. Should the overseer refuse the application for the fixed sum allowed for the second, third, or fourth child, the magistrates' single inquiry, on his appearance before them under a summons, would have been as to the custom of the parish or the hundred. 'At what number does allowance begin with you?' was the common mode of putting the question, as I was repeatedly assured by overseers. The previous or present earnings of the pauper, or of any of his family, were never mentioned." (*Ibid.* p. 31.)

[4] At Friston, Suffolk, Mr Stuart states that "a child is entitled to relief at the rate of three shillings a week on his own account from the age of fourteen." "At Bottisham, Cambridge," says Mr Power, "a boy of sixteen receives two shillings and sixpence for the week; he lives at home with his father; the family consists of his father, mother, brother, and himself. Seventeen is the age at which a young man is considered entitled to separate relief as an unemployed labourer; his pay then is three shillings and sixpence. The allowance to our single young men out of employ used to be two shillings and tenpence; according to scale, four quartern loaves, present price eightpence-halfpenny. Last November they came to the sessions in a body to complain of the insufficiency, and it was then raised to three shillings and sixpence. This sum they receive when above a certain age, although residing with their families." (*Ibid.* p. 31.)

[5] Mr Richardson states that, "in Sulgrave, Northamptonshire, the old and infirm are sold at the monthly meeting to the best bidder, at prices varying, according to the time of the year, from one shilling and sixpence a week to three shillings; that at Yardley-Hastings, all the unemployed men are put up to sale weekly; and that the clergyman of the parish told him that he had seen ten men the last week knocked down to one of the farmers for five shillings, and that there were at that time about seventy men let out in this manner out of a body of 170." (*Ibid.* p. 28.)

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much as this part of the statute had been neglected, its validity was still recognised by the judges. In the King *v.* Collett, 2, Barnewell and Cresswell, 324, Lord Tenterden decided it to be the duty of overseers to provide work, if possible, before they afforded relief. And whatever might have been the difficulty of finding *profitable* work, one could scarcely suppose the existence of a parish in which it would not be *possible* to provide some work, were it merely to dig holes and fill them again. But though such was the law, it appears, from the parliamentary returns, that payment for work was the most unusual form in which relief was administered. The poor-rate returns for the year ended the 25th of March 1832 state, that out of L.7,036,968 expended in that year for the relief of the poor, less than L.354,000, or scarcely more than one twentieth part, was paid for work, including work on the roads and in the workhouses. This might easily be accounted for.

In the first place, to afford relief gratuitously proved less troublesome to the parochial authorities than to require work in return for it. Wherever work was to be paid for, there must have been superintendence; but where paupers were the work-people, much more than the average degree of superintendence was necessary. In ordinary cases, all that the superintendent inquired was, whether the workmen had performed an average day's work; and where the work was piece-work, he needed not make even that inquiry. The practice of his trade fixed the market-price of the work, and he paid it without asking whether the workman had been one hour or one day in performing it, or whether it exceeded or fell below his wants. But the superintendent of pauper labourers had to ascertain, not what was an average day's work, or what was the market-price of a given service, but what was a fair day's work for a given individual, his strength and habits considered; at what rate of pay for that work, the number of his family considered, he would be able to earn the sum necessary for his and their subsistence; and, lastly, whether he had in fact performed the amount which, after taking all these elements into calculation, it appeared that he ought to have performed. It will easily be anticipated that this superintendence was very rarely given; and that in far the greater number of instances in which work was professedly required from paupers, in fact no work was done. In the second place, collecting the paupers in gangs for the performance of parish work was found to be more immediately injurious to their conduct than even allowance or relief without requiring any work at all. Whatever might have been the general character of the parish labourers, all the worst of the inhabitants were sure to be amongst the number; and it is well known that the effect of such an association is always to degrade the good, not to elevate the bad. It was amongst these gangs, who had scarcely any other employment or amusement than to collect in groups, and talk over their grievances, that the riots of 1830 appear to have originated. And, thirdly, parish employment did not afford direct profit to any individual. Under the greatest part of the other systems of relief, the immediate employers of labour could throw on the parish a part of the wages of their labourers. They preferred, therefore, those modes of relief which they could turn to their own account, and out of which they could extract profit under the mask of charity.[1]

In some of the agricultural districts, the prevalent mismanagement in this respect had created in the minds of the paupers a notion that it was their right to be exempted from the same degree of labour as independent labourers. But in many places, whilst the labour required by the parish was trifling, the pay equalled or exceeded that of the independent labourer.[2]

The Labour-Rate System.—By an agreement amongst the rate-payers, that each of them should employ and pay out of his own money a certain number of the labourers who had settlements in the parish, in proportion, not to his real demand for labour, but according to his rental or to his contribution to the rates, or to the number of horses that he kept for tillage, or to the number of acres that he occupied, or according to some other scale.

II.—OUT-DOOR RELIEF OF THE IMPOTENT.

The out-door relief to the impotent, using that word as comprehending all except the able-bodied and their families, was subject to less abuse. The great source of poor-law mal-administration was the desire of many of those who regulated the distribution of the parochial funds, to extract from it a profit to themselves. The out-door relief to the able-bodied, and all relief which was administered in the workhouse, afforded ample opportunities for effecting this purpose; but no use could be made of the labour of the aged and sick, and there was little room for jobbing if their pensions were paid in money. Accordingly, it was found that even in places distinguished in general by the most wanton parochial profusion, the allowances to the aged and infirm were moderate.

General Remarks on Out-door Relief.

We have dwelt at some length on out-door relief, because it appears to be the relief which was most extensively given, and because it appears to have contained in itself the elements of an almost indefinite extension; of an extension, in short, which might ultimately have absorbed the whole fund out of which it arose. Amongst the elements of extension were the constantly diminishing reluctance to claim an apparent benefit, the receipt of which imposed no sacrifice, except a sensation of shame, quickly obliterated by habit, even if not prevented by example; the difficulty, often amounting to impossibility, on the part of those who administered and awarded relief, of ascertaining whether any and what necessity for it existed; and the existence in many cases of positive motives on their parts to grant it when unnecessary, or themselves to create the necessity.

From the evidence collected by the Commissioners, it will be seen how zealous must be the agency, and how inperation.

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[1] "Either the work was completed by two or three o'clock, and the rest of the day spent in idleness, or the men consumed the whole day in the lazy performance of the work of a portion of the day."..."In Pollington, Yorkshire, they send many of them upon the highways, but they only work *four* hours per day. This is because there is not employment sufficient in that way; they sleep more than they work, and if any but the surveyor found them sleeping, they would laugh at them. In Rancliffe they employed a man in the winter of 1830-1831 to look over them; but they threatened *to drown* him, and he was obliged to withdraw."..."In the parish of Mancetter, in the county of Warwick, the overseer stated that young able men received two shillings and sixpence a week, and the magistrates would not allow the parish to employ them more than three days in the week, in order that they might get work for themselves. Upon inquiry, it appeared that their characters soon became so infamous, that no person would employ them, having devoted their spare time to thieving and poaching. In the township of Atherstone, Mr Wellday, a manufacturer, impatient of contributing his property to the encouragement of vice and idleness by paying men without exacting labour, purchased some water-carts himself, for the purpose of giving employment to paupers. The magistrates refused to allow them to be used after twelve o'clock in the day, in order that these men might procure work for themselves. They were also described as becoming the most worthless characters in the town." (Report, p. 37, 38.)

[2] Eastbourne, in Sussex, was a striking example. In that place, in which the average wages earned from individuals by hard work are twelve shillings a week, the parish pays for nominal labour as much as sixteen shillings a week. Two families alone received from it, in the year ended Lady-day 1832, L.92. 4s.; and the wives of the few independent labourers regret that their husbands are not paupers. (Ibid. p. 39.)

tense the vigilance, to prevent fraudulent claims from crowding in under such a system of relief. But it would require still greater vigilance to prevent the *bona fide* claimants from degenerating into impostors; and it was an aphorism amongst the active parish-officers, that "cases which are good to-day are bad to-morrow, unless they are incessantly watched." A person obtained relief upon the ground of sickness; but when he became capable of returning to moderate work, he was tempted, by the enjoyment of subsistence without labour, to conceal his convalescence, and fraudulently extend the period of relief. When it really depended upon the receivers whether the relief should cease with its occasion, it was too much to expect of their virtue that they should, in any considerable number of instances, voluntarily forego the pension.

Another evil connected with out-door relief, and arising from its undefined character, was the natural tendency to award to the deserving more than was necessary, or, where more than necessary relief was afforded to all, to distinguish the deserving by extra allowances. The scale which we have already referred to, promulgated by the magistrates for the town of Cambridge, as well as several others, all directed the parish-officers to reward or encourage the deserving. The whole evidence showed the danger of such an attempt. It appeared that such endeavours to constitute the distributors of relief into a tribunal for the reward of merit, out of the property of others, had not only failed in effecting the benevolent intentions of their promoters, but had become sources of fraud on the part of the distributors, and of discontent and violence on the part of the claimants.

A common consequence was, that to satisfy the clamours of the undeserving, the general scale of relief was raised; but the ultimate result of such a proceeding appears always to have been to augment the distress which it was intended to mitigate, and to render still more fierce the discontent which it was intended to appease. Profuse allowances excited the most extravagant expectations on the part of the claimants, who conceived that an inexhaustible fund was devoted to their use, and that they were wronged to the extent of whatever fell short of their claims. Such relief partook of the nature of indiscriminate alms-giving in its effects, as a bounty on indolence and vice; but the apparently legal sanction to this parochial alms-giving rendered the discontent on denial the most intense. Wherever, indeed, public charities are profusely administered, we hear, from those who are engaged in their administration, complaints of the discontent and disorders introduced.

It appeared from all the Commissioners' returns, that in every district the discontent of the labouring classes was proportioned to the money disbursed in poor-rates or in voluntary charities. The able-bodied unmarried labourers were discontented, from being put to a disadvantage as compared with the married. The paupers were discontented, from their expectations being raised by the ordinary administration of the system, beyond any means of satisfying them.[1]

Those who worked, though receiving good wages, being denominated *poor*, and classed with the really indigent, thought themselves entitled to a share of the "poor funds." Whatever addition was made to allowances under these circumstances excited the expectation of still further allowances, increased the conception of the extent of the right, and insured proportionate disappointment and hatred if that expectation were not satisfied. On the other hand, wherever the objects of expectation had been made definite, where wages, upon the performance of work, had been substituted for eleemosynary aid, and those wages had been allowed to remain matter of contract, employment had again produced content, and kindness became once more a source of gratitude.

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III.—IN-DOORS RELIEF.

In-doors relief, that which was given within the walls of the poor-house, or, as it was usually, but very seldom properly, denominated, the workhouse, was also subject to great mal-administration. But in by far the greater number of cases it was a large alms-house, in which the young were trained in idleness, and ignorance, and vice; the able-bodied maintained in sluggish and sensual indolence; the aged and more respectable exposed to all the misery incident to dwelling in such a society, without government or classification; and the whole body of inmates subsisting on food far exceeding, both in kind and in amount, not merely the diet of the independent labourer, but that of the majority of the persons who contributed to their support.

Extent of pauperism.

The progress of pauperism, as far as it can be inferred from the progress of expenditure, had been such as is exhibited in the following table; to which the prices of wheat, and the quantities which might have been purchased by the total sums expended, are added, for the purpose of checking, in some measure, the misapprehension which might otherwise arise as to the true value of the sums expended through the fluctuating values of money during the interval to which the table extends.

Years.	Sums expended for Relief of the Poor.	Population o England and Wales.[2]	Average Price of Wheat per Quarter.		Number of Quarters of Wheat for which the money could have been exchanged.
	L.		s.	d.	
1801	4,017,871	8,872,980	115	11	693,234
1803	4,077,891	9,148,314	57	1	1,428,751
1811	6,656,105	10,163,676	92	5	1,440,455
1814	6,294,581	10,755,034	72	1	1,746,474
1815	5,418,846	10,979,437	63	8	1,702,255
1816	5,724,839	11,160,557	76	2	1,503,240
1817	6,910,925	11,349,750	94	0	1,470,409
1818	7,870,801	11,524,389	83	8	1,881,466
1819	7,516,704	11,700,965	72	3	2,080,748
1820	7,330,256	11,893,155	65	10	2,226,913
1821	6,959,249	11,978,875	54	5	2,557,763
1822	6,358,702	12,313,810	43	3	2,940,440
1823	5,772,958	12,508,956	51	9	2,231,094
1824	5,736,898	12,699,098	62	0	1,850,612
1825	5,786,989	12,881,906	66	6	1,740,447
1826	5,928,501	13,056,931	56	11	2,083,221
1827	6,441,088	13,242,019	56	9	2,269,987
1828	6,298,000	13,441,913	60	5	2,084,855
1829	6,332,410	13,620,701	66	3	1,911,671
1830	6,829,042	13,811,467	64	3	2,125,772
1831	6,798,888	13,897,187	66	4	2,049,916
1832	7,036,968	14,105,645	58	8	2,398,966
1833	6,790,799	14,317,229	52	11	2,566,601

[2] The numbers given in this column for the years 1801, 1811, 1821, and 1831, are those ascertained at the enumeration of those years; those stated for the intermediate and for subsequent years are computed from the baptisms and burials, and from the rate of increase, as ascertained at each census.

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[1] "They, as well as the independent labourers, to whom the term poor is equally applied, are instructed," says Mr Chadwick, "that they have a right to 'a *reasonable* subsistence,' or 'a *fair* subsistence,' or 'an *adequate* subsistence.' When I have asked of the rate-distributors what '*fair*,' or '*reasonable*,' or '*adequate*' meant, I have in every instance been answered differently; some stating they thought it meant such as would give a good allowance of 'meat every day,' which no poor man (meaning a pauper) should be without; although a large proportion of the rate-payers do go without it." It is abundantly shown in the course of this inquiry, that where the terms used by the public authorities are vague, they are always filled up by the desires of the claimants, and the desires always wait on the imagination, which is the worst regulated and the most vivid in the most ignorant of the people. In Newbury and Reading, the money dispensed in poor-rates and charity is as great as could be desired by the warmest advocate either of compulsory or of voluntary relief; and yet, during the agricultural riots, many of the inhabitants in both towns were under strong apprehensions of the rising of the very people amongst whom the poor-rates and charities are so profusely distributed. The violence of most of the mobs seems to have arisen from an idea that all their privations arose from the cupidity or fraud of those intrusted with the management of the fund provided for the poor. (Report, p. 50.)

The following represents the results of the above table at the periods of the decennial census.

Years of the Census.	Cost in Wheat in the proportion of	Cost per head on total Population. s.	d.
1801	7	9	1
1811	14½	13	1
1821	25½	10	7
1831	20	9	9

The foregoing table, however, can by no means be adopted as indicating with any accuracy the real progress of the evil. In the first place, the progress in the amount expended only indicates an increased proportion of pauperism, inasmuch as the increase in the sums expended exceeds the increase in the population. Thus, from the year 1803 to the year 1823, the population increased from nine to twelve millions, whilst the sums expended for relief of the poor increased from four to five and three-fourth millions. This indicates but a small increase in pauperism relatively to the increase of population, and the number of paupers in every hundred persons might have been nearly the same at the two periods compared. We find, however, that the increase in the value of the money expended, as reckoned in the wheat purchaseable by it, was as fourteen to twenty-two, that is, an increase in pauperism which would have exceeded the progress of the population in the proportion of twenty per cent.; and in this period it is to be supposed, either that the numbers of paupers may have increased in the proportion of twenty per cent., or that the effective relief, that is, the quantity of commodities given on the one side and received on the other, had at least increased in the proportion of twenty per cent. But, during all this period, other necessaries and commodities of life had diminished in price in a still greater proportion. Thus it is calculated by Mr Porter,[1] from the extensive data contained in his tables, that the sum of nine shillings and ninepence, the amount of relief per head, in the year 1831, would have purchased as much as seventeen shillings would have bought in 1801.

The sums returned as expended in poor-rates, though, since 1834 and at present, they represent the whole amount of the burthen, did, in fact, up to the year 1834, include but a small part of the whole charge. Of the various modes in which relief was given to the able-bodied labourer, or rather extorted from a portion of the parishioners, two of those above described, viz. relief on the roundsman system, and that on the labour-rate system, were means of casting the burthen of a man's support upon a parishioner, without the levying or expending of any rate. No means exist to enable us to calculate the amount of the burthen thus incurred by the occupiers; and of course the means of calculating the sacrifices of landlords, who made deductions of rate in regard of these charges, are equally wanting. We however find, that amongst the most conspicuous instances in which the rents of a parish had been nearly or entirely absorbed in the relief afforded by these two systems, very small rates had been levied upon the occupiers in money. The Commissioners' evidence, particularly their Appendix (D), is full of instances of this source of indirect and unrecorded loss.[2]

It must also be borne in mind, that in proportion as these modes of relief to the able-bodied were extended, and as the real amount of the burthen was thus concealed, the deterioration of the labourer's habits of industry, involving, not a loss of the particular year, but a permanent destruction of his utility as a labourer, as well as of his prudence and morality, were proceeding in a ratio even more rapid than the progress of these insidious forms of relief.

Objections to amendment,

It might have been hoped, that, under such circumstances, a general feeling would have arisen that these abuses were intolerable, and must be put an end to at any risk or at any sacrifice. But many who acknowledged the evil seemed to expect the cure of an inveterate disease without exposing the patient to any suffering, or even discomfort. They exclaimed against the burthen as intolerable, but objected to any amendment, if it appeared that it must be, or might be, attended with any inconvenience. And amongst all parties, labourers, employers of labourers, and owners of property, many were to be found who thought that they would suffer some immediate injury from any change which should tend to throw the labouring classes on their own resources.

1. On the part of labourers;

The labourer felt that the existing system, though it generally gave him low wages, always gave him easy work. It gave him likewise, strange as it may appear, what he valued more, a sort of independence. He needed not bestir himself to seek work, he needed not study to please his master, he needed not put any restraint upon his temper, he needed not ask relief as a favour. He had all a slave's security for subsistence, without his liability to punishment. As a single man, indeed, his income did not exceed a bare subsistence; but he had only to marry, and it increased. Even then it was unequal to the support of a family, but it rose on the birth of every child. If his family were numerous, the parish became his principal paymaster; for, small as the usual allowance of two shillings a-head might be, yet, when there were more than three children, it generally exceeded the average wages given in a pauperised district. A man with a wife and six children, entitled, according to the scale, to have his wages made up to sixteen shillings a week, in a parish where the usual wages paid by individuals did not exceed ten shillings or twelve shillings, was almost an irresponsible being. All other classes of society were exbjections o Amend-ment.

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[1] See the Progress of the Nation, by G. R. Porter, Esq. small 8vo, 1836, p. 83.

[2] Mr Cowell's Report contains the examination of a large farmer and proprietor at Great Shelford, who, on 500 acres, situated in that parish, pays ten shillings per acre poor-rate, or L.250 a year. In addition, though he requires for his farm only sixteen regular labourers, he constantly employs twenty or twenty-one. The wages of these supernumerary labourers amount to L.150 a year, and he calculates the value of what they produce at L.50 a year; so that his real contribution to the relief of the poor is not L.250, the sum which would appear in the parliamentary returns, but L.350. In the same Report is to be found a letter from Mr Wedd of Royston, containing the following passages:—

"An occupier of land near this place told me to-day that he pays L.100 for poor-rates, and is compelled to employ fourteen men and six boys, and requires the labour of only ten men and three boys. His extra labour at ten shillings a week, which is the current rate for men, and half as much for boys, is L.130.

"Another occupier stated yesterday that he held 165 acres of land, of which half was pasture. He was compelled to employ twelve men and boys, and his farm required the labour of only five. He is about to give notice that he will quit. Every useless labourer is calculated to add five shillings an acre to the rent of a farm of 100 acres."

It contains also a letter from Mr Nash of Royston, the occupier of a farm in a neighbouring parish, stating that "The overseer, on the plea that he could no longer collect the money for the poor-rates without resorting to coercive measures, and that the unemployed poor must be apportioned amongst the occupiers of land in proportion to their respective quantities, had required him to take two more men. Mr Nash was consequently obliged to displace two excellent labourers, and of the two men sent in their stead one was a married man with a family sickly, and not much inclined to work; the other a single man addicted to drinking."

The subsequent history of these two men appears in Mr Power's Report. One killed a favourite blood mare of Mr Nash's, and the other he was obliged to prosecute for stealing his corn. (Report, p. 55.)

posed to the vicissitudes of hope and fear; he alone had nothing to lose or gain.[1]

It appeared to the pauper, that the government had undertaken to repeal, in his favour, the ordinary laws of nature; to enact that the children should not suffer for the misconduct of their parents, the wife for that of the husband, or the husband for that of the wife; that no one should lose the means of comfortable subsistence, whatever might be his indolence, prodigality, or vice; in short, that the penalty which, after all, must be paid by some one for idleness and improvidence, should fall, not on the guilty person, or on his family, but on the proprietors of the lands and houses encumbered by his settlement. Can we wonder if the uneducated were seduced into approving a system which aimed its allurements at all the weakest parts of our nature, which offered marriage to the young, security to the anxious, ease to the lazy, and impunity to the profligate?

On the art of em-loyers;

The employers of paupers were attached to a system which enabled them to dismiss and resume their labourers according to their daily or even hourly want of them, to reduce wages to the minimum of what would support an unmarried man, and to throw upon others the payment of a part, frequently of the greater part, and sometimes almost the whole, of the wages actually received by their labourers. And even if they paid in rates what they would otherwise pay in wages, they preferred the payment of rates, which occurred at intervals, and the payment of which might from time to time be put off, to the weekly ready-money expenditure of wages. High rates, too, were a ground for demanding an abatement from rent; but high wages were not.[2]

On the rt of pro-ietors.

The owners of rateable property might, at least, have been expected to be favourable to any change which should avert their impending ruin. But of the property liable to poor-rates, there is a portion, and a portion of considerable importance, less from its value, than from the number of rate-payers amongst whom it is divided, and their influence in vestries, which not only is, in practice, exempted from contributing to the parochial fund, but derives its principal value from the mal-administration of that fund. This property consists of cottages or apartments inhabited by the poor. In almost all places the dwellings of the poor, or at least of the settled poor, were exempted from rates, and, besides, the rent was, in a very large proportion, paid by the parish. The former practice enabled the proprietor often to increase the rent by the amount of rate remitted, and always to be an owner of real property, and yet escape the principal burdens to which such property was subjected. The latter practice gave him a solvent tenant, and, if he had influence with the vestry or with the overseer, a liberal one.

Objections to Amendment.

Of the higher classes of landlords, those who reside in towns seldom took much part in parochial government, or had any distinct ideas as to the extent or the effects of its mismanagement; and the majority of those who had become familiarized with the abuses of the villages seem to have acquired habits of thinking and feeling and acting which unfitted them to originate any real and extensive amendment, or even to understand the principles upon which it ought to be based. To suppose that the poor are the proper managers of their own concerns; that a man's wages ought to depend on his services, not on his wants; that the earnings of an ordinary labourer are naturally equal to the support of an ordinary family; that the welfare of that family naturally depends on his conduct; that he is bound to exercise any sort of prudence or economy; that anything is to be hoped from voluntary charity; are views which many of those who have long resided in pauperised rural districts seem to have rejected as too absurd for formal refutation.

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[1] Even in Barnard Castle, in Durham, Mr Wilson states, that if any remonstrance is made on account of the applicant's bad character, the reply of the magistrate commonly is, "the children must not suffer for it."

The following answers are specimens of the feeling and conduct in the southern districts:—"The answer given by the magistrates, when a man's bad conduct is urged by the overseer against his relief, is, 'We cannot help that; his wife and family are not to suffer because the man has done wrong.'"

"Too frequently petty thieving, drunkenness, or impertinence to a master, throw able-bodied labourers, perhaps with large families, on the parish funds, when relief is demanded as a right, and, if refused, enforced by a magistrate's order, without reference to the cause which has produced his distress, viz. his own misconduct, which remains as a barrier to his obtaining any fresh situation, and leaves him a dead weight upon the honesty and industry of his parish."

Mr Stuart states, that in Suffolk, children deserted by their parents are in general well taken care of, and that the crime of deserting them is largely encouraged by the certainty that the parish must support the family. Even the inconvenience which might fall on the husband by the punishment of his wife for theft, is made the subject of pecuniary compensation at the expense of the injured parish. Under what other system could there be a judicial instrument concluding thus:—

"And whereas it appears to us that the wife of the said Robert Reed is now confined in the house of correction at Cambridge, and that he is put to considerable expense in providing a person to look after his said five children, we do therefore *order* the churchwardens and overseers of the poor of the said parish, or such of them to whom these presents shall come, to pay unto the said Robert Reed the sum of eleven shillings weekly and every week, for and towards the support and maintenance of himself and family, for one month from the day of the date hereof. Given under our hands and seals this twentieth day of February, in the year of our Lord one thousand eight hundred aud thirty-three." (Report, p. 59.)

[2] In Mr Richardson's instructive statement of the reforms effected by Mr Litchfield, in Farthingoe, Northamptonshire, we find that Mr Litchfield has been opposed, not only by the labourers, but by the farmers; first, because they grudged giving the labourer with no children eight shillings a week; secondly, because they were afraid to displease the labourer who had two children, and preferred head-money; and, thirdly, because they were fearful lest, if the rates were lowered, their rents would be raised; and that they encouraged the labourers, at first openly, and afterwards covertly, in their attempts to deter Mr Litchfield by menaces and insult.

"When a valuer," says Mr Cowell, "values a farm to an in-coming tenant, or fixes the rent from time to time (in these parts they have no leases), he says, 'What are your poor-rates?' If the tenant answer, 'Rates are low, but wages are high,' the valuer says, 'I have nothing to do with *wages*, that is your affair; but *rates* are a *positive thing*, and I allow for *them*.' This Mr Ellman considers as a bad custom, as it holds out an inducement to the farmer to prefer low wages and high rates. Tenants at will, says Mr Cogshill, too often think, the more poor-rates the less rent. Confidence between landlord and tenant seems quite lost. I have witnessed a good deal of this."

The following replies to question 36 of the Commissioners' Rural Queries are further testimonies to the same effect.

"I think the poor-laws have not diminished the capital, but rather the rent of the landlord, as the tenant considers rents and rates as payment for the farm, and one can only be increased at the expense of the other."

"The farmers are aware that, excepting in cases of long tenures and very sudden augmentation of rates, the burden does not at all affect them. It is a rent paid to the parish instead of the landowner."

"It should be understood that poor-rates are deducted in all calculations for rent; and that landlords pay them, and not the farmers."

"Capital is decreasing, from the loose manner in which the laws are administered, and the tenants feeling that they do not in effect pay the rates, but the landlord. I cannot otherwise account for the apathy with which they view, and the tenacity with which, in many instances, they defend abuses." (Report, pp. 60, 61, 62.)

Effects of system on proprietors,

Yet were the effects of the system such, that it might reasonably have been expected that any plan affording a reasonable prospect of a remedy would have been welcomed by all classes. The proprietors, who had been mulcted every year of a larger and larger portion of their income, were not only deprived of the benefits to their property naturally dependent on a constant increase of the population and in the consumption of produce, each such increase bringing with it an accumulating charge of pauperism. Instances of the total abandonment of the land had not yet become numerous, but the approach towards it was in many cases imminent, and in all certain and rapid;[1] whilst every diminution of cultivation was seen to have a double effect in increasing the rate on the remaining cultivation, the number of unemployed labourers being increased at the same instant as the fund for payment of rates was diminished; and the abandonment of property once begun, gave induced cause to proceed at an accelerated ratio.

on employers,

The employers found the services of their labourers deteriorated both by the loss of industry, skill, and intelligence, which can only be secured by a recognition, on the part of the labourer, of the value to himself of such qualities; and they had to contend with many other habits of insolence and insubordination, the natural results of the labourer's ceasing to depend upon his good character.

on the labourers.

But by far the severest sufferers were those for whose benefit the system was supposed to have been introduced and perpetuated; we mean the labourers and their families. Amongst these, the effects were not confined to those actually relieved. Instances were everywhere found in which the prudence and forethought of a labourer became his punishment instead of a reward. So onerous was the entire support of a man with a large family, and entirely destitute, that the rate-payers in agricultural parishes were generally agreed in employing such a one, so as to keep his family off the rates, in preference to another who had not married, or who had no family, or who had the means, by greater prudence or by any good fortune, for a while to support himself.[2] The system, in short, was this.

Piece-work was refused to the single man, or to the married man, if he had any property, because they could exist upon day-wages; it was refused to the active and intelligent labourer, because he could earn too much. The enterprising man, who had fled from the tyranny and pauperism of his parish to some place where there was a demand and a reward for his services, was driven from a situation which suited him, and an employer to whom he was attached, by a labour-rate or some other device against non-parishioners, and forced back to his settlement to receive as alms a portion only of what he was obtaining by his own exertions. He was driven from a place where he was earning, as a free labourer, twelve or fourteen shillings a week, and was offered road-work as a pauper, at sixpence a day, or perhaps to be put up by the parish authorities to auction, and sold to the farmer who would take him at the lowest allowance.

Can we wonder, then, if the labourer abandoned virtues of which this was the reward; if he gave up the economy in return for which he had been proscribed, the diligence for which he had been condemned to involuntary idleness, and the prudence, if it can be called such, which diminished his means just as much as it diminished his wants? Can we wonder if, smarting under these oppressions, he considered the law, and all who administered the law, as his enemies, the fair objects of his fraud or his violence? Can we wonder if, to increase his income, and to revenge himself on the parish, he married, and thus helped to increase that local excess of population which was gradually eating away the fund out of which he and all the other labourers of the parish were to be maintained?

But though the injustice perpetrated upon the man who struggled, as far as he could struggle, against the oppression of the system, who refused, as far as he could refuse, to be its accomplice, was at first sight the most revolting, the severest sufferers were those that had become callous to their own degradation, who valued parish support as their privilege, and demanded it as their right, and complained only that it was limited in amount, or that some sort of labour or confinement was exacted in return. No man's principles can be corrupted without injury to society in general; but the person most injured is the person whose principles have been corrupted. The constant war which the pauper had to wage with all who employed or paid him, was destructive of his honesty and his temper; as his subsistence did not depend on his exertions, he lost all that sweetens labour, its association with reward, and got through his work, such as it was, with the reluctance of a slave. His pay, earned by importunity or fraud, or even violence, was not husbanded with the carefulness which would be given to the results of industry, but wasted in the intemperance to which his ample leisure invited him. The ground upon which relief was ordered to the idle and dissolute was, that the wife and children must not suffer for the vices of the head of the family; but as that relief was almost always

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[1] See the Commissioners' Report, page 65, where instances like the following are given from all parts of the country. The present is taken from Leicestershire, a county not within the range of the extreme operation of pauperism. "Mr Pilkington's description of several places in Leicestershire is equally alarming. In Hinckley he found the poor-rate exceeding one pound an acre, and rapidly increasing, and a general opinion that the day is not distant when rent must cease altogether. On visiting Wigston Magna, in November 1832, he was informed that the value of property had fallen one half since 1820, and was not saleable even at that reduction. It does not appear, indeed, that it ought to have sold for more than two or three years' purchase, the net rental not amounting to L.4000 a year, and the poor-rate expenditure growing at the rate of L.1000 increase in a single year. And on his return to that neighbourhood, three months afterwards, the statement made to him was, that property in land was gone; that even the rates could not be collected without regular summons and judicial sales; and that the present system must insure, and very shortly, the total ruin of every individual of any property in the parish. We cannot wonder, after this, at the statement of an eminent solicitor at Loughborough, that it is now scarcely possible to effect a sale of property in that neighbourhood at any price."

The following answers, taken from a multitude of others of a similar nature, contained in Appendix (B), are to the same effect:—

"Annual value of the real property, as assessed April 1815, L.3390; annual value of the real property, as assessed November 1829, L.1959. 5s. It has undoubtedly fallen in value since the last valuation, *i. e.* in the last two years; and the population has been more than trebled in thirty years—1801, 306; 1811, 707; 1821, 897; 1831, 938; and that in spite of an emigration of considerable amount, at the parish expense, in 1829. The eighteen-penny children will eat up this parish in ten years more, unless some relief be afforded us." (Report, pp. 65, 66.)

[2] See striking evidences of these influences in the Report, page 78. "Will it be believed that such is not merely the cruelty, but the folly, of the rate-payers in many places, that they prohibit this conduct (the anxiety of an independent labourer to make provisions for his family by his own exertions)—that they conspire to deny the man who, in defiance of the examples of all around him, has dared to save, and attempts to keep his savings, the permission to work for his bread? Such a statement appears so monstrous, that we will substantiate it by some extracts from our evidence."

Sir Harry Verney, in a communication which will be found in Appendix (C), says, "In the hundred of Buckingham, in which I act as a magistrate, many instances occur where labourers are unable to obtain employment, because they have property of their own. For instance, in the parish of Steeple Claydon, John Lines, formerly a soldier, a very good workman, is refused employment because he receives a pension. The farmers say that they cannot afford to employ those for whom they are not bound by law to provide."

Effects of System.

given into the hands of the vicious husband or parent, this excuse was obviously absurd. It appears from the evidence that the great supporters of the beer-shops were the paupers.

The worst of results, however, are still to be mentioned. In all ranks of society, the great sources of happiness and virtue were the domestic affections, and this was particularly the case amongst those who had so few resources as the labouring classes. Now pauperism seems to have become an engine for the purpose of disconnecting each member of a family from all the others, and of reducing all to the state of domesticated animals, fed, lodged, and provided for by the parish, without mutual dependence or mutual interest.[1]

CHAPTER IV.

REMEDIAL MEASURES PROPOSED AND ADOPTED.

Remedial Measures.

It has been a frequent subject of public remark, that the remedial measures proposed by the Commissioners of Inquiry were the result of a process more deliberately and completely inductive than was to be found in any other instance of English, or indeed of any legislation. It is impossible to give any impression of the extent and value of the evidence upon which their conclusions were supported, otherwise than by a repetition of nearly the whole of the Report in which their remedial measures were detailed. This is impossible in the space allotted to this article; but to those interested, not only in the present question, but in acquainting themselves with a most masterly example of legislative investigation, no greater service can be done than to refer them to the document itself, which has been characterized by one of the most eminent, candid, and experienced of our statesmen, as one of the ablest state-papers he ever read.

The following description will exhibit a mere summary of the remedies proposed and adopted, with little more than hints of the reasonings upon which they were founded.

The Commissioners by no means adopted the opinion that a poor-law could, in a community like ours, be dispensed with. They found that the most pressing of the evils of the poor-laws were those connected with the relief of the able-bodied, and to these they suggested their first remedies. They assumed as their principle of administration, that the public is warranted in imposing such conditions on the individual relieved, as are conducive to the comfort either of the individual himself, or of the country at large at whose expense he is relieved.

rinciple of lminister- 'g relief.

They proposed, then, as the first and most essential of all conditions of relief, that the situation of the pauper, upon the whole, should not be made really or apparently so eligible as the situation of the independent labourer of the lowest class. It was shown throughout the evidence, that as the condition of the pauper class was elevated, the condition of the independent class was depressed, their industry impaired, their employment rendered unsteady, and its remuneration diminished. Such persons, therefore, were under the strongest inducements to quit the *less eligible class of labourers*, and enter the *more eligible class of paupers*. The Commissioners maintained that the converse would be, and was found to be, the effect of placing the pauper class in its proper position below the condition of the independent labourer. They found, on a large examination of the cases of strict administration of relief on the principle of letting the labourer find in the parish the hardest taskmaster and the worst paymaster he can have, that the parish had always become his last, and not his first, resource; and they found largely exemplified those specific results which invariably ensue from such an administration.

Effects of this.

The first and immediate effect, was the conversion of the able-bodied paupers into independent labourers. The second result, indeed a corollary of the first, was the reduction of the parochial expenditure, constituting an increase of the fund for the employment of independent labourers. The third effect, closely connected with and following the absorption of able-bodied paupers, and their conversion into independent labourers, was the rise in wages. The fourth class of the observed specific effects was the diminution, not only of pauper-marriages, but of those imprudent marriages contracted with the knowledge and confidence that the worst result to be apprehended was an eventual dependence upon the poor-rate. The fifth and last specific effect dwelt upon by the Commissioners, and illustrated by their evidence, was the diminution of crime, and the contentment of the labourers increasing with their industry.

The Commissioners, in endeavouring to obtain the general adoption of this principle, cautiously avoided the recommendation of speculative remedies; they dwelt anxiously and emphatically upon the necessity and the safety of adopting a course of legislation which may be considered as wholly experimental. They propose, therefore, no changes in the principle of the law, but confine their recommendations to this, that the means which have been found the most effective in practice, should be applied wherever it was found applicable with the prospect of a beneficial result.

To secure this operation, they recommend the adoption of a new and more responsible agency to co-operate with and control that which had been found for the most part inefficient, or greatly efficient for mischief. Some excrescences in the law they propose to lop off, but no additions beyond the improvement of the agency were proposed to be introduced in the principle of the statute of Elizabeth, and the succeeding legislation. They recommend, therefore, "that those modes of administering relief which have been

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"The effect of allowance," says Mr Stuart, "is to weaken, if not to destroy, all the ties of affection between parent and child. Whenever a lad comes to earn wages, or to receive parish relief on his own account" (and this we must recollect is at the age of fourteen), "although he may continue to lodge with his parents, he does not throw his money into a common purse, and board with them, but buys his own loaf and piece of bacon, which he devours alone. The most disgraceful quarrels arise from mutual accusations of theft; and as the child knows that he has been nurtured at the expense of the parish, he has no filial attachment to his parents. The circumstances of the pauper stand in an inverted relation to those of every other rank in society. Instead of a family being a source of care, anxiety, and expense, for which he hopes to be rewarded by the filial return of assistance and support when they grow up, there is no period in his life in which he tastes less of solicitude, or in which he has the means of obtaining all the necessaries of life in greater abundance; but as he is always sure of maintenance, it is in general the practice to enjoy life when he can, and no thought is taken for the morrow. Those parents who are thoroughly degraded and demoralized by the effects of 'allowance,' not only take no means to train up their children to habits of industry, but do their utmost to prevent their obtaining employment, lest it should come to the knowledge of the parish-officers, and be laid hold of for the purpose of taking away the allowance."

"At Princes Risborough, we turned over the minute-book of the Select Vestry, and found the following entries:

"'Samuel Simmons's wife applied to be allowed something for looking after her mother, who is confined to her bed; the mother now receives 3s. 6d. weekly. To be allowed an additional 6d. for a few weeks.'

"'David Walker's wife applied to be allowed something for looking after her father and mother (old Stevens and his wife), now ill, who receive 6s. weekly. To be allowed 1s. weekly.'

"'Mary Lacy applies for something for waiting on her mother, now ill. Left to the governor.'

"'Elizabeth Prime applies to have something allowed for her sister looking after her father, now ill. Left to the governor.'" (Report, pp. 96, 97.)

Remedial Measures.

tried and found beneficial, be generally enforced" (Report, p. 261); and "that the practice of giving relief in well-regulated workhouses, and the abolition of partial relief to the able-bodied, having been tried and found beneficial, be extended to all places." (*Ibid.* p. 262.)

Workhouse recommendations.

The first and chief specific measure recommended by them was thus described:—" *First*, That, except as to medical attendance, and subject to the exception respecting apprenticeship hereinafter stated, all relief whatever to able-bodied persons, or to their families, otherwise than in well-regulated workhouses (*i. e.* places where they may be set to work according to the spirit and intention of the 43d of Elizabeth), shall be declared unlawful, and shall cease, in manner and at periods hereafter specified; and that all relief afforded in respect of children under the age of sixteen shall be considered as afforded to their parents." (*Ibid.* p. 262.)

This adoption of the workhouse and its restrictions as the condition upon which relief was to be administered, was advised, because it would operate, in the first place, as a self-acting test of the claim of the applicant, it being urged " That it is demoralizing and ruinous to offer to the able-bodied of the best characters more than a simple subsistence. The person of bad character, if he be allowed anything, could not be allowed less. By the means which we propose, the line between those who do, and those who do not, need relief, is drawn, and drawn perfectly. If the claimant does not comply with the terms on which relief is given to the destitute, he gets nothing; and if he does comply, the compliance proves the truth of the claim, namely, his destitution. If, then, regulations were established and enforced with the degree of strictness that has been attained in the dispauperised parishes, the workhouse doors might be thrown open to all who would enter them, and conform to the regulations. Not only would no agency for contending against fraudulent rapacity and perjury, no stages of appeals (vexatious to the appellants and painful to the magistrates), be requisite to keep the able-bodied from the parish; but the intentions of the statute of Elizabeth, in setting the idle to work, might be accomplished, and vagrants and mendicants actually forced on the parish, that is, forced into a condition of salutary restriction and labour. It would be found that they might be supported much cheaper under proper regulations than when living at large by mendicity or depredation." (*Ibid.* p. 264.)

In the *second* place, it was observed by the Commissioners, that " Little need be said on the next effect of the abolition of partial relief (even independently of workhouse regulations), in drawing a broad line of distinction between the paupers and the independent labourers. Experience has shown, that it will induce many of those whose wants arise from their idleness, to earn the means of subsistence; repress the fraudulent claims of those who have now adequate means of independent support; and obtain for others assistance from their friends, who are willing to see their relations pensioners, but would exert themselves to prevent their being inmates of a workhouse." (*Ibid.* p. 276.)

In the *third* place, it was relied on to remove much of the evil arising from the situation of the distributors of relief, who, having many modes of relief at their disposal, were rendered liable to odium and revenge when they chose a more strict mode of administration, and were liable to be seduced by all the motives which the love of popularity, fear, or the cajolery, importunity, or menaces of the applicant presented, to adopt a lax administration.

How far adopted.

These reasons appear to have entirely prevailed with the legislature, who accordingly adopted them in principle, only modifying them thus far in their form. Combining the effect of this recommendation with the one subsequently to be described, the institution of a central board, the legislature—not fixing any determinate period, but bearing in mind the magnitude of the amount of the existing out-door relief to able-bodied men and their families, with the possibility that the means might not suffice at the periods to be specified, for affording all the workhouse relief that might be required upon a sudden cessation of all other relief—adopted the plan of leaving the determination of the period at which out-door relief should cease, and relief in the workhouse become the invariable rule, to the judgment of the central board; that board having power to adopt a different course in different districts, to adopt the workhouse relief entirely and at once where the means existed, and in others to prepare the way by procuring workhouses, and the gradual substitution of relief in kind for relief in money, and by other intermediate and preparatory operations. (See the Act, sect. 52.) As a consequence of adopting this course, all restrictions imposed by previous acts upon officers, with a view of preventing them from applying the workhouse to able-bodied men, are repealed (sect. 53); and authority to direct the purchase, the furnishing, and the management of workhouses is given to the central board.

Parents' liability.

The legislature adopted, without change, except by way of addition, so much of this recommendation as has the effect of identifying the relief to an unemancipated child with the relief to the parent; the intended effect being to render the parent as responsible for providing for his children as for himself, and subject to the same consequences of neglect in either case, so that he cannot seek relief for his child, without submitting to the condition upon which alone he could obtain it for himself, or otherwise. The legislature adopted with this recommendation these expansions and additions: Relief of the wife is made relief to the husband; of the child, to the parent, to the father if living, or otherwise to the widow (sect. 56); and of the bastard child, to the mother (sect. 71). Moreover, a man marrying since the act, is made liable to maintain the children which his wife has at the time of her marriage, until they attain the age of sixteen, or until her death (sect. 57); this last provision being made with the view that the man is liable to all the civil obligations of his wife existing at the time of her marriage, excepting this obligation, which must commonly have been of all her obligations the most notorious. As the law stood, a woman's family, legitimate or illegitimate, was, by her marriage, cast on the parish for support, and the allowances made to them constituted an annuity to the married couple, forming an inducement of extraordinary frequency to marriages in all other respects the most improvident.

Central control.

The Commissioners' second specific measure was thus proposed:—" We recommend, therefore, the appointment of a central board to control the administration of the poor-laws, with such assistant commissioners as may be found requisite; and that the commissioners be empowered and directed to frame and enforce regulations for the government of workhouses, and as to the nature and amount of the relief to be given and the labour to be exacted in them; and that such regulations shall, as far as may be practicable, be uniform throughout the country." (Report, p. 296.)

The reasons for the establishment of this agency are eloquently and most instructively stated in the Report; especially the reasons for relying rather upon a constantly acting agency, with the means of judging at every moment of the extent to which its measures would then apply, in preference to relying upon a mere legislative enactment, however valuable the principle involved, or stringent its provisions might be. Instances of the most striking kind are given, not only of the failure of such enactments, but of their conversion to purposes directly contrary to their object, where no authority was erected responsible for conducting their operations. The other grounds for this recommendation were chiefly the impossibility of choosing a succession of overseers or other annual officers with ap-

Remedial Measures.

propriate knowledge, still less with the enlarged experience of the means to be used, or an enlightened appreciation of the objects to be attained; next, the short duration of the office, which, even where able officers are occasionally found, prevents the continued application of their experience, precisely at the time when their efficiency has become the greatest; next, the division of the districts for which they served, preventing co-operation or the dispersion of the knowledge obtained on one spot over the others to which it might be applicable. Scarcely an instance was found of a parish being dispauperised, the example of which was followed even by a single adjoining parish. Reference was also made to the inadequacy of the motives of any officer to support a sound administration: his responsibility little or none,—his gain no more than that of every other rate-payer occupying as largely as himself,—the loss of time and of energy,—the danger of misapprehension by those he sought to serve, and of failure in the whole object, great,—the certainty of odium from the pauper and from the prejudiced amongst his fellow-parishioners, and of jealousy from rival officers, being inevitable,—whilst, on the other hand, the strength of the interests in abusive administration, by which one man may make to himself a gain of the losses of many, whilst by the best administration he can only save himself from the loss falling to the share of one,—the confederacy of those who recognise their interest in such corrupt gain,—the popularity to be acquired by liberality in the disposal of funds contributed by others,—form some few of the motives to uphold the prevailing abusive administration. In these views the Commissioners adopted the conclusion, that whatever might be the intentions of the legislature, they would be best carried out by a permanent authority, accumulating experience in itself, independent of local control, uninterested in favour of local abuse, but responsible for carrying into effect the law which it was appointed to execute. This recommendation was adopted by the legislature, according to the spirit in which it was made. A board of three commissioners was to be appointed by the king (sects. 1 to 11), themselves appointing assistant commissioners, capable of receiving the powers of the commission by delegation (sects. 8 to 13); the commission having power to direct and control the whole administration of relief throughout England and Wales, and especially the government of workhouses, and it being left to them to determine the extent to which the measures to be carried out should be rendered uniform.

nion of ishes.

But the districts for the administration of relief, that is, parishes by the statute of Elizabeth, and town-lands by the 13th and 14th Charles II., had been fortuitously created, sometimes containing but one householder, sometimes containing a population exceeding 100,000. There were in 1831, in England and Wales, fifty-six parishes containing less than ten persons, and which may be therefore calculated, one with the other, to contain but two adult males; a hundred and forty-eight parishes containing but from ten to twenty persons, the largest of these on the average containing five adult males; and five hundred and thirty-three parishes containing from twenty to fifty persons, the largest of which would give less than twelve adult males per parish. Taking into consideration the small number of our adult male population who can read and write, a conception may be formed of the absurdity of the expectation, that every parish can adequately supply a constant succession of annual officers competent to perform the very complicate and difficult duties of the levier and collector of rates, and distributor of relief.

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The evidence shows a large proportion of the overseers exercising these functions, though unable otherwise to sign their accounts than by their mark, attested by the justice's clerk. But if it was difficult to find a supply of officers for these districts, it would have been preposterous to expect that each district should supply itself with an efficient workhouse, however indispensable that should be as a means of protection to its population. It was found, on an examination of the largest, of the smallest, and of the intermediate parishes, in the seven first counties in England, taken in alphabetical order, that the largest districts gave the lowest cost per head, the smallest gave the greatest cost per head, and those of intermediate size an intermediate cost. The results are thus stated in the Report: The sixty-seven largest parishes gave 9s. 0¾d. per head in population; the sixty-six intermediate gave 14s. 4d. per head in population; the sixty-seven least gave 14s. 11¾d. per head in population; whilst, if we take all England, there are the still more striking results, viz. the hundred absolutely largest parishes, containing a population of 3,196,064, gave 6s. 7d. per head; the hundred intermediate parishes, containing a population of 19,841, gave 15s. per head; the hundred least parishes from which poor-rate returns are made, with a population of 1708, gave L.1. 11s. 11½d. per head.

Such are the results as tested by the cost of administration in the larger and in the smaller districts; but the moral effects in producing pauperism were as disastrous in the smaller districts. The Commissioners observe, that they "have no recent returns of proportions of paupers in the parishes referred to in the preceding statement; but on referring to the parliamentary returns of the number of paupers in each parish in the years 1803 and 1813, it appears that the number of persons relieved in the large and small parishes bore some proportion to their relative amount of rates. In the three hundred parishes of which the comparative amount of the poor's rates on the population has been stated, the average number of persons relieved was, in the hundred largest parishes, in 1803, 1 in 16, or 6¼ per cent.; in 1813, 1 in 13, or 7¾ per cent.: in the hundred intermediate ditto, in 1803, 1 in 10, or 10 per cent.; in 1813, 1 in 8, or 12½ per cent.; and in the hundred smallest ditto, in 1803, 1 in 6, or 16⅔ per cent.; in 1813, 1 in 4, or 25 per cent." And the progress of the disaster was shown to be most rapid in the smallest districts: thus, "the increase of pauperism on population, from 1803 to 1813, was, in the hundred largest parishes, 1½ per cent.; in the hundred intermediate ditto, 2½ per cent.; and in the hundred smallest ditto, 8⅓ per cent." The economy of extended management was thus experimentally proved in every possible direction, and the moral interests were shown to be the same with the pecuniary.

The Commissioners entered largely into the examination of this subject in all its bearings, and ended by recommending "that the central board be empowered to cause any number of parishes which they may think convenient, to be incorporated for the purpose of workhouse management, and for providing new workhouses where necessary; to declare their workhouses to be the common workhouses of the incorporated district, and to assign to those workhouses separate classes of poor, though composed of the poor of distinct parishes, each distinct parish paying to the support of the permanent workhouse establishment, in proportion to the average amount of the expense incurred for the relief of its poor for the three previous years, and paying separately for the food and clothing of its own paupers." This recommendation was adopted by the legislature in all points. The common workhouses are provided for by sections 23, 24, 26; the maintenance of the workhouse and establishment charges is fixed in the proportion of the average expenditure of the three previous years by section 28, with the power of taking future averages; the cost of the maintenance of its individual paupers being borne by each parish, under section 26.

Accounts.

The necessity of providing for a clear and uniform system of accounts was shown in an extraordinary manner in the inquiries of the Commission; but it is too obvious to re-

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quire further remark, and the previous observations show in some measure the difficulty of obtaining efficient parochial officers, and the necessity of resorting to further means to attain the object.

The Commissioners recommended "that the central board be empowered and required to take measures for the general adoption of a complete, clear, and, as far as may be practicable, uniform system of accounts." This recommendation was also adopted in full by the legislature, the Commissioners' powers being given by section 15, the audit being provided for by sections 46 and 89.

Paid and permanent officers.

Upon the subject of officers, the Commissioners recommend, "that the central board be empowered to incorporate, for the purpose of appointing and paying permanent officers, and for the execution of works of public labour;" and "that the central board be directed to state the general qualifications which shall be necessary to candidates for paid offices connected with the relief of the poor, to recommend to parishes and incorporations proper persons to act as paid officers, and to remove any paid officers whom they shall think unfit for their situations."

This also is adopted in the 46th section of the act, except that the Commissioners have no power to recommend the persons to act as paid officers, but have ample powers to determine, by regulation, the qualification and removal of all paid officers. The chief remaining recommendation affecting the general administration of the law by the Commissioners was, "that the board be required to submit a report annually to one of your majesty's principal secretaries of state, containing, 1. an account of their proceedings; 2. any further amendments which they may think it advisable to suggest; 3. the evidence on which the suggestions are founded; 4. bills carrying those amendments, if any, into effect, which bills the board shall be empowered to prepare with professional assistance."

This is also adopted, as far as the annual report is concerned, without, however, any definition in the act of the subjects upon which the Commissioners are to report, that being left to their discretion and to the condition of affairs to determine, section 5; they are to make a current record of their proceedings, section 4; and they are bound to give any information respecting their proceedings which the secretary of state may at any time call for, section 6.

Remedia Measure

Settleme law.

The remaining recommendations of the Commissioners relate chiefly to the law of settlement and that of bastardy. These subjects were more important when all who could gain a settlement might claim the benefit of that settlement, without any check. The improved administration, especially the inducements which now act as restraints upon the applications for relief, have diminished the motives to the voluntary pauper to fix his settlement in a good parish, and have proportionally diminished the danger to parishes, both from the attempts of the pauper, and from the exertions of the officers of other parishes to shift their burthens, by giving to their own poor the means to acquire a new settlement elsewhere. The most important change in the settlement law recommended and adopted, was that which repealed the settlement by hiring and service; a settlement which impeded the free circulation, the effects of which in restraining labourers to their parishes, and creating a reliance on their parishes, was shown to constitute the great plague-spot of the poor-law system as it then existed.[1] This law of settlement was repealed by the 64th and 65th sections, as were the settlement by occupation of a tenement without payment of poor-rates by the 66th, and that by apprenticeship to the sea-service by the 67th; and improvements in the whole law of removal, by which great wrong had been mutually done by parishes one to the other, were introduced by the 79th and following sections.

Bastardy law.

The bastardy law, which had made it a more prudent speculation for a woman to have a family of bastard children than to have an equal number of legitimate children, by enabling her to cast off the burthen of the children, which the widow could not do, and thus to enforce from the parish, and through the parish from whomsoever she charged as the father, such a contribution as would induce her to keep them. This law, also, by subjecting the person charged as the father, and who could not give security to pay, to imprisonment, was a means of terror by which a woman was often enabled to compel a marriage; a means to which recourse was had to an extent almost incredible.[2]

These demoralizing influences the legislature, by the re-

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[1] "The Reverend R. R. Bailey, chaplain to the Tower, who has had extensive opportunities of observing the operation of the poor-laws in the rural districts, was asked,—'Can you give any instances within your own knowledge, of the operation of the existing law of settlement? I was requested by Colonel Bogson, Kesgrove House, to furnish him with a farming bailiff. I found a man in all respects qualified for his situation; he was working at nine shillings a week in the parish where I lived. The man was not encumbered by a family, and he thankfully accepted my offer; the situation was, in point of emolument, and comfort, and station, a considerable advance; his advantages would have been doubled. In about a week he altered his mind, and declined the situation, in consequence, as I understood, of his fearing to remove from what was considered a good parish to a bad one, the parish to which it was proposed to remove him being connected with a hundred house, in which there is more strict management. I was requested by a poor man, whom I respected, to find a situation for his son in London. The son was a strong young man, working at that time at about eight shillings a week. I eventually succeeded in getting him a good situation of one guinea per week in London, where his labour would have been much less than it was in the country; but when the period arrived at which he was expected in London, he was not forthcoming. It appeared he had altered his mind, and determined not to take the place; as I understood, his reason for refusing to accept it arose from a reluctance to endanger his settlement in his parish. Such are the instances which are continually presented to my observation with respect to the operation of the present system of settlement.'

"Among our present modes of conferring a settlement," says Mr Russell, in the replies to which we have already adverted, "that by hiring and service is incomparably the most pernicious; it tells the poor man that he shall encounter a prohibitory duty in every market in which he attempts to dispose of the only commodity he must live by selling; it shuts the door against the most respectable and advantageous employment in which a servant can engage; by abridging the term, it impairs the strength of the connection between him and his master; and it not only drives the servant from his place, but often betrays him, during the interval between his being discharged from one house and hired at another, into bad company, dissipation, and vice. (Report, p. 155–6.)

[2] The following is an instance of the testimony as to the operation of the act, given in a letter from the overseer of Llanasa, in the county of Flint, in answer to an inquiry from the board, "Why the bastards in the parish are so few now? I can only observe, that, in the first place, we never force the putative father to marry the mother; and we compel the mother, as well as the father, to pay her quota towards the maintenance of the child. This was our simple mode of treating the business. One thing I must observe, and it tells well for the new poor-law act, that in our parish we have from fifteen to twenty weddings in the year, and it seldom happened that at the ceremony the bride did not think it decent and requisite (I am now speaking of the lower order of persons) to conceal her shape under a cloak. But in the eighteen marriages which we have had since last August, all the ladies, except one, retained their virgin shape, and appeared without the mantle." (First Annual Report, pp. 57, 58.)

"An unmarried girl, upon leaving the workhouse after her fourth confinement, said to the master, 'Well, if I have the good luck to have another child, I shall draw a good sum from the parish; and, with what I can earn myself, shall be better off than any married woman in the parish;' and the master added, that she had met with the good luck she hoped for, as she told him, a short time before I was at Holbeach, that she was five months gone with child. I asked him what she had for each child? He answered, two

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commendation of the Commissioners, deprived of further effect, *first*, by rendering the mother of a bastard liable for its maintenance, in the like manner as a widow for the maintenance of her legitimate children, section 71; *secondly*, by rendering it unlawful to pay to her any sums which the putative father might be compelled to contribute for the reimbursement of the parish; and, *thirdly*, by rendering it necessary that evidence additional to that of the mother should be required to corroborate her charge against the person accused of being the father.

Such, in the main, were the recommendations of the Commissioners, the views with which they were urged, and those with which they were adopted by the legislature. Other provisions were also adopted, necessary, indeed, to give effect to these more important purposes, but not of sufficient importance, or sufficiently characteristic of any great principle, to require remark here.

CHAPTER V.

EFFECTS OF THE AMENDED SYSTEM.

It has been seen that one of the duties with which the Commissioners were charged was that of reporting annually to the secretary of state. The Commissioners having superintended the administration for four years from August 1834, have made four Reports, and have circulated them largely. From them our chief information must be drawn; for although much discussion has taken place with respect both to the principle of the measure and the mode in which effect has been given to it, no enlarged examination of its working has, with but one exception, been made. This exception is found in the inquiry by the committees of the House of Commons appointed to inquire into certain charges made against the administration of the Commissioners. The evidence of these committees, taken during the two sessions of 1836–37 and 1837–38, and the Report made by the last, though they contain much valuable matter, and especially a very detailed account of the operation of the measure upon the morals and the condition of the labouring poor, are in the main corroborative of the Commissioners' own Report, and in disaffirmance of the charges made against the principle of the act, and the manner of its execution. This evidence, therefore, has also the effect of referring us again for information to the Reports of the Commissioners.

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It appears from the Reports of the Commissioners, that in four years they have succeeded in uniting 14,811 parishes, which they have arranged in 565 unions; and in placing thirteen parishes under boards of governors, organized and acting in a like manner as in unions. Of these, a hundred and eleven were declared and organized in the first year, two hundred and fifty-two in the second, two hundred and five in the third year, and seventeen in the fourth year. These unions have since become the districts of administration of the act for the registration of births, deaths, and marriages. The presidency of the boards of guardians has been taken by the nobility and leading gentry in their respective unions.[1] Each union is administered by a board of guardians, one guardian at least being elected for each parish or town-land. This board meets in most cases weekly; but many instances exist where, by improved skill in the performance of their functions, and by diminished pauperism, they are enabled to perform their duties efficiently by meeting once a fortnight. Three hundred and twenty-eight unions have workhouses completed and in operation; a hundred and forty-one have workhouses building or in course of alteration. Of the remaining unions, thirty-eight boards of governors have taken no steps for providing themselves with this requisite for good management. Each union is provided with the following officers: A clerk, usually a professional man, auditor, chaplain, medical officers, relieving officers, master and matron of the workhouse, schoolmaster and schoolmistress, and porter.

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Savings.

These arrangements involve a large expenditure, but are indispensable to secure the advantages of an improved administration, and of the vastly preponderating saving derivable only from a better system. Before the Poor-Law Amendment Act was passed, the Commission of Inquiry had excited universal attention to the abuses in the poor-laws. The dispersion of their searching inquiries throughout the kingdom; the visits of their assistant Commissioners; above all, the startling picture of abuse contained in the extracts from their information, and the inviting account contained in the same extracts, of the effects, pecuniary and moral, resulting in Cookham, Uley, Southwell, Bingham, Swallowfield, Hatfield, and some few other dispauperised parishes; had produced a wide-spread inclination, a sanguine hope, and in many places a vigorous effort, to reduce the abuses everywhere recognised as now prevailing. The magistracy and clergy especially aided this movement. We find, therefore, the effects of the inquiry developing themselves before the act was passed, and in some measure in the very way in which the act itself was intended to operate. The years 1833 and 1834 thus present a reduction below the previous years, as will be seen in the table at page 375, which is here repeated, and completed up to the present year.

Years.	Sums expended for Relief of the Poor.	Population of England and Wales.[2]	Average Price of Wheat per Quarter.		Number of Quarters of Wheat for which the money could have been exchanged.
	L.		s.	d.	
1801	4,017,871	8,872,980	115	11	693,234
1803	4,077,891	9,148,314	57	1	1,428,751
1811	6,656,105	10,163,676	92	5	1,440,455
1814	6,294,581	10,755,034	72	1	1,746,474
1815	5,418,846	10,979,437	63	8	1,702,255
1816	5,724,839	11,160,557	76	2	1,503,240
1817	6,910,925	11,349,750	94	0	1,470,409
1818	7,870,801	11,524,389	83	8	1,881,466
1819	7,516,704	11,700,965	72	3	2,080,748
1820	7,330,256	11,893,155	65	10	2,226,913
1821	6,959,249	11,978,875	54	5	2,557,763
1822	6,358,702	12,313,810	43	3	2,940,440
1823	5,772,958	12,508,956	51	9	2,231,094
1824	5,736,898	12,699,098	62	0	1,850,612
1825	5,786,989	12,881,906	66	6	1,740,447
1826	5,928,501	13,056,931	56	11	2,083,221
1827	6,441,088	13,242,019	56	9	2,269,987
1828	6,298,000	13,441,913	60	5	2,084,855
1829	6,332,410	13,620,701	66	3	1,911,671
1830	6,829,042	13,811,467	64	3	2,125,772
1831	6,798,888	13,897,187	66	4	2,049,916
1832	7,036,968	14,105,645	58	8	2,398,966
1833	6,790,799	14,317,229	52	11	2,566,601
1834	6,317,255	14,531,987	46	2	2,736,717
1835	5,526,418	14,749,966	46	2	2,394,116
1836	4,717,630	14,971,214	39	4	2,398,796
1837	4,044,741	15,195,782	53	8	1,507,357
1838	4,123,604	15,423,718	52	6	1,570,897

[2] The numbers given in this column for the years 1801, 1811, 1821, and 1831, are those ascertained at the enumeration of those years; those stated for the intermediate and for subsequent years are computed from the baptisms and burials, and from the rate of increase, as ascertained at each census.

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shillings; and that women in that neighbourhood could easily earn five shillings a week all the year through. Thus she will have fifteen shillings a week." (*Ibid.* p. 172.)

"At Nuneaton, the solicitor to the parish, Mr Greenaway, stated, that his house looked into the churchyard; that he was in the habit purposely of watching the persons resorting to the church for marriage, and that he could confidently say, that seventeen out of every twenty of the female poor who went there to be married were far advanced in pregnancy." (*Ibid.* 173.)

[1] See List of Officers, &c. in the Fourth Annual Report, Appendix (C), No. 2, pp. 209, *et supra*.

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To complete the view here given, the cost per head, calculating the population of the year 1838 as 15,423,718, being at the average rate of increase ascertained by the last census, will give this result, in which, for the purposes of comparison, the portion before given is here repeated.

	s.	d.
In 1800 the payments were......	9s.	1d. each.
1811..	13	1
1821..	10	7
1831..	9	9
1838..	5	4¼

For a connected view of the progress of expenditure, so far as it can now be obtained, previously to the year of inquiry, 1832, during that of the succeeding year, being that of the enactment of the Poor-Law Amendment Act, and thenceforward to the present time, reference may be had to the following table, the details of which for each county may be found at pp. 324, 325, 326, 327, of the Third Annual Report.

Amount of Money expended for the Relief of the Poor in England and Wales in the several years for which Returns have been required by Parliament.

Average of the three years ending at Easter 1748, 1749, and 1750........................		L.689,971
Year ending at Easter 1776........................		1,530,800
Average of the three years ending at Easter 1783, 1784, and 1785........................		2,004,239
Year ending at Easter........................	1803	4,077,891
... ...	1813	6,656,106
... ...	1814	6,294,581
Year ending on the 25th March...........	1815	5,418,846
... ...	1816	5,724,839
... ...	1817	6,910,925
... ...	1818	7,870,801
... ...	1819	7,516,704
... ...	1820	7,330,254
... ...	1821	6,959,251
... ...	1822	6,358,704
... ...	1823	5,772,962
... ...	1824	5,736,900
... ...	1825	5,786,989
... ...	1826	5,928,505
... ...	1827	6,441,089
... ...	1828	6,298,003
... ...	1829	6,332,411
... ...	1830	6,829,042
... ...	1831	6,798,888
... ...	1832	7,036,968
... ...	1833	6,790,799
... ...	1834	6,317,254
... ...	1835	5,526,416
... ...	1836	4,717,629
... ...	1837	4,044,741
... ...	1838	4,123,604

This table shows, that, in comparison with the parochial year ended March 1834, the savings in expenditure were—

1st year......	1835.........	L.790,838, or 13	per cent.
2d year.......	1836.........	1,599,625, or 25	...
3d year.......	1837.........	2,272,513, or 36	...
4th year.......	1838.........	2,193,650, or 35	...

making a total saving during the period the act has been in operation of L.6,856,626, as compared with the year ended March 1834.

The two following statements will show the amount of money expended for the relief and maintenance of the poor during the years ended Easter 1803, and 25th March 1818 and 1837, respectively, specifying the amount, rate per cent., and rate per head, of decrease in 1837, as compared with the years 1803 and 1818 respectively; the former being the year in which the smallest, and the latter the year in which the largest sum of money was expended for the relief of the poor, for which authentic parliamentary returns have been received:

Population in 1801, 8,872,980; expended for relief, &c. of the poor during the year ended Easter 1803, L.4,077, 891.

Population in 1821, 11,978,875; expended for relief, &c. of the poor during the year ended 25th of March 1818, L.7,870,801.

Population in 1831, 13,897,187; expended for relief, &c. of the poor during the year ended 25th of March 1837, L.4,044,741.

From this statement of the population and the expenditure at the periods described, the following results were obtained. The tables show, what is a striking exemplification of the operation of the new system, that the amount expended in 1837 was one per cent. less than that of the lowest year for which any official returns exist, apparently the lowest year in the present century. But when the increase of population is considered, this comparison becomes vastly more favourable to the improved administration. The expenditure in the year 1803, in comparison with the population of 1801, was as nine shillings and twopence per head, whilst that of 1837 was, with comparison of the population of 1831, only five shillings and tenpence.

Amount of decrease in the year ended 25th of March 1837, compared with 1803, L.33,150; ditto compared with 1818, L.3,826,060.

Decrease per cent. in 1837, compared with 1803, one; ditto compared with 1818, forty-nine.

Expenditure per head in 1803, with reference to population in 1801, nine shillings and twopence; ditto in 1818, with reference to population in 1821, thirteen shillings and twopence; ditto in 1837, with reference to population in 1831, five shillings and tenpence.

Decrease per head in 1837, compared with 1803, three shillings and fourpence; ditto compared with 1818, seven shillings and fourpence.

This, however, is still a very unfavourable view of the operations of the new system, as it does not allow for the great increase of population between the years 1831 and 1837. Estimating the population between the years 1801 and 1803 as increasing at the same rate per cent. as the increase shown in the census taken in 1811, and estimating in like manner the increase between 1831 and 1837, in accordance with the rate of increase as shown at the census of 1831, we have these results.

Rate per head in the year 1803..........	8s.	11d.
Ditto in 1837..	5	4
In favour of 1837.........	3s.	7d. per head.

Moral results.

The means of comparison between the state of the pauper and of the labouring population in the two periods preceding and succeeding the passing of the act, are not by any means so abundant as those of making the comparison of expenditure. It is nevertheless clearly apparent, that in proportion as the expenditure is diminished, the number of paupers maintained has diminished; and that the reliance on the rate, the idleness which it rendered possible, and the indulgence which it afforded, must have been on the whole proportionally diminished. We have full evidence that the diminution in enjoyment has not been at the expense of the aged, the infirm, or the impotent. The restrictive rules applied by the Commissioners (see Appendix to their First Report, p. 85) to various classes of able-bodied paupers, with various degrees of strictness, carefully preserved to the aged and impotent the benefits of the relief, such as might have been given them under the old system, but which, as shown by the Commissioners of Inquiry, was refused to them, and lavished on the insolent and reckless of the able-bodied. Now the returns show, that precisely in the places where able-bodied pauperism most prevailed, there, at the same time, the relief of the aged was least cared for; and they equally

Amended System.

show, that with the diminution of relief to the able-bodied, that to the aged and infirm has become more liberal. (See Appendix to the Second Annual Report, p. 309, 311, 416.)[1]

Improved ndustry.

The evidence as to the improvement of the labourer is too abundant to allow us even to refer the reader to all the passages in the Commissioners' Reports; but conclusive evidence will be found in the passages referred to under the title "Labourers" in the index of the Second Annual Report. These show a great improvement in the general conduct of labourers when made dependent upon the good opinion or good will of their employers; a manifest improvement in the labour of workmen when wages were substituted for relief, and, what might be expected, a parallel increased demand for the improved labour. Equally strong is the evidence of the decrease of crime, and particularly of those petty offences, such as poaching, snaring, and the smaller kinds of depredation, for which the former unsteady occupation of the farm-labourer afforded him facilities. The illustration of these subjects will be found most abundant, and in greatest detail, in the evidence given before the Select Committees of the House of Commons in the sessions 1836–37 and 1837–38. There will also be found evidence of the diminution of improvident habits generally; the increase of benefit clubs, and of deposits in savings' banks, though shown here, is made even more manifest by the returns collected and observed upon by Mr Tufnell in the Appendix to the Fourth Annual Report (p. 220–222), extracts from which are here given.

Amended System.

Providence.

"With so many circumstances tending to retard the prosperity of the labouring classes, it is gratifying to have to observe, that, so far as can be collected from statistical documents (and to figures, as being less capable of error, I am always desirous of referring), their welfare seems to have been upon the whole in a state of steady advancement since the enforcement of the regulations of the new poor-law. As one proof of this I beg to refer to the following table, which shows the deposits during the last seven years in the savings' banks in the two counties of Kent and Sussex, from friendly societies, and from the depositors of sums under L.20. I have selected these two classes of depositors, as amongst them, more than in any other class, the labouring population are chiefly to be found.

Date.	In the Kent Savings' Banks.	In the Sussex Savings' Banks.	Observations.
	L.	L.	
On the 20th November 1831	93,694	41,164	Years previous to the passing of the Poor-Law Amendment Act.
.... 1832	87,592	39,889	
.... 1833	91,371	41,686	
.... 1834	94,918	43,466	Poor-Law Amendment Act discussed and passed.
.... 1835	97,613	45,897	Poor-Law Amendment Act brought into *partial* operation.
.... 1836	106,156	50,148	Poor-Law Amendment Act brought into *universal* operation.
.... 1837	110,156	51,409	

"The three years previous to the passing of the Poor-Law Amendment Act were by no means unprosperous ones as respects those natural circumstances that affect the condition of the labourers. Yet it will be perceived how slowly the

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[1] Mr Raper, clerk of the Westhampnett Union, gave much valuable evidence on the beneficial working of the amended system before the committee of the House of Commons in session 1836–37, from which we make the following extracts:—

"With reference to the aged and infirm, have you been in the habit of giving them relief out of the house?—Certainly.

"Have you ordered them into the house on any occasions, refusing them relief out of it?—The order to an aged or infirm person to come into the house has been an exception; the general rule has been to give the relief out.

"What was the state of things in that respect before the new poor-law came into operation?—The allowances to the aged and infirm have been, generally speaking, increased since the union.

"With regard to going into the house or not?—I think there have been less aged and infirm ordered into the house since the union than previously." (3165–68.)

In the parish of Graffham, in the same union, the payments made to aged persons under the old law are stated by Mr Sadler to have been as follows:—

"By reference to the poor-book I will describe the former payments; the former allowance to this same couple, who now receive five shillings a week, was two shillings a week; the widow woman who now receives two shillings and sixpence a week used to receive one shilling a week; and the single man who now receives two shillings and sixpence, used to receive two shillings.

"Then in the parish of Graffham the payment to the aged appears to have increased?—Doubled, exactly." (17,503–4.)

The extracts from the evidence of Mr Ellis, Mr Butt, and Mr Ford, each of whom is unfavourable to the regulations of the amended system, all relate to the Petworth Union:—

"How has it (the new law) affected the aged and infirm?—The aged are taken care of now in their own parish, the same as they were before the union.

"Have many of the aged and infirm been removed into the workhouses?—Very few; not more than we had before the union." (349; Mr Ford.)

"Upon the aged and infirm paupers what do you think has been the effect of the act?—I should think that they are full as well off, and perhaps better, than they were before.

"Do they receive out-door relief?—Yes, mostly; and if I might be allowed to say, that is one of the arguments that I make use of when I ask that we may have the discretion with respect to the labourers with large families. We have the discretion with respect to the aged, and therefore have used it, and enabled them to receive that comfort under this poor-law that they had before, or perhaps more." (1490–1.)

"You have stated that you consider the condition of the aged poor to be improved; in what respect?—I hardly stated that they were improved; I said that they were as well off, if not better. In the case of aged persons, we give them the choice whether they will live out at a certain allowance, about two shillings and sixpence a week, or come into the old poor-house. If they have a child to live with, or any other person, they generally take the two shillings and sixpence instead of coming into the poor-house.

"Was not that the condition of the poor before the poor-law came into operation?—Yes, the same.

"Then in what way is their condition improved?—I think that our allowance was rather more than was given by the parishes." (1629–31; Mr Ellis.)

"Have the aged and infirm received the same amount of comforts, or a greater amount of comforts?—Greater; more liberal.

"Has there been any severity exercised towards widows or children, or single women?—Not in our Union; quite the reverse." (2664–5; Mr Butt.)

Amended System.

deposits increased in comparison to what they have done since the passing of the poor-law, and that in 1832 there was a large diminution.

“ The following table, showing the increase of the various classes of depositors in the Tunbridge Wells savings' banks between 1831 and 1837, presents gratifying proof of the greater prevalence of a spirit of providence, especially amongst the poorer classes :—

	In 1836.	In 1837.	Increase per Cent.
Servants	361	483	34
Agricultural labourers	46	137	200
Children	357	388	9
Journeymen and apprentices	39	57	46
Charitable societies	14	26	86
Benefit societies	4	5	25
Small shopkeepers	8	16	100
Small farmers, and others not described.	54	68	26
Total	883	1180	34

“ The increase of forethought in the labourers is perhaps still more strikingly manifested by the increase of members in friendly societies, which are now far more generally established on principles calculated to secure a certain provision in sickness and old age, instead of those injurious institutions, hitherto so prevalent, which seem intended only to minister to the profit of publicans, and which are usually founded on principles that must inevitably cause their dissolution when old age overtakes the members, and consequently when the utility of such societies would be most apparent, and their benefits most needed.

“ I have received the numbers that have annually belonged to three benefit societies, and these I give below. The first is a friendly society in the county of Sussex.

“ Number of members in 1831, 84; in 1832, 64; in 1833, 56; in 1834, 48; in 1835, 49; in 1836, 64; in 1837, 98.

“ The following are the returns from two Kentish friendly societies :—

“ Number of members in 1832, 378; in 1833, 363; in 1834, 356; in 1835, 353; in 1836, 420; in 1837, 478.

“Number of members in 1831, 461; in 1832, 477; in 1833, 519; in 1834, 533; in 1835, 609; in 1836, 611; in 1837, 770.

“ It will be perceived that these figures indicate either a very slow increase or an actual diminution previous to the passing of the new law, and a rapid advancement since.

“ These contrasts, however, are far less favourable to the present system than they would appear, had not the failure of the crops and the hardness of the seasons during the last year and a half pressed with peculiar severity on the labouring classes of this district. Every natural circumstance seems to have combined to test to the utmost the soundness of the principles of the poor-laws, and put their efficacy to the proof. In the two counties of Kent and Sussex referred to in the above table of the deposits in savings' banks, *upwards of a million of money has been subtracted from the poor-rates since the regulations of the Poor-Law Amendment Act came into operation*; and if, in the face of this large reduction, and of many adverse circumstances, we are enabled to refer, not to obscure deductions and conjectures, but to the unimpeachable testimony of facts like the above, are we not entitled to assume that the effect of the measure has not been hurtful to the interests of the labourers or of society in general, and that the apprehensions entertained of it are not justified by the result?”

The most impressive proof that strong motives must have been given to the able-bodied to resume the habits of honest and independent industry, may be found in a return of the operation of the law in the county of Sussex, a county in which able-bodied pauperism appeared to have had the firmest root, and the circumstances of which county afforded, at the passing of the act, the least hope of eradicating this evil. It will be seen in the table, that almost in proportion as the rate of savings in the year are large, is the effect most strikingly shown upon the able-bodied paupers.

“ *Summary of what Sussex Pauperism was under the Old System, and what it is, after little more than One Year's experiment, under the New.*

“Name of Union.	Population.	Average Annual Rates at the Formation of the Union.	Rates for the Quarter, June—September 1836.	Rate of Saving on Year.	Number of Able-bodied Paupers at the time of forming the Union.	Number of Able-bodied Paupers in March 1836.	Number of Able-bodied Paupers in June 1836.
Uckfield	16,109	16,643	1,479	61½	218	8	...
Cuckfield	12,017	17,139	2,136	46¾	419	45	...
Chailey	6,977	9,576	1,114	30¼	139	33	15
Eastbourne	7,823	11,964	1,410	40	265	12	...
Hailsham	11,825	18,351	No return.	...	350	69	...
West Fisle	2,364	2,957	539	26	40	15	...
Tinhurst	13,347	10,915	1,569	50	360	12	1
Battle	12,068	14,235	1,413	33	608	...	...
Lewes	9,297	5,770	912	36	175	4	2
East Grinstead	11,476	12,053	3,162	...	658	43	3
Hastings	13,280	6,969	1,319	24½	266	13	6
Rye	11,418	11,588	1,377	52	372	42	14
Westbourne	6,585	8,095	1,753	32	90	6	...
Steyning	11,071	9,339	1,120	15	236	11	30
Thakham	7,311	9,796	1,313	30	542	25	...
Horsham	12,270	14,663	1,776	57	454	51	1
Medhurst	12,239	17,536	1,478	66	306	20	...
Petworth	9,042	12,226	995	32	382	71	52
West Hampnett	15,017	16,457	1,687	49	216	18	...
Newhaven	4,400	3,371	492	41	64	11	...
Total	205,936	229,643	27,044	45	6160	554	124”

Marriage. One of the moral effects most to be desired was the rendering marriage no longer a consideration of policy as regarded the chances of the couple to relief, or as a means of obtaining an annuity with a family of ante-nuptial children; an effect sought by the recommendations of the Commissioners and the enactments described, and one which appears to have been abundantly realised in the operation of the measure. Dr Kay, assistant poor-law commissioner, in his examination before the Committee of the House of Commons in the last session, gave some valuable evidence relative to the decrease in the number of marriages in the counties of Norfolk and Suffolk, the counties under his superintendence, from which we have made some extracts.

"Have you any return relative to marriages which have taken place in Norfolk and Suffolk?—Last spring I instructed the relieving officers of a great number of unions to apply for returns of the marriages which occurred in the parishes in their districts in the years 1833, 1834, 1835, and 1836. A considerable difficulty was experienced in procuring those returns. Where they were procured they were given by the clergymen of the parishes very kindly, as a favour to the relieving officers; but they did not comprise, in consequence of certain difficulties which were experienced, every parish in every officer's district, but only certain of the parishes; but in every case in which the return was obtained from any parishes, it included all those years.

"From the return do you find that the number of marriages has increased or decreased in the period?—I find in this return that the marriages in the year 1833, in the districts to which it relates, were 762; in 1834 they were 771; in 1835, 663; and in 1836, 549; which I believe may be taken as evidence that there has been a considerable diminution of improvident marriages in these districts."

Bastardy. Unfortunately the question of pauper-marriage was too much connected with the operation of the law of bastardy (marriages sometimes brought about by the bribe of the allowance to a family of such children, sometimes by the threat of the jail directed against the man accused of being the father) to allow the effects of the law in diminishing marriages and in diminishing bastardy to be separated or clearly distinguished; but the direct operation of the law in checking unchastity will be seen in the extracts from the Commissioners' Second Annual Report, as inserted below.[1]

Litigation. An important indication of the improved working of the law, proving also an increased cordiality and recognition of common interests between parishes, and showing still more incontestably the benefit of the improvements in the settlement laws, is to be found in the rapid decrease of law-expenses. The sums expended in law-charges and the removal of paupers amounted in the years ended 25th March 1834 to L.258,604, in 1835 to L.202,527, in 1836 to L.172,482, in 1837 to L.126,951, and in 1838 to L.93,982.

This, however, does by no means give a sufficiently favourable view of the effect of the law; for as the amount stated includes all law-expenses, it comprises the expenditure, which has since the passing of the act been very large, in the preparation and execution of contracts, and more particularly of the conveyancing expenses connected with the purchase and hire of lands for workhouses, and with the sales of parish property, which have taken place to a large extent, but which cannot be repeated.

Prospects. It has often been asserted that the diminished cost and improved administration were owing, not so much to the enactment of the Poor-Law Amendment Act, and the new organization introduced by it, as to other general causes; a general improvement in intelligence being sometimes assigned, the increase of certain modes of employment of the people at other times, and innumerable other causes, according to the views of the person offering the explanation. The Fourth Report of the Commissioners affords a very convincing instance of the fact, that where the improved organization has not been effected, all the causes which formerly operated to render the administration stationary, or to make it retrograde, still operate with full effect. Birmingham and Aston are adjoining parishes, with populations of the same habits, and equally participating in every element of prosperity or decline. The year 1837 severely tried the operation of the act. A great failure in many branches of trade and commerce, and two severe winters, had contributed to render the distress of the poor more urgent and more general than at any period since the passing of the act. The high price of provisions during a very large part of the period enhanced these effects. The result has been, that although on the entire operations of the last year every reason appears for entertaining the belief that the improvements in the administration had not been less progressive than in preceding years, the saving in money is, upon the whole, very little greater than that of the year ending March 1837. Birmingham has not yet been placed under the control of the Commissioners' regulations. Aston has been placed under a board of guardians, and is governed under the Commissioners' regulations. It is difficult to suppose that Birmingham has not had its full share of any advantage derivable from increased intelligence or increased prosperity; at all events, it is difficult to suppose that Aston, usually regarded as a part of Birmingham, can have the advantage of any such general influence, and Birmingham be deprived of it. The account shows that, under the trial of circumstances to which each has been equally subjected, the parish of Birmingham has been driven to an increased expenditure of forty-one per cent., while the parish of Aston has successfully withstood the operation of the like circumstances, and has effected a diminution upon its previous expenditure of thirty-five per cent. The comparison, the whole of the details of which are given in the Commissioners' Fourth Annual Report, pp. 362–64, stands thus:—

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[1] "The Rev. Thomas Pitman, minister of Eastbourne, says, 'Among the labouring classes there is a decided and progressive alteration. Even the farmers themselves have observed to me, that there is in the general conduct of the agricultural labourers a civility of manner, and attention to their masters' wishes, which of late years has been little perceptible. Perhaps the most marked difference in the lower orders, observable by us as clergymen, is the almost total cessation of early and improvident marriages. I should not forget also to mention, that, as far as I can form a judgment, there is also a decided improvement in the marriages that do take place. The altar is not now, as heretofore, disgraced by the appearance of a woman, to take upon her the solemn obligation of matrimony, in the last stage of pregnancy; a fact which, I think, goes far to show, that the morals of the people are undergoing a change for the better, and promises that ere long we may hope for all that domestic happiness among our poorer neighbours which results from a match of pure affection, in the place of all that wretchedness, discord, and misery which are the too sure produce of a marriage commenced in sin, and fostered only by a hope of procuring a means from the parish of carrying on from time to time sinful indulgences.'

"Reverend John Austin, minister of Pulborough, states that 'We now begin to look for moral and religious improvement, as the hard-working men engaged in industry are become civil and attentive to their masters. Only two marriages have been solemnized since December last, the yearly average being fifteen; and only one bastard has been christened between July 12, 1835, and May 17, 1836. (The population of this parish is 1976, according to the census of 1831.)'

"It is satisfactory to us to observe, that the practice, which was at one time almost universal, of dealing with the mothers of bastard children differently from other paupers, is rapidly giving way; and the sounder course of giving them relief only according to the measure and character of their wants is more generally adopted.

"The information which we have received on the subject of the clauses in the new act, with relation to bastardy, is confirmatory of the facts and conclusions stated upon the subject in our last Annual Report. From the returns which we have received, it appears that the whole number of bastards chargeable to the parishes of England and Wales was, in the year 1835, 71,298; the number chargeable in the year 1836 was 61,826; being a decrease of 9472, or of thirteen per cent.

"But the progressive operation of the bill appears in the numbers affiliated during the two years, which numbers were, in 1835, 12,381; in 1836, 7686; being a decrease of 4695, or of thirty-eight per cent.

"We endeavoured to obtain an account of the numbers born during those years chiefly, as shown in the baptismal registers; but our respondents declare that these returns are extremely imperfect, and are so much at variance with other testimony, that no reliance can be placed upon them for accuracy. In some parishes very many of the bastard children are never baptized; and in many other parishes, where they have not been accustomed to baptize them before the passing of the act, children have been baptized subsequently, in consequence of the fact of a woman being known to have had a bastard not rendering her liable to the interference of the parish-officer where she does not claim relief.

"The evidence of midwives and parish-officers, and other witnesses, speaking upon their own knowledge of their respective parishes, would prove that the diminution of the number of births was considerable.

"The number returned as born in the year 1835, was 17,036; and in the year ended 25th March 1836, was 17,578. This variation between the two years is attributed to the more full registration in the last year.

"According to the population returns, the number of bastards born in the year 1831 was 20,039, which, if allowance were made for the increase of population since that year, would show a decrease of between 4000 and 5000 born in the last year." (Second Annual Report, pp. 17, 18, 19.)

Birmingham Parish.

		L.	s.	d.	
Expenditure in	1836–7......	24,686	15	0	
Ditto	1837–8......	34,755	10	0	
Increase.........		L.10,068	15	0,	or 41 per cent.

Aston Parish.

Expenditure in	1836–7......	6,801	9	7	
Ditto	1837–8......	4,497	17	9	
Decrease.........		L.2,303	11	10,	or 35 per cent.

A better proof can scarcely be found of the efficiency of the amendments to protect the country against a return to the state of things from which the law has so recently extricated us. (A. A. A. A. A.)

POORNAH, a river of Hindustan, which rises in the Injardy Hills, whence it flows westward through Berar, and falls into the Tuptee about twenty miles below Boorhanpoor.

POORPOOROO, a small island in the Eastern Seas, near the north-eastern coast of Borneo. Long. 117. 54. E. Lat. 6. 18. N.

POORUNDER, a celebrated town and fortress of Hindustan, in the province of Bejapore. It belonged till lately to the peshwa. It was in this fortress that the widow of Narrain Row took refuge after the murder of her husband, and where she brought forth her posthumous child, who succeeded to the dignity of peshwa. It is seventeen miles from Poonah. Long. 74. 5. E. Lat. 18. 16. N.

POORWAH, a town of Hindustan, in the nabob of Oude's territories, twenty-eight miles south-south-west from Lucknow. Long. 80. 44. E. Lat. 20. 28. N.

POOSHKUR, or PHOKUR, a town of Hindustan, in the province of Ajmeer, and situated on the shore of a romantic lake. It contains a remarkable temple dedicated to Brahma, with an image that has four heads and as many arms, besides other temples dedicated to Vishnu and Seva. The town contains about 700 houses, the inhabitants of which are mostly Brahmins, who depend entirely on charity for support. Here is also a mosque, built by a Mahommedan nobleman, tutor to the Emperor Akbar. It is four miles from Ajmeer.

POOTELLAM, a town of Hindustan, on the western coast of Ceylon, celebrated for an extensive manufactory of sea-salt, which formerly supplied Candy and the interior. Long. 79. 51. E. Lat. 8. 5. N.

POOTI, a river on the east coast of Sumatra, which falls into the Sea of Java. Long. 105. 45. E. Lat. 4. 38. S.

POPAYAN, a province included in the republic of New Grenada, in South America. It is situated in the department of Cauca, and is bounded on the south by Pasto, on the west by Buenaventura and Choco, on the east by Neiva and Bogota, and on the north by Antioquia. This province is somewhat rugged and mountainous, but withal one of the richest and finest districts in all America. The banks of the river Cauca appear to present the greatest indications of opulence, the soil being deep, and the pasturages rich and fertile. Even the muleteers, proud of being whites, are ashamed to go on foot, so that it is difficult to distinguish the poor from the rich. This prosperity and opulence are to be ascribed to a fertile soil, and to abundant gold mines, though they are unskilfully worked.

Popayan, the capital of the province, is finely situated on the banks of the Cauca, at the foot of the volcanic mountain of Purace. Mollien, who visited this city, speaks highly in praise of its site. "It is said," he remarks, "that the position of Popayan seems to have been created by the imagination of poets; and in fact it is difficult to find one more beautiful. It was selected by Benalcazar, who is less known than either Pizzaro, Cortes, or Quesada, but deserves to be more celebrated, as he was the founder of many towns, all delightfully situated." It is handsomely built, and its elevation above the sea, which is 5750 feet, renders the climate mild and agreeable. This city suffered greatly, as did the whole province, during the war of independence; and in the year 1827 it was almost entirely destroyed by an earthquake, which was accompanied by an eruption of the volcano of Purace, and an overflow of the Cauca. Before this calamity, the inhabitants were estimated at 20,000.

Amongst the other towns of this province may be mentioned that of Purace, which is agreeably situated above the valley of Popayan. It is a neat place, each house being built in the midst of an enclosure. Caly is another prettily-built town, situated on the declivity of the western cordilleras. Considerably further down the Cauca, almost at the extremity of the great plain, is situated Carthago. It stands near the point where the two cordilleras approach, leaving only a narrow passage for the river, and is the entrepôt for the goods destined for Santa Fe, which arrive by the Quindiu, and those for the Antilles or the ocean, which come by way of Novita, situated near the Rio San Juan. The population of the whole province of Popayan is estimated at about 107,000.

POPE, a name which comes from the Greek word Παπα, and signifies *Father*. In the East this appellation is given to all Christian priests, and in the West bishops were called by it in ancient times; but for many centuries it has been appropriated to the bishop of Rome, whom the Roman Catholics look upon as the common Father of all Christians.

Within the last two or three centuries, much has been said and written, and many warm disputes have been carried on, concerning the Pope, and the power belonging to him. After describing the manner of his election, we shall here, without entering into controversy, lay down distinctly, from the best authority, what the Roman Catholics really believe concerning the Pope; and we shall give some other particulars relating to this subject which seem to deserve notice, and which are not generally known in this country.

All those in communion with the see of Rome unanimously hold that our Saviour Jesus Christ constituted St Peter the apostle chief pastor under himself, to watch over his whole flock here upon earth, and to preserve the unity of the church, at the same time giving him the power requisite for these ends. They also believe that our Saviour ordained that St Peter should have successors with the like authority and power, to the end of time. Now, as they allege that St Peter resided for many years at Rome, and there suffered martyrdom, they consider the bishops of Rome as his successors in the dignity and office of the universal pastor of the whole Catholic Church.

There have been some varieties in the manner of choosing the bishop of Rome in different ages, as alterations may be made in discipline; but still the clergy of Rome have always had the chief part in the election; and that clergy is now represented by, or in some manner consists of, the cardinals, who have for several centuries been the sole electors of the Pope.

These cardinals, or principal persons of the church of Rome, are seventy in number, when the sacred college, as it is called, is complete. Of these, six are cardinal bishops, viz. the bishops of Ostia, Porto, Albano, Sabino, Tusculum or Frascati, and Præneste or Palestrina, which are the six suburbicarian churches; fifty are cardinal priests, who have all titles from parish churches in Rome; and fourteen are cardinal deacons, who have their titles from churches in Rome of less note, called *diaconias* or deaconries. These cardinals are created by the Pope when there happen to be vacancies. Sometimes he names one or two only at a time; but commonly he defers the promotion until there be ten or twelves vacancies or more; and then at every second such promotion, the emperor, the kings of Spain and France, and of Great Britain when Catholic, are allowed to present one each, to be made cardinal, whom the Pope always admits if there be not some very great and evident objection. These cardinals are commonly promoted from amongst such clergymen as have borne offices in the Roman court; some are assumed from religious orders; and eminent ecclesiastics of other countries are likewise often honoured with this dignity. Sons of sovereign princes have frequently been members of the sacred college. Their distinctive dress is scarlet, to signify that they ought to be ready to shed their blood for the faith and the church, when the defence and honour of either require it. They wear a scarlet cap and hat. The cap is given to them by the Pope if they are at Rome, and is sent to them if they are absent; but the hat is never given but by the Pope's own hand. These cardinals form the Pope's standing council or consistory for the management of the public affairs of church and state. They are divided into different congregations for the more easy despatch of business; and some of them hold the principal offices in the pontifical court, as that of cardinal-vicar, penitentiary, chancellor, camerlingo or chamberlain, prefect of the signature of justice, prefect of memorials, and secretary of state. They have the title of *eminence* and *most eminent* given them. But here we consider them principally as the persons intrusted with the choice of the Pope.

On the demise of a Pope, his pontifical seal is immediately broken by the chamberlain, and all public business is interrupted that can be delayed. Messengers are despatched to all the Catholic sovereigns to acquaint them of the event, that they may take what measures they think proper, and that the cardinals in their dominions, if any there be, may hasten to the future election if they choose to attend; whilst the whole attention of the sacred college is turned to the preservation of tranquillity in the city and state, and to the necessary preparations for the future election. The cardinal chamberlain, during the vacancy of the holy see, possesses great authority; he coins money with his own arms on it, lodges in the Pope's apartments, and is attended by body-guards. He, and the first cardinal bishop, the first cardinal priest, and the first cardinal deacon, have, during that time, the government almost entirely in their hands. The body of the deceased Pope is carried to St Peter's, where funeral service is performed for him with great pomp during nine days, and the cardinals attend there every morning. In the mean time, all necessary preparations for the election are made; and the place where they assemble for that purpose, which is called the conclave, is fitted up in that part of the Vatican palace which is nearest St Peter's church, as this has long been thought the most convenient situation. Here is formed by partitions of wood a number of cells or chambers equal to the number of cardinals, with a small distance between every two, and a broad gallery before them. A number is put upon every cell, and small papers with corresponding numbers are put into a box. Every cardinal, or some one for him, draws out one of these papers, which determines in what cell he is to lodge. The cells are lined with cloth; and there is a part of each one separated for the conclavists or attendants, of whom two are allowed to each cardinal, and three to cardinal princes. They are persons of some rank, and generally of great confidence; but they must carry in their master's meals, serve him at table, and perform all the offices of a menial servant. Two physicians, two surgeons, an apothecary, and some other necessary officers, are chosen for the conclave by the cardinals.

On the tenth day after the Pope's death, the cardinals who are then at Rome, and in a competent state of health, meet in the chapel of St Peter's, which is called the Gregorian Chapel, where a sermon on the choice of a Pope is preached to them, and mass is said for invoking the grace of the Holy Ghost. Then the cardinals proceed to the conclave in procession two by two, and take up their abode. When all is properly settled, the conclave is shut up, having boxed wheels or places of communication in convenient quarters; and there are also strong guards placed all around. When any foreign cardinal arrives after the inclosure, the conclave is opened for his admission. In the beginning every cardinal signs a paper, containing an obligation, that if he shall be raised to the papal chair he will not alienate any part of the pontifical dominion; that he will not be prodigal to his relations; and such other stipulations as may have been settled in former times or framed for the occasion.

We come now to the election itself; and that this may be effectual, two thirds of the cardinals present must vote for the same person. As this is often not easily obtained, they sometimes remain whole months in the conclave. They meet in the chapel twice every day for giving their votes; and the election may be effected by scrutiny, accession, or acclamation. Scrutiny is the ordinary method, and consists in this: Every cardinal writes his own name on the inner part of a piece of paper, and this is folded up and sealed. On a second fold of the same paper a conclavist writes the name of the person for whom his master votes. This, according to the practice observed for some centuries, must be one of the sacred college. On the outer side of the paper is written a sentence at random, which the voter must well remember. Every cardinal, on entering into the chapel, goes to the altar and puts his paper into a large chalice.

When all are convened, two cardinals number the votes; and if they are more or less than the number of cardinals present, the voting must be repeated. When that is not the case, the cardinal appointed for the purpose reads the outer sentence, and the name of the cardinal under it, so that each voter hearing his own sentence and the name joined with it, knows that there is no mistake. The names of all the cardinals that are voted for are taken down in writing, with the number of votes for each; and when it appears that any has two thirds of the number present in his favour the election is over; but when this does not happen, the voting papers are all immediately burned without opening up the inner part. When several trials of coming to a conclusion by this method of scrutiny have been made in vain, recourse is sometimes had to what is called accession. By it, when a cardinal perceives that one or very few votes are wanting to any one for whom he had not voted at that time, he may say that he accedes to the one who has nearly the number of votes requisite; and if his one vote suffices to make up the two thirds, or if he is followed by a sufficient number of new voters for the said cardinal, the election is accomplished. Lastly, a Pope is sometimes elected by acclamation; that is, when a cardinal, being pretty sure that he will be joined by a sufficient number, cries out in the open chapel, that such a one shall be Pope. If he is supported properly, the election becomes unanimous; those who would perhaps oppose it foreseeing that their opposition would be fruitless, and rather hurtful to themselves. It is to be observed, that the emperor of Germany and the kings of France and Spain claimed a right of excluding one cardinal from being Pope at every election. Hence, when the ambassador at Rome of any of these sovereigns perceived that any cardinal disagreeable to his master was likely to be made Pope, he demanded an audience of the conclave, was admitted, and there declared his master's will, which was always attended to for the common good. But each of those sovereigns was thus allowed to exclude only one at a time; and they unwillingly and seldom put this right in execution.

When a Pope is chosen in any of the three above-mentioned ways, the election is immediately announced from the balcony in the front of St Peter's; homage is paid to the new pontiff; and couriers are sent off with the news to all parts of Christendom. The Pope appoints a day for his coronation at St Peter's, and for his taking possession of the patriarchal church of St John Lateran; all which is performed with great solemnity. He is addressed by the title of Holiness, and Most Holy Father.

Let us now proceed to state what authority Roman Catholics attribute to the Pope thus chosen. They believe, then, that the bishop of Rome is, under Christ, supreme pastor of the whole church; and as such, is not only the first bishop in order and dignity, but has also a power and jurisdiction over all Christians, to preserve unity and purity of faith and moral doctrine, and to maintain order and regularity in all churches. Wherefore they hold, that when the Pope understands that any error has been broached against faith or manners, or that any considerable difference on such subjects has arisen in any part of Christendom, it belongs to him, after due deliberation and consultation, to issue out his pastoral decree, condemning the error, clearing up the doubt, and declaring what has been handed down, and what is to be believed. Some Catholic divines are of opinion that the Pope cannot err when he thus addresses himself to all the faithful on matters of doctrine. They well know, that as a private doctor he may fall into mistakes as well as any other man; but they think, that when he teaches the whole church, Providence must preserve him from error; and they apprehend, that this may be deduced from the promises of Christ to St Peter, and from the writings of the ancient fathers. It is to be observed, however, that this infallibility of the Pope, even when he pronounces in the most solemn manner, is only an opinion, and not an article of Roman Catholic faith. Wherefore, when he sends forth doctrinal decrees, the other bishops, who are also guardians of the faith in an inferior degree, may, with due respect, examine these decrees; and if they find them agree with what has always been taught, they either formally signify their acceptance, or they tacitly acquiesce, which, considering their duty, is equivalent to a formal approbation. When the acceptation of the generality of the bishops has been obtained, either immediately or after some mutual correspondence and explanation, the decrees of the Pope thus accepted come to be the sentence of the whole church, and are believed to be beyond the possibility of error.

Sometimes it happens that the disputes and differences may be so great and intricate, that, to the end it may be seen more clearly what has really been delivered down, and to give all possible satisfaction, it may appear proper to convene all the bishops who can conveniently attend, at one place, to learn from them more distinctly what has been taught and held in their respective churches. Roman Catholics believe that it belongs to the Pope to call such general councils, and to preside in them in person or by his legates. They likewise hold, that when the Pope has approved the decrees of such councils concerning faith or manners, such decrees become final, and must be received as such by all Catholics. In all this they believe that the particular assistance of the Holy Ghost is with the pastors of the church, and that therefore "the gates of hell shall never prevail against her."

The see of Rome, according to the Roman Catholics, is the centre of Catholic unity. All their bishops communicate with the Pope, and by his means with one another, and so form one body. However distant their particular churches may be, they all meet at Rome either in person or by their delegates, or at least by their letters; and, according to the discipline of the latter ages, though they are presented to the Pope for their office from their respective countries, yet from him they must receive their bulls of consecration before they can take possession of their sees.

In matters of ecclesiastical discipline, the Pope, as chief pastor, not only must take care that the canons actually in force be observed in all churches, but he may also make new canons and regulations when he sees it necessary or expedient for the spiritual benefit of the faithful, according to times and circumstances. But in doing this he must not infringe the established rights or customs to the injury of any person; which if, through mistake or wrong information, he should ever do, the persons who think themselves aggrieved may remonstrate with respect, and sue for redress. He may establish new episcopal sees where there have been none before, and he may alter the limits of former dioceses; but in such alterations he always of course consults the temporal sovereign, if in communion with him. He sends pastors to preach the gospel to all countries where the Catholic religion is not by law established; and to him appeals may be made from all parts of Christendom in ecclesiastical causes of importance.

The Pope may dispense with the observation of ecclesiastical canons when there are just reasons for it; he may also dispense with vows when they are made with the express or tacit condition[1] that he really may dispense with them; he may also on some occasions declare that obligations have really ceased when that is truly the case, from a great alteration of circumstances. But he can never grant any dispensation to the injury of any third person, and can never allow any one to do what is unjust, or to say what he knows to be false, whatever advantage might be expected to accrue from it.

The reader who wishes to learn what may be urged for and against the supremacy of the Pope, and who is fitted by his knowledge of ecclesiastical history to understand the nature of the question at issue, may consult, on the one hand, the works of Bellarmine, with the chapter on Supremacy in Milner's Letters to a Prebendary; and on the other, Barrow's treatise on the Pope's Supremacy, together with Chillingworth's Religion of Protestants.

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[1] Any other man may unquestionably do the same when they are made with that express condition.

POPE.

POPE, ALEXANDER, the most brilliant of all wits who have at any period applied themselves to the poetic treatment of human manners, to the selecting from the play of human character what is picturesque, or the arresting what is fugitive, was born in the city of London on the 21st[1] day of May in the memorable year 1688; about six months, therefore, before the landing of the Prince of Orange, and the opening of that great revolution which gave the final ratification to all previous revolutions of that tempestuous century. By the "city" of London the reader is to understand us as speaking with technical accuracy of that district which lies within the ancient walls and the jurisdiction of the lord mayor. The parents of Pope, there is good reason to think, were of "gentle blood," which is the expression of the poet himself when describing them in verse. His mother was so undoubtedly; and her illustrious son, in speaking of her to Lord Harvey, at a time when any exaggeration was open to an easy refutation, and writing in a spirit most likely to provoke it, does not scruple to say, with a tone of dignified haughtiness not unbecoming the situation of a filial champion on behalf of an insulted mother, that by birth and descent she was not below that young lady (one of the two beautiful Miss Lepels) whom his lordship had selected from all the choir of court beauties as the future mother of his children. Of Pope's extraction and immediate lineage for a space of two generations we know enough: beyond that we know little: of this little a part is dubious; and what we are disposed to receive as *not* dubious, rests chiefly on his own authority. In the prologue to his Satires, having occasion to notice the lampooners of the times, who had represented his father as "a mechanic, a hatter, a farmer, nay a bankrupt," he feels himself called upon to state the truth about his parents; and naturally much more so at a time when the low scurrilities of these obscure libellers had been adopted, accredited, and diffused by persons so distinguished in all points of personal accomplishment and rank as Lady Mary Wortley Montagu and Lord Harvey: "*hard as thy heart*," was one of the lines in their joint pasquinade, "*hard as thy heart, and as thy birth obscure*." Accordingly he makes the following formal statement: "Mr Pope's father was of a gentleman's family in Oxfordshire, the head of which was the Earl of Downe. His mother was the daughter of William Turner, Esq. of York: she had three brothers, one of whom was killed; another died in the service of King Charles [meaning Charles I.]; the eldest, following his fortunes, and becoming a general officer in Spain, left *her* what estate remained after the sequestrations and forfeitures of her family." The sequestrations here spoken of were those inflicted by the commissioners for the parliament; and usually they levied a fifth, or even two fifths, according to the apparent delinquency of the parties. But in such cases two great differences arose in the treatment of the royalists; first, that the report was coloured according to the interest which a man possessed, or other private means for biassing the commissioners; secondly, that often, when money could not be raised on mortgage to meet the sequestration, it became necessary to sell a family estate suddenly, and therefore in those times at great loss; so that a nominal fifth might be depressed by favour to a tenth, or raised by the necessity of selling to a half. And hence might arise the small dowry of Mrs Pope, notwithstanding the family estate in Yorkshire had centred in her person. But, by the way, we see from the fact of the eldest brother having sought service in Spain, that Mrs Pope was a Papist; not, like her husband, by conversion, but by hereditary faith. This account, as publicly thrown out in the way of challenge by Pope, was, however, sneered at by a certain Mr Pottinger of those days, who, together with his absurd name, has been safely transmitted to posterity in connection with this single feat of having contradicted Alexander Pope. We read in a diary published

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[1] Dr Johnson, however, and Joseph Warton, for reasons not stated, have placed his birth on the 22d. To this statement, as opposed to that which comes from the personal friends of Pope, little attention is due. Ruffhead and Spence, upon such questions, must always be of higher authority than Johnson and Warton, and *a fortiori* than Bowles. But it ought not to be concealed, though hitherto unnoticed by any person, that some doubt after all remains whether *any* of the biographers is right. An anonymous writer, contemporary with Pope, and evidently familiar with his personal history, declares that he was born on the 8th of June; and he connects it with an event that, having a public and a partisan interest (the birth of that Prince of Wales who was known twenty-seven years afterwards as the Pretender), would serve to check his own recollections, and give them a collateral voucher. It is true he wrote for an ill-natured purpose; but no purpose whatever could have been promoted by falsifying this particular date. What is still more noticeable, however, Pope himself puts a most emphatic negative upon all these statements. In a pathetic letter to a friend, when his attention could not have been wandering, for he is expressly insisting upon a sentiment which will find an echo in many a human heart, viz. that a birthday, though from habit usually celebrated as a festal day, too often is secretly a memorial of disappointment, and an anniversary of sorrowful meaning, he speaks of the very day on which he is then writing as his own birthday; and indeed what else could give any propriety to the passage? Now the date of this letter is January 1, 1733. Surely Pope knew his own birthday better than those who have adopted a random rumour without investigation.

But, whilst we are upon this subject, we must caution the readers of Pope against too much reliance upon the chronological accuracy of his editors. *All* are scandalously careless; and generally they are faithless. Many allusions are left unnoticed, which a very little research would have illustrated; many facts are omitted, even yet recoverable, which are essential to the just appreciation of Pope's satirical blows; and dates are constantly mis-stated. Mr Roscoe is the most careful of Pope's editors; but even he is often wrong. For instance, he has taken the trouble to write a note upon Pope's humorous report to Lord Burlington of his Oxford journey on horseback with Lintot; and this note involves a sheer impossibility. The letter is undated, except as to the month; and Mr Roscoe directs the reader to supply 1714 as the true date, which is a gross anachronism. For a ludicrous anecdote is there put into Lintot's mouth, representing some angry critic, who had been turning over Pope's Homer, with frequent *pshaws*, as having been propitiated, by Mr Lintot's dinner, into a gentler feeling towards Pope, and, finally, by the mere effect of good cheer, without an effort on the publisher's part, as coming to a confession, that what he ate and what he had been reading were equally excellent. But in the year 1714 *no part* of Pope's Homer was printed; June 1715 was the month in which even the subscribers first received the four earliest books of the Iliad; and the public generally not until July. This we notice by way of specimen; in itself, or as an error of mere negligence, it would be of little importance; but it is a case to which Mr Roscoe has expressly applied his own conjectural skill, and solicited the attention of his reader. We may judge therefore of his accuracy in other cases which he did not think worthy of examination.

There is another instance, presenting itself in every page, of ignorance concurring with laziness, on the part of all Pope's editors, and with the effect not so properly of misleading as of perplexing the general reader. Until Lord Macclesfield's bill for altering the style in the very middle of the eighteenth century, six years therefore after the death of Pope, there was a custom, arising from the collision between the civil and ecclesiastical year, of dating the whole period that lies between December 31st and March 25th (both days *exclusively*) as belonging indifferently to the past or the current year. This peculiarity had nothing to do with the old and new style, but was, we believe, redressed by the same act of parliament. Now in Pope's time it was absolutely necessary that a man by the Microcosm, "*Met a large hat, with a man under it.*" And so, here, we cannot so properly say that Mr Pottinger brings down the contradiction to our times, as that the contradiction brings down Mr Pottinger. "Cousin Pope," said Pottinger, "had made himself out a fine pedigree, but he wondered where he got it:" and he then goes on to plead in abatement of Pope's pretensions, "that an old maiden aunt, equally related" (that is, standing in the same relation to himself and to the poet), "a great genealogist, who was always talking of her family, never mentioned this circumstance." And again we are told, from another quarter, that the Earl of Guildford, after express investigation of this matter, "was sure that," amongst the descendants of the Earls of Downe, "there was none of the name of Pope." How it was that Lord Guildford came to have any connection with the affair, is not stated by the biographers of Pope; but we have ascertained that, by marriage with a female descendant from the Earls of Downe, he had come into possession of their English estates.

Finally, though it is rather for the honour of the Earls of Downe than of Pope to make out the connection, we must observe that Lord Guildford's testimony, *if ever given at all*, is simply negative; he had found no proofs of the connection, but he had not found any proofs to destroy it; whilst, on the other hand, it ought to be mentioned, though unaccountably overlooked by all previous biographers, that one of Pope's anonymous enemies, who hated him personally, but was apparently master of his family history, and too honourable to belie his own convictions, expressly affirms of his own authority, and without reference to any claim put forward by Pope, that he was descended from a junior branch of the Downe family: which testimony has a double value; first, as corroborating the probability of Pope's statement viewed in the light of a fact; and, secondly, as corroborating that same statement viewed in the light of a current story, true or false, and not as a disingenuous fiction put forward by Pope to confute Lord Harvey.

It is probable to us, that the Popes, who had been originally transplanted from England to Ireland, had in the person of some cadet been re-transplanted to England; and that having in that way been disconnected from all personal recognition, and all local memorials of the capital house, by this sort of *postliminium*, the junior branch had ceased to cherish the honour of a descent which was now divided from all direct advantage. At all events, the researches of Pope's biographers have not been able to trace him farther back in the paternal line than to his grandfather; and he (which is odd enough, considering the popery of his descendants) was a clergyman of the established church in Hampshire. This grandfather had two sons: of the eldest nothing is recorded beyond the three facts, that he went to Oxford, that he died there, and that he spent the family estate.[1] The younger son, whose name was Alexander, had been sent when young, in some commercial character, to Lisbon;[2] and there it was, in that centre of bigotry, that he became a sincere and most disinterested Catholic. He returned to England; married a Catholic young widow; and became the father of a second Alexander Pope, *ultra Sauromatas notus et Antipodes.*

By his own account to Spence, Pope learned "very early to read;" and writing he taught himself "by copying from printed books;" all which seems to argue, that, as an only child, with an indolent father and a most indulgent mother, he was not molested with much schooling in his infancy. Only one adventure is recorded of his childhood, viz. that he was attacked by a cow, thrown down, and wounded in the throat.

Pope escaped this disagreeable kind of vaccination with-

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should use this double date, because else he was liable to be seriously misunderstood. For instance, it was then always said that Charles I. had suffered on the 30th of January $164\frac{8}{9}$; and why? Because, had the historian fixed the date to what it really was, 1649, in that case all those (a very numerous class) who supposed the year 1649 to commence on Ladyday, er March 25, would have understood him to mean that this event happened in what we *now* call 1650, for not until 1650 was there any January which *they* would have acknowledged as belonging to 1649, since *they* added to the year 1648 all the days from January 1 to March 24. On the other hand, if he had said simply that Charles suffered in 1648, he would have been truly understood by the class we have just mentioned; but by another class, who began the year from the 1st of January, he would have been understood to mean what we *now* mean by the year 1648. There would have been a sheer difference, not of one, as the reader might think at first sight, but of *two* entire years in the chronology of the two parties; which difference, and all possibility of doubt, is met and remedied by the fractional date $\frac{1648}{1649}$; for that date says in effect it was 1648 to you who do not open the new year till Ladyday; it was 1649 to you who open it from January 1. Thus much to explain the real sense of the case; and it follows from this explanation, that no part of the year ever *can* have the fractional or double date except the interval from January 1 to March 24 inclusively. And hence arises a practical inference, viz. that the very same reason, and no other, which formerly enjoined the use of the compound or fractional date, viz. the prevention of a capital ambiguity or dilemma, now enjoins its omission. For in our day, when the double opening of the year is abolished, what sense is there in perplexing a reader by using a fraction which offers him a choice without directing him how to choose. In fact, it is the *denominator* of the fraction, if one may so style the lower figure, which expresses to a modern eye the true year. Yet the editors of Pope, as well as many other writers, have confused their readers by this double date; and why? Simply because they were confused themselves. Many errors in literature of large extent have arisen from this confusion. Thus it was said properly enough in the contemporary accounts, for instance in Lord Monmouth's Memoirs, that Queen Elizabeth died on the last day of the year 1602, for she died on the 24th of March; and by a careful writer this event would have been dated as March 24, $\frac{1602}{1603}$. But many writers, misled by the phrase above cited, have asserted that James I. was proclaimed on the 1st of January 1603. Heber, bishop of Calcutta, again, has ruined the entire chronology of the life of Jeremy Taylor, and unconsciously vitiated the facts, by not understanding this fractional date. Mr Roscoe even too often leaves his readers to collect the true year as they can: thus, *e. g.* at p. 503 of his Life, he quotes from Pope's letter to Warburton, in great vexation for the surreptitious publication of his letters in Ireland, under date of February 4, $174\frac{0}{1}$. But why not have printed it intelligibly as 1741? Incidents there are in most men's lives, which are susceptible of a totally different moral value, according as they are dated in one year or another. That might be a kind and honourable liberality in 1740, which would be a fraud upon creditors in 1741. Exile to a distance of ten miles from London in January 1744, might argue, that a man was a turbulent citizen, and suspected of treason; whilst the same exile in January 1745 would simply argue that, as a Papist, he had been included amongst his whole body in a general measure of precaution to meet the public dangers of that year. This explanation we have thought it right to make, both for its extensive application to *all* editions of Pope, and on account of the serious blunders which have arisen from the case when ill understood; and because, in a work upon education, written jointly by Messrs Lant Carpenter and Shephard, though generally men of ability and learning, this whole point is erroneously explained.

[1] It is apparently with allusion to this part of his history, which he would often have heard from the lips of his own father, that Pope glances at his uncle's memory somewhat disrespectfully in his prose letter to Lord Harvey.

Some accounts, however, say to Flanders, in which case, perhaps, Antwerp or Brussels would have the honour of his conversion.

out serious injury, and was not farther tormented by cows or schoolmasters until he was about eight years old, when the family priest, that is, we presume, the confessor of his parents, taught him, agreeably to the Jesuit system, the rudiments of Greek and Latin concurrently. This priest was named Banister; and his name is frequently employed, together with other fictitious names, by way of signature to the notes in the Dunciad, an artifice which was adopted for the sake of giving a characteristic variety to the notes, according to the tone required for the illustration of the text. From his tuition Pope was at length dismissed to a Catholic school at Twyford, near Winchester. The selection of a school in this neighbourhood, though certainly the choice of a Catholic family was much limited, points apparently to the old Hampshire connection of his father. Here an incident occurred which most powerfully illustrates the original and constitutional determination to satire of this irritable poet. He knew himself so accurately, that in after times, half by way of boast, half of confession, he says,

> But touch me, and no Minister so sore:
> Whoe'er offends, at some unlucky time
> Slides into verse and hitches in a rhyme,
> Sacred to ridicule his whole life long,
> And the sad burthen of some merry song.

Already, it seems, in childhood he had the same irresistible instinct, victorious over the strongest sense of personal danger. He wrote a bitter satire upon the presiding pedagogue, was brutally punished for this youthful indiscretion, and indignantly removed by his parents from the school. Mr Roscoe speaks of Pope's personal experience as necessarily unfavourable to public schools; but in reality he knew nothing of public schools. All the establishments for Papists were narrow, and suited to their political depression; and his parents were too sincerely anxious for their son's religious principles to risk the contagion of Protestant association by sending him elsewhere.

From the scene[1] of his disgrace and illiberal punishment, he passed, according to the received accounts, under the tuition of several other masters in rapid succession. But it is the less necessary to trouble the reader with their names, as Pope himself assures us that he learned nothing from any of them. To Banister he had been indebted for such trivial elements of a schoolboy's learning as he possessed at all, excepting those which he had taught himself. And upon himself it was, and his own admirable faculties, that he was now finally thrown for the rest of his education, at an age so immature that many boys are then first entering their academic career. Pope is supposed to have been scarcely twelve years old when he assumed the office of self-tuition, and bade farewell for ever to schools and tutors.

Such a phenomenon is at any rate striking: it is the more so, under the circumstances which attended the plan, and under the results which justified its execution. It seems, as regards the plan, hardly less strange that prudent parents should have acquiesced in a scheme of so much peril to his intellectual interests, than that the son, as regards the execution, should have justified their confidence by his final success. More especially this confidence surprises us in the father. A doating mother might shut her eyes to all remote evils in the present gratification to her affections; but Pope's father was a man of sense and principle; he must have weighed the risks besetting a boy left to his own intellectual guidance; and to these risks he would allow the more weight from his own conscious defect of scholarship and inability to guide or even to accompany his son's studies. He could neither direct the proper choice of studies; nor in any one study taken separately could he suggest the proper choice of books.

The case we apprehend to have been this: Alexander Pope the elder, was a man of philosophical desires and unambitious character. Quiet and seclusion and innocence of life,—these were what he affected for himself; and that which had been found available for his own happiness, he might reasonably wish for his son. The two hinges upon which his plans may be supposed to have turned, were, first, the political degradation of his sect; and, secondly, the fact that his son was an only child. Had he been a Protestant, or had he, though a Papist, been burthened with a large family of children, he would doubtless have pursued a different course. But to him, and, as he sincerely hoped, to his son, the strife after civil honours was sternly barred. Apostacy only could lay it open. And, as the sentiments of honour and duty in this point fell in with the vices of his temperament, high principle concurring with his constitutional love of ease, we need not wonder that he should early retire from commerce with a very moderate competence, or that he should suppose the same fortune sufficient for one who was to stand in the same position. This son was from his birth deformed. That made it probable that he might not marry. If he should, and happened to have children, a small family would find an adequate provision in the patrimonial funds; and a large one at the worst could only throw him upon the same commercial exertions to which he had been obliged himself. The Roman Catholics, indeed, were just then situated as our modern Quakers are: law to the one, as conscience to the other, closed all modes of active employment except that of commercial industry. Either his son, therefore, would be a rustic recluse, or, like himself, he would be a merchant.

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[1] This however was not Twyford, according to an anonymous pamphleteer of the times, but a Catholic seminary in Devonshire Street, that is, in the Bloomsbury district of London; and the same author asserts, that the scene of his disgrace, as indeed seems probable beforehand, was not the first, but the last of his arenas as a schoolboy. Which indeed was first and which last, is very unimportant; but with a view to another point, which is not without interest, namely, as to the motive of Pope for so bitter a lampoon as we must suppose it to have been, as well as with regard to the topics which he used to season it, this anonymous letter throws the only light which has been offered; and strange it is, that no biographer of Pope should have hunted upon the traces indicated by him. Any solution of Pope's virulence, and of the master's bitter retaliation, even *as* a solution, is so far entitled to attention; apart from which the mere straightforwardness of this man's story, and its minute circumstantiality, weigh greatly in its favour. To our thinking, he unfolds the whole affair in the simple explanation, nowhere else to be found, that the master of the school, the mean avenger of a childish insult by a bestial punishment, was a Mr Bromley, one of James II.'s Popish apostates; whilst the particular statements which he makes with respect to himself and the young Duke of Norfolk of 1700, as two schoolfellows of Pope at that time and place, together with his voluntary promise to come forward in person, and verify his account if it should happen to be challenged,—are all, we repeat, so many presumptions in favour of his veracity. "Mr Alexander Pope," says he, "before he had been four months at this school, or was able to construe Tully's Offices, employed his muse in satirizing his master. It was a libel of at least one hundred verses, which (a fellow-student having given information of it) was found in his pocket; and the young satirist was soundly whipped, and kept a prisoner to his room for seven days; whereupon his father fetched him away, and I have been told he never went to school more." This Bromley, it has been ascertained, was the son of a country gentleman in Worcestershire, and must have had considerable prospects at one time, since it appears that he had been a gentleman-commoner at Christ's Church, Oxford. There is an error in the punctuation of the letter we have just quoted, which affects the sense in a way very important to the question before us. Bromley is described as "one of King James's converts in Oxford, some years *after* that prince's abdication;" but, if this were really so, he must have been a conscientious convert. The latter clause should be connected with what follows: "*Some years after that prince's abdication he kept a little seminary;*" that is, when his mercenary views in quitting his religion were effectually defeated, when the Boyne had sealed his despair, he humbled himself into a petty schoolmaster. These facts are interesting, because they suggest at once the motive for the merciless punishment inflicted upon Pope. His own father was a Papist like Bromley, but a sincere and honest Papist, who had borne double taxes, legal stigmas, and public hatred for conscience' sake. His contempt was habitually pointed at those who tampered with religion for interested purposes. His son inherited these upright feelings. And we may easily guess what would be the bitter sting of any satire he would write on Bromley. Such a topic was too true to be forgiven, and too keenly barbed by Bromley's conscience. By the way, this writer, like ourselves, reads in this juvenile adventure a prefiguration of Pope's satirical destiny.

With such prospects, what need of an elaborate education? And where was such an education to be sought? At the petty establishments of the suffering Catholics, the instruction, as he had found experimentally, was poor. At the great national establishments his son would be a degraded person; one who was permanently repelled from every arena of honour, and sometimes, as in cases of public danger, was banished from the capital, deprived of his house, left defenceless against common ruffians, and rendered liable to the control of every village magistrate. To one in these circumstances solitude was the wisest position; and the best qualification for that was an education that would furnish aids to solitary thought. No need for brilliant accomplishments to him who must never display them; forensic arts, pulpit erudition, senatorial eloquence, academical accomplishments—these would be lost to one against whom the courts, the pulpit, the senate, the universities, were closed. Nay, by possibility worse than lost; they might prove so many snares or positive bribes to apostacy. Plain English, therefore, and the high thinking of his compatriot authors, might prove the best provision for the mind of an English Papist destined to seclusion.

Such are the considerations under which we read and interpret the conduct of Pope's parents; and they lead us to regard as wise and conscientious a scheme which, under ordinary circumstances, would have been pitiably foolish. And be it remembered, that to these considerations, derived exclusively from the civil circumstances of the family, were superadded others derived from the astonishing prematurity of the individual. That boy who could write at twelve years of age the beautiful and touching stanzas on Solitude, might well be trusted with the superintendence of his own studies. And the stripling of sixteen, who could so far transcend in good sense the accomplished statesmen or men of the world with whom he afterwards corresponded, might challenge confidence for such a choice of books as would best promote the development of his own faculties.

In reality, one so finely endowed as Alexander Pope, could not easily lose his way in the most extensive or ill-digested library. And though he tells Atterbury, that at one time he abused his opportunities by reading controversial divinity, we may be sure that his own native activities, and the elasticity of his mind, would speedily recoil into a just equilibrium of study, under wider and happier opportunities. Reading, indeed, for a person like Pope, is rather valuable as a means of exciting his own energies, and of feeding his own sensibilities, than for any direct acquisitions of knowledge, or for any trains of systematic research. All men are destined to devour much rubbish between the cradle and the grave; and doubtless the man who is wisest in the choice of his books, will have read many a page before he dies that a thoughtful review would pronounce worthless. This is the fate of all men. But the reading of Pope, as a general result or measure of his judicious choice, is best justified in his writings. They show him well furnished with whatsoever he wanted for matter or for embellishment, for argument or illustration, for example and model, or for direct and explicit imitation.

Possibly, as we have already suggested, within the range of English literature Pope might have found all that he wanted. But variety the widest has its uses; and, for the extension of his influence with the polished classes amongst whom he lived, he did wisely to add other languages; and a question has thus arisen with regard to the extent of Pope's attainments as a self-taught linguist. A man, or even a boy, of great originality, may happen to succeed best, in working his own native mines of thought, by his unassisted energies: here it is granted that a tutor, a guide, or even a companion, may be dispensed with, and even beneficially. But in the case of foreign languages, in attaining this machinery of literature, though anomalies even here do arise, and men there are, like Joseph Scaliger, who form their own dictionaries and grammars in the mere process of reading an unknown language, by far the major part of students will lose their time by rejecting the aid of tutors. As there has been much difference of opinion with regard to Pope's skill in languages, we shall briefly collate and bring into one focus the stray notices.

As to the French, Voltaire, who knew Pope personally, declared that he "could hardly *read* it, and spoke not one syllable of the language." But perhaps Voltaire might dislike Pope? On the contrary, he was acquainted with his works, and admired them to the very level of their merits. Speaking of him *after death* to Frederick of Prussia, he prefers him to Horace and Boileau, asserting that, by comparison with *them*,

> Pope *approfondit* ce qu'ils ont *effleuré*.
> D'un esprit plus hardi, d'un pas plus assuré,
> Il porta le flambeau dans l'abîme de l'être;
> Et l'homme *avec lui seul* apprit à se connoître.
> L'art quelquefois frivole, et quelquefois divine,
> L'art des vers est dans Pope utile au genre humain.

This is not a wise account of Pope, for it does not abstract the characteristic feature of his power; but it is a very kind one. And of course Voltaire could not have meant any unkindness in denying his knowledge of French. But he was certainly wrong. Pope, in *his* presence, would decline to speak or to read a language of which the pronunciation was confessedly beyond him. Or, if he did, the impression left would be still worse. In fact, no man ever will pronounce or talk a language which he does not use, for some part of every day, in the real intercourse of life. But that Pope read French of an ordinary cast with fluency enough, is evident from the extensive use which he made of Madame Dacier's labours on the Iliad, and still more of La Valterie's prose translation of the Iliad. Already in the year 1718, and long before his personal knowledge of Voltaire, Pope had shown his accurate acquaintance with some voluminous French authors, in a way which, we suspect, was equally surprising and offensive to his noble correspondent. The Duke of Buckingham[1] had addressed to Pope a letter, containing some account of the controversy about Homer, which had then been recently carried on in France between La Motte and Madame Dacier. This account was delivered with an air of teaching, which was very little in harmony with its excessive shallowness. Pope, who sustained the part of pupil in this interlude, replied in a manner that exhibited a knowledge of the parties concerned in the controversy much superior to that of the duke. In particular, he characterized the excellent notes upon Horace of M. Dacier the husband in very just terms, as distinguished from those of his conceited and half-learned wife; and the whole reply of Pope seems very much as though he had been playing off a mystification on his grace. Undoubtedly the pompous duke felt that he had caught a Tartar. Now M. Dacier's Horace, which, with the text, fills nine volumes, Pope could not have read *except* in French; for they are not even yet translated into English. Besides, Pope read critically the French translations of his own Essay on Man, Essay on Criticism, Rape of the Lock, &c. He spoke of them as a critic; and it was at no time a fault of Pope's to make false pretensions. All readers of Pope's Satires must also recollect numerous proofs that he had read Boileau with so much feeling of his peculiar merit, that he has appropriated and naturalized in English some of his best passages. Voltaire was, therefore, certainly wrong.

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[1] That is, Sheffield, and, legally speaking, of Buckingham*shire*. For he would not take the title of Buckingham, under a fear that there was lurking somewhere or other a claim to that title amongst the connections of the Villiers family. He was a pompous grandee, who lived in uneasy splendour, and, as a writer, most extravagantly overrated; accordingly, he is now forgotten. Such was his vanity, and his ridiculous mania for allying himself with royalty, that he first of all had the presumption to court the Princess (afterwards Queen) Anne. Being rejected, he then offered himself to the illegitimate daughter of James II., by the daughter of Sir Charles Sedley. She was as ostentatious as himself, and accepted him.

Of Italian literature, meantime, Pope knew little or nothing; and simply because he knew nothing of the language. Tasso, indeed, he admired; and, which is singular, more than Ariosto. But we believe that he had read him only in English; and it is certain that he could not take up an Italian author, either in prose or verse, for the unaffected amusement of his leisure.

Greek, we all know, has been denied to Pope, ever since he translated Homer, and chiefly in consequence of that translation. This seems at first sight unfair, because criticism has not succeeded in fixing upon Pope any errors of ignorance. His deviations from Homer were uniformly the result of imperfect sympathy with the naked simplicity of the antique, and therefore wilful deviations, not (like those of his more pretending competitors, Addison and Tickell) pure blunders of misapprehension. But yet it is not inconsistent with this concession to Pope's merits, that we must avow our belief in his thorough ignorance of Greek when he first commenced his task. And to us it seems astonishing that nobody should have adverted to that fact as a sufficient solution, and in fact the only plausible solution, of Pope's excessive depression of spirits in the earliest stage of his labours. This depression, after he had once pledged himself to his subscribers for the fulfilment of his task, arose from, and could have arisen from nothing else than, his conscious ignorance of Greek in connection with the solemn responsibilities he had assumed in the face of a great nation. Nay, even countries as presumptuously disdainful of tramontane literature as Italy took an interest in this memorable undertaking. Bishop Berkeley found Salvini reading it at Florence; and Madame Dacier even, who read little but Greek, and certainly no English until then, condescended to study it. Pope's dejection, therefore, or rather agitation (for it impressed by sympathy a tumultuous character upon his dreams, which lasted for years after the cause had ceased to operate) was perfectly natural under the explanation we have given, but not otherwise. And how did he surmount this unhappy self-distrust? Paradoxical as it may sound, we will venture to say, that, with the innumerable aids for interpreting Homer which even then existed, a man sufficiently acquainted with Latin might make a translation even critically exact. This Pope was not long in discovering. Other alleviations of his labour concurred, and in a ratio daily increasing.

The same formulæ were continually recurring, such as,

But him answering, thus addressed the swift-footed Achilles;

Or,

But him sternly beholding, thus spoke Agamemnon the king of men.

Then, again, universally the Homeric Greek, from many causes, is easy; and especially from these two: 1*st*, The simplicity of the thought, which never gathers into those perplexed knots of rhetorical condensation which we find in the dramatic poets of a higher civilization: 2*dly*, From the constant bounds set to the expansion of the thought by the form of the metre; an advantage of verse which makes the poets so much easier to a beginner in the German language than the illimitable weavers of prose. The line or the stanza reins up the poet tightly to his theme, and will not suffer him to expatiate. Gradually, therefore, Pope came to read the Homeric Greek, but never accurately; nor did he ever read Eustathius without aid from Latin. As to any knowledge of the Attic Greek, of the Greek of the dramatists, the Greek of Plato, the Greek of Demosthenes, Pope neither had it nor affected to have it. Indeed it was no foible of Pope's, as we will repeat, to make claims which he had not, or even to dwell ostentatiously upon those which he had. And with respect to Greek in particular, there is a manuscript letter in existence from Pope to a Mr Bridges at Falham, which, speaking of the original Homer, distinctly records the knowledge which he had of his own "imperfectness in the language." Chapman, a most spirited translator of Homer, probably had no very critical skill in Greek; and Hobbes was, beyond all question, as poor a Grecian as he was a doggerel translator; yet in this letter Pope professes his willing submission to the "authority" of Chapman and Hobbes, as superior to his own.

Finally, in *Latin* Pope was a "considerable proficient," even by the cautious testimony of Dr Johnson; and in this language only the doctor was an accomplished critic. If Pope had really the proficiency here ascribed to him, he must have had it already in his boyish years; for the translation from Statius, which is the principal monument of his skill, was executed *before* he was fourteen. We have taken the trouble to throw a hasty glance over it; and whilst we readily admit the extraordinary talent which it shows, as do all the juvenile essays of Pope, we cannot allow that it argues any accurate skill in Latin. The word Malĕa, as we have seen noticed by some editor, he makes Malēa; which in itself, as the name was not of common occurrence, would not have been an error worth noticing; but, taken in connection with the certainty that Pope had the original line before him—

Arripit ex templo Maleæ de valle resurgens,

when not merely the scanning theoretically, but the whole rhythmus practically, to the most obtuse ear, would be annihilated by Pope's false quantity, is a blunder which serves to show his utter ignorance of prosody. But, even as a version of the sense, with every allowance for a poet's license of compression and expansion, Pope's translation is defective, and argues an occasional inability to construe the text. For instance, at the council summoned by Jupiter, it is said that he at his first entrance seats himself upon his starry throne, but not so the inferior gods;

Nec protinus ausi
Cœlicolæ, veniam donec pater ipse sedendi
Tranquilla jubet esse manu.

In which passage there is a slight obscurity, from the ellipsis of the word *sedere*, or *sese locare;* but the meaning is evidently that the other gods did not presume to sit down *protinus*, that is, in immediate succession to Jupiter, and interpreting his example as a tacit license to do so, until, by a gentle wave of his hand, the supreme father signifies his express permission to take their seats. But Pope, manifestly unable to extract any sense from the passage, translates thus:

At Jove's assent the deities around
In solemn state the consistory *crown'd;*

where at once the whole picturesque solemnity of the celestial ritual melts into the vaguest generalities. Again, at

v. 178, *ruptæque vices* is translated "*and all the ties of nature broke*;" but by *vices* is indicated the alternate reign of the two brothers, as ratified by mutual oaths, and subsequently violated by Eteocles. Other mistakes might be cited, which seem to prove that Pope, like most self-taught linguists, was a very imperfect one.[1] Pope, in short, never rose to such a point in classical literature as to read either Greek or Latin authors without effort, and for his private amusement.

The result, therefore, of Pope's self-tuition appears to us, considered in the light of an attempt to acquire certain accomplishments of knowledge, a most complete failure. As a linguist, he read no language with ease; none with pleasure to himself; and none with so much accuracy as could have carried him through the most popular author with a general independence on interpreters. But, considered with a view to his particular faculties and slumbering originality of power, which required perhaps the stimulation of accident to arouse them effectually, we are very much disposed to think that the very failure of his education as an artificial training was a great advantage finally for inclining his mind to throw itself, by way of indemnification, upon its native powers. Had he attained, as with better tuition he would have attained, distinguished excellence as a scholar, or as a student of science, the chances are many that he would have settled down into such studies as thousands could pursue not less successfully than he; whilst as it was, the very dissatisfaction which he could not but feel with his slender attainments must have given him a strong motive for cultivating those impulses of original power which he felt continually stirring within him, and which were vivified into trials of competition as often as any distinguished excellence was introduced to his knowledge.

Pope's father, at the time of his birth, lived in Lombard Street;[2] a street still familiar to the public eye, from its adjacency to some of the chief metropolitan establishments, and to the English ear possessing a degree of historical importance; first, as the residence of those Lombards, or Milanese, who affiliated our infant commerce to the matron splendours of the Adriatic and the Mediterranean; next, as the central resort of those jewellers, or "goldsmiths," as they were styled, who performed all the functions of modern bankers from the period of the parliamentary war to the rise of the Bank of England, that is, for six years after the birth of Pope; and, lastly, as the seat, until lately, of that vast Post Office, through which, for so long a period, has passed the correspondence of all nations and languages, upon a scale unknown to any other country. In this street Alexander Pope the elder had a house, and a warehouse, we presume, annexed, in which he conducted the wholesale business of a linen merchant. As soon as he had made a moderate fortune he retired from business, first to Kensington, and afterwards to Binfield, in Windsor Forest. The period of this migration is not assigned by any writer. It is probable that a prudent man would not adopt it with any prospect of having more children. But this chance might be considered as already extinguished at the birth of Pope; for though his father had then only attained his forty-fourth year, Mrs Pope had completed her forty-eighth. It is probable, from the interval of seven days which is said to have elapsed between Pope's punishment and his removal from the school, that his parents were then living at such a distance from him as to prevent his ready communication with them, else we may be sure that Mrs Pope would have flown on the wings of love and wrath to the rescue of her darling. Supposing, therefore, as we *do* suppose, that Mr Bromley's school in London was the scene of his disgrace, it would appear on this argument that his parents were then living in Windsor Forest. And this hypothesis falls in with another anecdote in Pope's life, which we know partly upon his own authority. He tells Wycherley that he had seen Dryden, and barely seen him. *Virgilium vidi tantum.* This is presumed to have been in Will's Coffee-house, whither any person in search of Dryden would of course resort; and it must have been before Pope was twelve years old, for Dryden died in 1700. Now there is a letter of Sir Charles Wogan's, stating that he first took Pope to Will's; and his words are, "from our forest." Consequently, at that period, when he had not completed his twelfth year, Pope was already living in the forest.

From this period, and so long as the genial spirits of youth lasted, Pope's life must have been one dream of pleasure. He tells Lord Harvey that his mother did not spoil him; but that was no doubt because there was no room for wilfulness or waywardness on either side, when all was one placid scene of parental obedience and gentle filial authority. We feel persuaded that, if not in words, in spirit and inclination, they would, in any notes they might have occasion to write, subscribe themselves "your dutiful parents." And of what consequence in whose hands were the reins which were never needed? Every reader must be pleased to know that these idolizing parents lived to see their son at the very summit of his public elevation; even his father lived two years and a half after the publication of his Homer had commenced, and when his fortune was made; and his mother lived for nearly eighteen years more. What a felicity for her, how rare and how perfect, to find that he, who to her maternal eyes was naturally the most perfect of human beings, and the idol of her heart, had already been the idol of the nation before he had completed his youth. She had also another blessing not always commanded by the most devoted love; many sons there are who think it essential to manliness that they should treat their mother's doating anxiety with levity, or even ridicule. But Pope, who was the model of a good son, never swerved in words, manners, or conduct, from the most respectful tenderness, or intermitted the piety of his attentions. And so far did he carry this regard for his mother's comfort, that, well knowing how she lived upon his presence or by his image, he denied himself for many years all excursions which could not be fully accomplished within the revolution of a week. And to this cause, combined with the excessive length of his mother's life, must be ascribed the fact that Pope never went abroad; not to Italy with Thomson or with Berkeley, or any of his diplomatic friends; not to Ireland, where his presence would have been hailed as a national honour; not even to France, on a visit to his admiring and admired friend Lord Bolingbroke. For as to the fear of sea-sickness, *that* did not arise until a late period of his life; and at any period would not have operated to prevent his crossing from Dover to Calais. It is possible that, in his earlier and more sanguine years, all the perfection of his filial love may not have availed to prevent him from now and then breathing a secret murmur at confinement so constant. But it is certain that, long before he passed the meridian of his life, Pope had come to view this confinement with far other thoughts. Experience had then taught him, that to no man is the privilege granted of possessing more than one or two friends who are such in extremity. By that time he had come to view his mother's death with fear and anguish. She, he knew by many a sign, would have been happy to lay down her life for his sake; but for others, even those who were the most friendly and the most constant in their attentions, he felt but too certainly that his death, or his heavy affliction, might cost them a few sighs, but would not materially disturb their peace of mind. "It is but in a very narrow circle," says he, in a confidential letter, "that friendship walks in this world, and I care not to tread out of it more than I needs must; knowing well it is but to two or three (if quite so many) that any man's welfare or memory can be of consequence." After such acknowledgements, we are not surprised to find him writing thus of his mother, and his fearful struggles to fight off the shock of his mother's death, at a time when it was rapidly approaching. After having said of a friend's death, "the subject is beyond writing upon, beyond cure or ease by reason or reflection, beyond all but one thought, that it is the will of God," he goes on thus, "So will the death of my mother be, which now I tremble at, now resign to, now bring close to me, now set farther off; every day alters, turns me about, confuses my whole frame of mind." There is no pleasure, he adds, which the world can give "equivalent to countervail either the death of one I have so long lived with, or of one I have so long lived for." How will he comfort himself after her death? "I have nothing left but to turn my thoughts to one comfort, the last we usually think of, though the only one we should in wisdom depend upon. I sit in her room, and she is always present before me but when I sleep. I wonder I am so well. I have shed many tears; but now I weep at nothing."

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[1] Meantime, the felicities of this translation are at times perfectly astonishing; and it would be scarcely possible to express more nervously or amply the words,

——————*jurisque secundi*
Ambitus impatiens, et summo dulcius unum
Stare loco——————

than this child of fourteen has done in the following couplet, which, most judiciously, by reversing the two clauses, gains the power of fusing them into connection:

And impotent desire to reign alone,
That scorns the dull reversion of a throne.

But the passage for which beyond all others we must make room, is a series of eight lines, corresponding to six in the original; and this for two reasons: First, Because Dr Joseph Warton has deliberately asserted, that in our whole literature, "we have scarcely eight more beautiful lines than these;" and though few readers will subscribe to so sweeping a judgment, yet certainly these must be wonderful lines for a boy, which could challenge such commendation from an experienced *polyhistor* of infinite reading. Secondly, Because the lines contain a night-scene. Now it must be well known to many readers, that the famous night-scene in the Iliad, so familiar to every school-boy, has been made the subject, for the last thirty years, of severe, and, in many respects, of just criticisms. This description will therefore have a double interest by comparison; whilst, whatever may be thought of either taken separately for itself, considered as a translation, this which we now quote is as true to Statius as the other is undoubtedly faithless to Homer:

Jamque per emeriti surgens confinia Phœbi
Titanis, late mundo subvecta silenti
Rorifera gelidum tenuaverat aera biga.
Jam pecudes volucresque tacent: jam somnus avaris
Inserpit curis, pronusque per aera nutat,
Grata laboratæ referens oblivia vitæ.
Theb. i. 336–341.

'Twas now the time when Phœbus yields to night,
And rising Cynthia sheds her silver light;
Wide o'er the world in solemn pomp she drew
Her airy chariot hung with pearly dew.
All birds and beasts lie hush'd. Sleep steals away
The wild desires of men and toils of day;
And brings, descending through the silent air,
A sweet forgetfulness of human care.

[2] One writer of that age says, in Cheapside; but probably this difference arose from contemplating Lombard Street as a prolongation of Cheapside.

A man, therefore, happier than Pope in his domestic relations cannot easily have lived. It is true these relations were circumscribed; had they been wider they could not have been so happy. But Pope was equally fortunate in his social relations. What, indeed, most of all surprises us, is the courteous, flattering, and even brilliant reception which Pope found from his earliest boyhood amongst the most accomplished men of the world. Wits, courtiers, statesmen, grandees the most dignified, and men of fashion the most brilliant, all alike treated him not only with pointed kindness, but with a respect that seemed to acknowledge him as their intellectual superior. Without rank, high birth, fortune, without even a literary name, and in defiance of a deformed person, Pope, whilst yet only sixteen years of age, was caressed, and even honoured; and all this with no one recommendation but simply the knowledge of his dedication to letters, and the premature expectations which he raised of future excellence. Sir William Trumbull, a veteran statesman, who had held the highest stations, both diplomatic and ministerial, made him his daily companion. Wycherley, the old *roué* of the town, a second-rate wit, but not the less jealous on that account, showed the utmost deference to one whom, as a man of fashion, he must have regarded with contempt, and between whom and himself there were nearly "fifty good years of fair and foul weather." Cromwell,[1] a fox-hunting country gentleman, but uniting with that character the pretensions of a wit, and affecting also the reputation of a rake, cultivated his regard with zeal and conscious inferiority. Nay, which never in any other instance happened to the most fortunate poet, his very inaugural essays in verse were treated, not as prelusive efforts of auspicious promise, but as finished works of art, entitled to take their station amongst the literature of the land; and in the most worthless of all his poems, Walsh, an established authority, and whom Dryden pronounced the ablest critic of the age, found proofs of equality with Virgil.

The literary correspondence with these gentlemen is interesting, as a model of what once passed for fine letter-writing. Every nerve was strained to outdo each other in carving all thoughts into a fillagree work of rhetoric; and the amœbæan contest was like that between two village-cocks from neighbouring farms endeavouring to overcrow each other. To us, in this age of purer and more masculine taste, the whole scene takes the ludicrous air of old and young fops dancing a minuet with each other, practising the most elaborate grimaces, sinkings and risings the most awful, bows the most overshadowing, until plain walking, running, or the motions of natural dancing, are thought too insipid for endurance. In this instance the taste had perhaps really been borrowed from France, though often enough we impute to France what is the native growth of all minds placed in similar circumstances. Madame de Sevigné's Letters were really models of grace. But Balzac, whose letters, however, are not without interest, had in some measure formed himself upon the truly magnificent rhetoric of Pliny and Seneca. Pope and his correspondents, meantime, degraded the dignity of rhetoric, by applying it to trivial commonplaces of compliment; whereas Seneca applied it to the grandest themes which life or contemplation can supply. Lady Mary Wortley Montagu, on first coming amongst the wits of the day, naturally adopted their style. She found this sort of *euphuism* established; and it was not for a very young woman to oppose it. But her masculine understanding and powerful good sense, shaken free, besides, from all local follies by travels and extensive commerce with the world, first threw off these glittering chains of affectation. Dean Swift, by the very constitution of his mind, plain, sinewy, nervous, and courting only the strength that allies itself with homeliness, was always indisposed to this mode of correspondence. And, finally, Pope himself, as his earlier friends died off, and his own understanding acquired strength, laid it aside altogether. One reason doubtless was, that he found it too fatiguing; since in this way of letter-writing he was put to as much expense of wit in amusing an individual correspondent as would for an equal extent have sufficed to delight the whole world. A funambulist may harass his muscles and risk his neck on the tight-rope, but hardly to entertain his own family. Pope, however, had another reason for declining this showy system of fencing; and strange it is that he had not discovered this reason from the very first. As life advanced, it happened unavoidably that real business advanced; the careless condition of youth prompted no topics, or at least prescribed none, but such as were agreeable to the taste, and allowed of an ornamental colouring. But when downright business occurred, exchequer bills to be sold, meetings to be arranged, negotiations confided, difficulties to be explained, here and there by possibility a jest or two might be scattered, a witty allusion thrown in, or a sentiment interwoven; but for the main body of the case, it neither could receive any ornamental treatment, nor if, by any effort of ingenuity, it *had*, could it look otherwise than silly and unreasonable:

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[1] Dr Johnson said, that all he could discover about Mr Cromwell, was the fact of his going a hunting in a tie-wig; but Gay has added another fact to Dr Johnson's, by calling him "honest *hatless* Cromwell with red breeches." This epithet has puzzled the commentators; but its import is obvious enough. Cromwell, as we learn from more than one person, was anxious to be considered a fine gentleman, and devoted to women. Now it was long the custom in that age for such persons, when walking with ladies, to carry their hats in their hand. Louis XV. used to ride by the side of Madame de Pompadour hat in hand.

> Ornari res ipsa negat, contenta doceri.

Pope's idleness, therefore, on the one hand, concurring with good sense and the necessities of business on the other, drove him to quit his gay rhetoric in letter-writing. But there are passages surviving in his correspondence which indicate, that, after all, had leisure and the coarse perplexities of life permitted it, he still looked with partiality upon his youthful style, and cherished it as a first love. But in this harsh world, as the course of true love, so that of rhetoric, never did run smooth; and thus it happened that, with a lingering farewell, he felt himself forced to bid it adieu. Strange that any man should think his own sincere and confidential overflowings of thought and feeling upon books, men, and public affairs, less valuable in a literary view than the legerdemain of throwing up bubbles into the air for the sake of watching their prismatic hues, like an Indian juggler with his cups and balls. We of this age, who have formed our notions of epistolary excellence from the chastity of Gray's, the brilliancy of Lady Mary Wortley Montagu's during her later life, and the mingled good sense and fine feeling of Cowper's, value only those letters of Pope which he himself thought of inferior value. And even with regard to these, we may say that there is a great mistake made; the best of those later letters between Pope and Swift, &c. are not in themselves at all superior to the letters of sensible and accomplished women, such as leave every town in the island by every post. Their chief interest is a derivative one; we are pleased with any letter, good or bad, which relates to men of such eminent talent; and sometimes the subjects discussed have a separate interest for themselves. But as to the quality of the discussion, apart from the person discussing and the thing discussed, so trivial is the value of these letters in a large proportion, that we cannot but wonder at the preposterous value which was set upon them by the writers.[1] Pope especially ought not to have his ethereal works loaded by the mass of trivial prose which is usually attached to them.

This correspondence, meantime, with the wits of the time, though one mode by which, in the absence of reviews, the reputation of an author was spread, did not perhaps serve the interests of Pope so effectually as the poems which in this way he circulated in those classes of English society whose favour he chiefly courted. One of his friends, the truly kind and accomplished Sir William Trumbull, served him in that way, and perhaps in another eventually even more important. The library of Pope's father was composed exclusively of polemical divinity, a proof, by the way, that he was not a blind convert to the Roman Catholic faith; or, if he was so originally, had reviewed the grounds of it, and adhered to it after strenuous study. In this dearth of books at his own home, and until he was able to influence his father in buying more extensively, Pope had benefited by the loans of his friends; amongst whom it is probable that Sir William, as one of the best scholars of the whole, might assist him most. He certainly offered him the most touching compliment, as it was also the wisest and most paternal counsel, when he besought him, as one *goddess-born*, to quit the convivial society of deep-drinkers:

> Heu, fuge nate dea, teque his, ait, eripe malis.

With these aids from friends of rank, and his way thus laid open to public favour, in the year 1709 Pope first came forward upon the stage of literature. The same year which terminated his legal minority introduced him to the public. *Miscellanies* in those days were almost periodical repositories of fugitive verse. Tonson happened at this time to be publishing one of some extent, the sixth volume of which offered a sort of ambush to the young aspirant of Windsor Forest, from which he might watch the public feeling. The volume was opened by Mr Ambrose Philips, in the character of pastoral poet; and in the same character, but stationed at the end of the volume, and thus covered by his bucolic leader, as a soldier to the rear by the file in advance, appeared Pope; so that he might win a little public notice, without too much seeming to challenge it. This half-clandestine emersion upon the stage of authorship, and his furtive position, are both mentioned by Pope as accidents, but as accidents in which he rejoiced, and not improbably accidents which Tonson had arranged with a view to his satisfaction.

It must appear strange that Pope at twenty-one should choose to come forward for the first time with a work composed at sixteen. A difference of five years at that stage of life is of more effect than of twenty at a later; and his own expanding judgment could hardly fail to inform him that his Pastorals were by far the worst of his works. In reality, let us not deny, that had Pope never written any thing else, his name would not have been known as a name even of promise, but would probably have been redeemed from oblivion by some satirist or writer of a Dunciad. Were a man to meet with such a nondescript monster as the following, viz. "*Love out of Mount Ætna by Whirlwind,*" he would suppose himself reading the Racing Calendar. Yet this hybrid creature is one of the many zoological monsters to whom the Pastorals introduce us:

> I know thee, love! on foreign mountains born,
> Wolves gave thee suck, and savage tigers fed.
> Thou wert from Ætna's burning entrails torn,
> Got by fierce whirlwinds, and in thunder born.

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[1] It is strange indeed to find, not only that Pope had so frequently kept rough copies of his own letters, and that he thought so well of them as to repeat the same letter to different persons, as in the case of the two lovers killed by lightning, or even to two sisters, Martha and Therese Blount (who were sure to communicate their letters), but that even Swift had retained copies of *his*.

But the very names "Damon" and "Strephon," "Phillis" and "Delia," are rank with childishness. Arcadian life is, at the best, a feeble conception, and rests upon the false principle of crowding together all the luscious sweets of rural life, undignified by the danger which attends pastoral life in our climate, and unrelieved by shades, either moral or physical. And the Arcadia of Pope's age was the spurious Arcadia of the opera theatre, and, what is worse, of the French opera.

The hostilities which followed between these rival wooers of the pastoral muse are well known. Pope, irritated at what he conceived the partiality shown to Philips in the Guardian, pursued the review ironically; and, whilst affecting to load his antagonist with praises, draws into pointed relief some of his most flagrant faults. The result, however, we cannot believe. That all the wits, except Addison, were duped by the irony, is quite impossible. Could any man of sense mistake for praise the remark, that Philips had imitated "*every* line of Strada;" that he had introduced wolves into England, and proved himself the first of gardeners by making his flowers "blow all in the same season." Or, suppose those passages unnoticed, could the broad sneer escape him, where Pope taxes the other writer (viz. himself) with having deviated "into downright poetry;" or the outrageous ridicule of Philip's style, as setting up for the ideal type of the pastoral style, the quotation from Gay, beginning,

> Rager, go vetch tha kee, or else tha zun
> Will quite bego before ch' 'avs half a don!

Philips is said to have resented this treatment by threats of personal chastisement to Pope, and even hanging up a rod at Button's coffee-house. We may be certain that Philips never disgraced himself by such ignoble conduct. If the public indeed were universally duped by the paper, what motive had Philips for resentment? Or, in any case, what plea had he for attacking Pope, who had not come forward as the author of the essay? But, from Pope's confidential account of the matter, we know that Philips saw him daily, and never offered him "any indecorum;" though, for some cause or other, Pope pursued Philips with virulence through life.

In the year 1711, Pope published his Essay on Criticism, which some people have very unreasonably fancied his best performance; and in the same year his Rape of the Lock, the most exquisite monument of playful fancy that universal literature offers. It wanted, however, as yet, the principle of its vitality, in wanting the machinery of Sylphs and Gnomes, with which addition it was first published in 1714.

In the year 1712, Pope appeared again before the public as the author of the Temple of Fame, and the Elegy to the Memory of an Unfortunate Lady. Much speculation has arisen on the question concerning the name of this lady, and the more interesting question concerning the nature of the persecutions and misfortunes which she suffered. Pope appears purposely to decline answering the questions of his friends upon that point; at least the questions have reached us, and the answers have not. Joseph Warton supposed himself to have ascertained four facts about her: that her name was Wainsbury; that she was deformed in person; that she retired into a convent from some circumstances connected with an attachment to a young man of inferior rank; and that she killed herself, not by a sword, as the poet insinuates, but by a halter. As to the latter statement, it may very possibly be true; such a change would be a very slight exercise of the poet's privileges. As to the rest, there are scarcely grounds enough for an opinion. Pope certainly speaks of her under the name of Mrs (*i. e.* Miss) W——, which at least argues a poetical exaggeration in describing her as a being "that once had *titles*, honour, wealth, and fame;" and he may as much have exaggerated her pretensions to beauty. It is indeed noticeable, that he speaks simply of her *decent* limbs, which, in any English use of the word, does not imply much enthusiasm of praise. She appears to have been the niece of a Lady A——; and Mr Craggs, afterwards secretary of state, wrote to Lady A—— on her behalf, and otherwise took an interest in her fate. As to her being a relative of the Duke of Buckingham's, that rests upon a mere conjectural interpretation applied to a letter of that nobleman's. But all things about this unhappy lady are as yet enveloped in mystery. And not the least part of the mystery is a letter of Pope's to a Mr C——, bearing date 1732, that is, just twenty years after the publication of the poem, in which Pope, in a manly tone, justifies himself for his estrangement, and presses against his unknown correspondent the very blame which he had applied generally to the kinsman of the poor victim in 1712. Now, unless there is some mistake in the date, how are we to explain this gentleman's long lethargy, and his sudden sensibility to Pope's anathema, with which the world had resounded for twenty years?

Pope had now established his reputation with the public as the legitimate successor and heir to the poetical supremacy of Dryden. His Rape of the Lock was unrivalled in ancient or modern literature, and the time had now arrived when, instead of seeking to extend his fame, he might count upon a pretty general support in applying what he had already established to the promotion of his own interest. Accordingly, in the autumn of 1713, he formed a final resolution of undertaking a new translation of the Iliad. It must be observed, that already in 1709, concurrently with his Pastorals, he had published specimens of such a translation; and these had been communicated to his friends some time before. In particular, Sir William Trumbull, on the 9th of April 1708, urged upon Pope a complete translation of both Iliad and Odyssey. Defective skill in the Greek language, exaggeration of the difficulties, and the timidity of a writer as yet unknown, and not quite twenty years old, restrained Pope for five years and more. What he had practised as a sort of *bravura*, for a single effort of display, he recoiled from as a daily task to be pursued through much toil, and a considerable section of his life. However, he dallied with the purpose, starting difficulties in the temper of one who wishes to hear them undervalued; until at length Sir Richard Steele determined him to the undertaking, a fact overlooked by the biographers, but which is ascertained by Ayre's account of that interview between Pope and Addison, probably in 1716, which sealed the rupture between them. In the autumn of 1713, he made his design known amongst his friends. Accordingly, on the 21st of October, we have Lord Lansdown's letter, expressing his great pleasure at the communication; on the 26th, we have Addison's letter encouraging him to the task; and in November of the same year occurs the amusing scene so graphically described by Bishop Kennet, when Dean Swift presided in the conversation, and, amongst other indications of his conscious authority, "instructed a young nobleman, that the best poet in England was Mr Pope, who had *begun* a translation of Homer into English verse, for which he must have them all subscribe: for," says he, "*the author shall not begin to print until I have a thousand guineas for him.*"

If this were the extent of what Swift anticipated from the work, he fell miserably below the result. But, perhaps, he spoke only of a cautionary *arrha* or earnest. As this was unquestionably the greatest literary labour, as to profit, ever executed, not excepting the most lucrative of Sir Walter Scott's, if due allowance be made for the altered value of money, and if we consider the Odyssey as forming part of the labour, it may be right to state the particulars of Pope's contract with Lintot.

The number of subscribers to the Iliad was 575, and the number of copies subscribed for was 654. The work was to be printed in six quarto volumes; and the subscription was a guinea a volume. Consequently by the subscription Pope obtained six times 654 guineas, or L.4218. 6s. (for the guinea then passed for 21s. 6d.); and for the copyright of each volume Lintot offered L.200, consequently L.1200 for the whole six; so that from the Iliad the profit exactly amounted to L.5310. 16s. Of the Odyssey, 574 copies were subscribed for. It was to be printed in five quarto volumes, and the subscription was a guinea a volume. Consequently by the subscription Pope obtained five times 574 guineas, or L.3085. 5s.; and for the copyright Lintot offered L.600. The total sum received therefore by Pope, on account of the Odyssey, was L.3685. 5s. But in this instance he had two coadjutors, Broome and Fenton; between them they translated twelve books, leaving twelve to Pope. The notes also were compiled by Broome; but the Postscript to the notes was written by Pope. Fenton received L.300, Broome L.500. Such at least is Warton's account, and more probable than that of Ruffhead, who not only varies the proportions, but increases the whole sum given to the assistants by L.100. Thus far we had followed the guidance of mere probabilities, as they lie upon the face of the transaction. But we have since detected a written statement of Pope's, unaccountably overlooked by the biographers, and serving of itself to show how negligently they have read the works of their illustrious subject. The statement is entitled to the fullest attention and confidence, not being a hasty or casual notice of the transaction, but pointedly shaped to meet a calumnious rumour against Pope in his character of paymaster; as if he who had found so much liberality from publishers in his own person, were niggardly or unjust as soon as he assumed those relations to others. Broome, it was alleged, had expressed himself dissatisfied with Pope's remuneration. Perhaps he had. For he would be likely to frame his estimate for his own services from the scale of Pope's reputed gains; and those gains would, at any rate, be enormously exaggerated, as uniformly happens where there is a basis of the marvellous to begin with. And, secondly, it would be natural enough to assume the previous result from the Iliad as a fair standard for computation; but in this, as we know, all parties found themselves disappointed, and Broome had the less right to murmur at this, since the arrangement with himself as chief journeyman in the job was one main cause of the disappointment. There was also another reason why Broome should be less satisfied than Fenton. Verse for verse, any one thousand lines of a translation so purely mechanical might stand against any other thousand; and so far the equation of claims was easy. A book-keeper, with a pen behind his ear, and Cocker's Golden Rule open before him, could do full justice to Mr Broome *as a poet* every Saturday night. But Broome had a separate account-current for pure prose against Pope. One he had in conjunction with Fenton for verses delivered on the premises at so much per hundred, on which there could be no demur, except as to the allowance for tare and tret as a discount in favour of Pope. But the prose account, the account for notes, requiring very various degrees of reading and research, allowed of no such easy equation. *There* it was, we conceive, that Broome's discontent arose. Pope, however, declares, that he had given him L.500, thus confirming the proportions of Warton against Ruffhead (that is, in effect, Warburton), and some other advantages which were not in money, nor deductions at all from his own money profits, but which may have been worth so much money to Broome as to give some colourable truth to Ruffhead's allegation of an additional L.100. In direct money, it remains certain that Fenton had three and Broome five hundred pounds. It follows, therefore, that for the Iliad and Odyssey jointly he received a sum of L.8996. 1s., and paid for assistance L.800, which leaves to himself a clear sum of L.8196. 1s. And, in fact, his profits ought to be calculated without deduction, since it was his own choice, from indolence, to purchase assistance.

The Iliad was commenced about October 1713. In the summer of the following year he was so far advanced as to begin making arrangements with Lintot for the printing; and the first two books, in manuscript, were put into the hands of Lord Halifax. In June 1715, between the 10th and 28th, the subscribers received their copies of the first volume; and in July Lintot began to publish that volume generally. Some readers will inquire, who paid for the printing and paper, &c.? All this expense fell upon Lintot, for whom Pope was superfluously anxious. The sagacious bookseller understood what he was about; and, when a pirated edition was published in Holland, he counteracted the injury by printing a cheap edition, of which 7500 copies were sold in a few weeks; an extraordinary proof of the extended interest in literature. The second, third, and fourth volumes of the Iliad, each containing, like the first, four books, were published successively in 1716, 1717, 1718; and in 1720 Pope completed the work by publishing the fifth volume, containing five books, and the sixth, containing the last three, with the requisite supplementary apparatus.

The Odyssey was commenced in 1723 (not 1722, as Mr Roscoe virtually asserts at p. 259), and the publication of it was finished in 1725. The sale, however, was much inferior to that of the Iliad; for which more reasons than one might be assigned. But there can be no doubt that Pope himself depreciated the work, by his undignified arrangements for working by subordinate hands. Such a process may answer in sculpture, because there a quantity of rough-hewing occurs, which can no more be improved by committing it to a Phidias, than a common shop-bill could be improved in its arithmetic by Sir Isaac Newton. But in literature such arrangements are degrading; and, above all, in a work which was but too much exposed already to the presumption of being a mere effort of mechanic skill, or (as Curll said to the House of Lords) "*a knack;*" it was deliberately helping forward that idea to let off parts of the labour. Only think of Milton letting off by contract to the lowest offer, and to be delivered by such a day (for which good security to be found), six books of Paradise Lost. It is true, the great dramatic authors were often *collaborateurs*, but their case was essentially different. The loss, however, fell not upon Pope, but upon Lintot, who, on this occasion, was out of temper, and talked rather broadly of prosecution. But that was out of the question. Pope had acted indiscreetly, but nothing could be alleged against his honour; for he had expressly warned the public, that he did not, as in the other case, profess *to translate*, but to *undertake*[1] *a translation* of the Odyssey. Lintot, however, was no loser absolutely, though he might be so in relation to his expectations; on the contrary, he grew rich, bought land, and became sheriff of the county in which his estates lay.

We have pursued the Homeric labours uninterruptedly from their commencement in 1713 till their final termination in 1725, a period of twelve years or nearly; because this was the task to which Pope owed the dignity, if not the comforts, of his life, since it was this which enabled him to decline a pension from all administrations, and even from his friend Craggs, the secretary, to decline the express offer of L.300 per annum. Indeed Pope is always proud to own his obligations to Homer. In the interval, however, between the Iliad and the Odyssey, Pope listened to proposals made by Jacob Tonson, that he should revise an edition of Shakspeare. For this, which was in fact the first attempt at establishing the text of the mighty poet, Pope obtained but little money, and still less reputation. He received, according to tradition, only L.217. 12s. for his trouble of collation, which must have been considerable, and some other trifling editorial labour. And the opinion of all judges, from the first so unfavourable as to have depreciated the money-value of the book enormously, perhaps from a prepossession of the public mind against the fitness of Pope for executing the dull labours of revision, has ever since pronounced this work the very worst edition in existence. For the edition we have little to plead; but for the editor it is but just to make three apologies. In the *first* place, he wrote a brilliant preface, which, although (like other works of the same class) too much occupied in displaying his own ability, and too often, for the sake of an effective antithesis, doing deep injustice to Shakspeare, yet undoubtedly, as a whole, extended his fame, by giving the sanction and countersign of a great wit to the national admiration. *Secondly*, as Dr Johnson admits, Pope's failure pointed out the right road to his successors. *Thirdly*, even in this failure it is but fair to say, that in a graduated scale of merit, as distributed amongst the long succession of editors through that century, Pope holds a rank proportionable to his age. For the year 1720, he is no otherwise below Theobald, Hanmer, Capell, Warburton, or even Johnson, than as they are successively below each other, and all of them as to accuracy below Steevens, as he again was below Malone and Read.

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[1] The word *undertake* had not yet lost the meaning of Shakspeare's age, in which it was understood to describe those cases where, the labour being of a miscellaneous kind, some person in chief offered to overlook and conduct the whole, whether with or without personal labour. The modern *undertaker*, limited to the care of funerals, was then but one of numerous cases to which the term was applied.

The gains from Shakspeare would hardly counterbalance the loss which Pope sustained this year from the South Sea bubble. One thing, by the way, is still unaccountably neglected by writers on this question: how it was that the great Mississippi bubble, during the Orleans regency in Paris, should have happened to coincide with that of London. If this were accident, how marvellous that the same insanity should possess the two great capitals of Christendom in the same year? If, again, it were not accident, but due to some common cause, why is not that cause explained? Pope to his nearest friends never stated the amount of his loss. The biographers report that at one time his stock was worth from twenty to thirty thousand pounds. But that is quite impossible. It is true, that as the stock rose at one time a thousand per cent., this would not imply on Pope's part an original purchase beyond twenty-five hundred pounds or thereabouts. But Pope has furnished an argument against *that*, which we shall improve. He quotes, more than once, as applicable to his own case, the old proverbial riddle of Hesiod, ϖλεον ἡμισυ ϖαντος, *the half is more than the whole*. What did he mean by that? We understand it thus: that between the selling and buying, the variations had been such as to sink his shares to one half of the price they had once reached, but, even at that depreciation, to leave him richer on selling out than he had been at first. But the half of L.25,000 would be a far larger sum than Pope could have ventured to risk upon a fund confessedly liable to daily fluctuation. L.3000 would be the utmost he could risk; in which case the half of L.25,000 would have left him so very much richer, that he would have proclaimed his good fortune as an evidence of his skill and prudence. Yet, on the contrary, he wished his friends to understand at times that he had lost. But his friends forgot to ask one important question: was the word *loss* to be understood in relation to the imaginary and nominal wealth which he once possessed, or in relation to the absolute sum invested in the South Sea fund? The truth is, Pope practised on this, as on other occasions, a little finessing, which is the chief foible in his character. His object was, that, according to circumstances, he might vindicate his own freedom from the common mania, in case his enemies should take that handle for attacking him; or might have it in his power to plead poverty, and to account for it, in case he should ever accept that pension which had been so often tendered but never sternly rejected.

In 1723 Pope lost one of his dearest friends, Bishop Atterbury, by banishment; a sentence most justly incurred, and mercifully mitigated by the hostile Whig government. On the bishop's trial a circumstance occurred to Pope which flagrantly corroborated his own belief in his natural disqualification for public life. He was summoned as an evidence on his friend's behalf. He had but a dozen words to say, simply explaining the general tenor of his lordship's behaviour at Bromley, and yet, under this trivial task, though supported by the enthusiasm of his friendship, he broke down. Lord Bolingbroke, returning from exile, met the bishop at the sea-side; upon which it was wittily remarked that they were "exchanged." Lord Bolingbroke supplied to Pope the place, or perhaps more than supplied the place, of the friend he had lost; for Bolingbroke was a free-thinker, and so far more entertaining to Pope, even whilst partially dissenting, than Atterbury, whose clerical profession laid him under restraints of decorum, and latterly, there is reason to think, of conscience.

In 1725, on closing the Odyssey, Pope announces his intention to Swift of quitting the labours of a translator, and thenceforwards applying himself to original composition. This resolution led to the Essay on Man, which appeared soon afterwards; and, with the exception of two labours, which occupied Pope in the interval between 1726 and 1729, the rest of his life may properly be described as dedicated to the further extension of that Essay. The two works which he interposed were a collection of the fugitive papers, whether prose or verse, which he and Dean Swift had scattered amongst their friends at different periods of life. The avowed motive for this publication, and, in fact, the secret motive, as disclosed in Pope's confidential letters, was to make it impossible thenceforwards for piratical publishers like Curll. Both Pope and Swift dreaded the malice of Curll in case they should die before him. It was one of Curll's regular artifices to publish a heap of trash on the death of any eminent man, under the title of his Remains; and in allusion to that practice it was that Arbuthnot most wittily called Curll "one of the new terrors of death." By publishing *all*, Pope would have disarmed Curll beforehand; and *that* was in fact the purpose; and that plea only could be offered by two grave authors, one forty, the other sixty years old, for reprinting *jeux d'esprit* that never had any other apology than the youth of their authors. Yet, strange to say, after all, some were omitted; and the omission of one opened the door to Curll as well as that of a score. Let Curll have once inserted the narrow end of the wedge, he would soon have driven it home.

This Miscellany, however, in three volumes (published in 1727, but afterwards increased by a fourth in 1732), though in itself a trifling work, had one vast consequence. It drew after it swarms of libels and lampoons, levelled almost exclusively at Pope, although the cipher of the joint authors stood entwined upon the title-page. These libels in *their* turn produced a second re-action; and, by stimulating Pope to effectual anger, eventually drew forth, for the everlasting admiration of posterity, the very greatest of Pope's works; a monument of satirical power the greatest which man has produced, not excepting the MacFleckno of Dryden, namely, the immortal Dunciad.

In October of the year 1727, this poem, in its original form, was completed. Many editions, not spurious altogether, nor surreptitious, but with some connivance, not yet explained, from Pope, were printed in Dublin and in London. But the first quarto and acknowledged edition was published in London early in "1728–9," as the editors choose to write it, that is (without perplexing the reader), in 1729: on March 12 of which year it was presented by the prime minister, Sir Robert Walpole, to the king and queen at St James's.

Like a hornet, who is said to leave his sting in the wound, and afterwards to languish away, Pope felt so greatly exhausted by the efforts connected with the Dunciad (which are far greater, in fact, than all his Homeric labours put together), that he prepared his friends to expect for the future only an indolent companion and a hermit. Events rapidly succeeded which tended to strengthen the impression he had conceived of his own decay, and certainly to increase his disgust with the world. In 1732 died his friend Atterbury; and on December the 7th of the same year Gay, the most unpretending of all the wits whom he knew, and the one with whom he had at one time been domesticated, expired, after an illness of three days, which Dr Arbuthnot declares to have been "the most precipitate" he ever knew. But in fact Gay had long been decaying, from the ignoble vice of too much and too luxurious eating. Six months after this loss, which greatly affected Pope, came the last deadly wound which this life could inflict, in the death of his mother. She had for some time been in her dotage, and recognised no face but that of her son, so that her death was not unexpected; but that circumstance did not soften the blow of separation to Pope. She died on the 7th of June 1733, being then ninety-three years old. Three days after, writing to Richardson the painter for the purpose of urging him to come down and take her portrait before the coffin was closed, he says, "I thank God, her death was as easy as her life was innocent; and as it cost her not a groan, nor even a sigh, there is yet upon her countenance such an expression of tranquillity" that "it would afford the finest image of a saint expired that ever painting drew. Adieu, may you die as happily." The funeral took place on the 11th; Pope then quitted the house, unable to support the silence of her chamber, and did not return for months, nor in fact ever reconciled himself to the sight of her vacant apartment.

Swift also he had virtually lost for ever. In April 1727 this unhappy man had visited Pope for the last time. During this visit occurred the death of George I. Great expectations arose from that event amongst the Tories, in which, of course, Swift shared. It was reckoned upon as a thing of course that Walpole would be dismissed. But this bright gleam of hope proved as treacherous as all before; and the anguish of this final disappointment perhaps it was which brought on a violent attack of Swift's constitutional malady. On the last of August he quitted Pope's house abruptly; concealed himself in London; and finally quitted it, as stealthily as he had before quitted Twickenham, for Ireland, never more to return. He left a most affectionate letter for Pope; but his affliction, and his gloomy anticipations of insanity, were too oppressive to allow of his seeking a personal interview.

Pope might now describe himself pretty nearly as *ultimus suorum;* and if he would have friends in future, he must seek them, as he complains bitterly, almost amongst strangers and another generation. This sense of desolation may account for the acrimony which too much disfigures his writings henceforward. Between 1732 and 1740, he was chiefly engaged in satires, which uniformly speak a high moral tone in the midst of personal invective; or in poems directly philosophical, which almost as uniformly speak the bitter tone of satire in the midst of dispassionate ethics. His Essay on Man was but one link in a general course which he had projected of moral philosophy, here and there pursuing his themes into the fields of metaphysics, but no farther in either field of morals or metaphysics than he could make compatible with a poetical treatment. These works, however, naturally entangled him in feuds of various complexions with people of very various pretensions; and to admirers of Pope so fervent as we profess ourselves, it is painful to acknowledge that the dignity of his latter years, and the becoming tranquillity of increasing age, are sadly disturbed by the petulance and the tone of irritation which, alike to those in the wrong and in the right, inevitably besiege all personal disputes. He was agitated, besides, by a piratical publication of his correspondence. This emanated of course from the den of Curll, the universal robber and "*blatant beast*" of those days; and, besides the injury offered to his feelings by exposing some youthful sallies which he wished to have suppressed, it drew upon him a far more disgraceful imputation, most assuredly unfounded, but accredited by Dr Johnson, and consequently in full currency to this day, of having acted collusively with Curll, or at least through Curll, for the publication of what he wished the world to see, but could not else have devised any decent pretext for exhibiting. The disturbance of his mind on this occasion led to a circular request, dispersed amongst his friends, that they would return his letters. All complied except Swift. He only delayed, and in fact shuffled. But it is easy to read in his evasions, and Pope, in spite of his vexation, read the same tale, viz. that, in consequence of his recurring attacks and increasing misery, he was himself the victim of artifices amongst those who surrounded him. What Pope apprehended happened. The letters were all published in Dublin and in London, the originals being then only returned when they had done their work of exposure.

Such a tenor of life, so constantly fretted by petty wrongs, or by leaden insults, to which only the celebrity of their object lent force or wings, allowed little opportunity to Pope for recalling his powers from angry themes, and converging them upon others of more catholic philosophy. To the last he continued to conceal vipers beneath his flowers; or rather, speaking proportionately to the case, he continued to sheath amongst the gleaming but innocuous lightnings of his departing splendours, the thunderbolts which blasted for ever. His last appearance was his greatest. In 1742 he published the fourth book of the Dunciad; to which it has with much reason been objected, that it stands in no obvious relation to the other three, but which, taken as a separate whole, is by far the most brilliant and the weightiest of his works. Pope was aware of the *hiatus* between this last book and the rest, on which account he sometime called it the greater Dunciad; and it would have been easy for him, with a shallow Warburtonian ingenuity, to invent links that might have satisfied a mere *verbal* sense of connection. But he disdained this puerile expedient. The fact was, and could not be disguised from any penetrating eye, that the poem was not a pursuit of the former subjects; it had arisen spontaneously at various times, by looking at the same general theme of dulness (which, in Pope's sense, includes all aberrations of the intellect, nay, even any defective equilibrium amongst the faculties) under a different angle of observation, and from a different centre. In this closing book, not only bad authors, as in the other three, but all abuses of science or antiquarian knowledge, or connoisseurship in the arts, are attacked: virtuosi, medalists, butterfly-hunters, florists, erring metaphysicians, &c. are all pierced through and through as with the shafts of Apollo. But the imperfect plan of the work as to its internal economy, no less than its exterior relations, is evident in many places; and in particular the whole catastrophe of the poem, if it can be so called, is linked to the rest by a most insufficient incident. To give a closing grandeur to his work, Pope had conceived the idea of representing the earth as lying universally under the incubation of one mighty spirit of dulness; a sort of millennium, as we may call it, for ignorance, error, and stupidity. This would take leave of the reader with effect; but how was it to be introduced? at what era? under what exciting cause? As to the eras, Pope could not settle that; unless it were a *future* era, the description of it could not be delivered as a prophecy; and, not being prophetic, it would want much of its grandeur.

Yet, *as* a part of futurity, how is it connected with our present times? Do they and their pursuits lead to it as a possibility, or as a contingency upon certain habits which we have it in our power to eradicate (in which case this vision of dulness has a *practical* warning), or is it a mere necessity, one amongst the many changes attached to the cycles of human destiny, or which chance brings round with the revolutions of its wheel? All this Pope could not determine; but the exciting cause he *has* determined, and it is preposterously below the effect. The goddess of dulness yawns; and her yawn, which, after all, should rather express the fact and state of universal dulness than its cause, produces a change over all nations tantamount to a long eclipse. Meantime, with all its defects of plan, the poem, as to execution, is superior to all which Pope has done; the composition is much superior to that of the Essay on Man, and more profoundly poetic: the parodies drawn from Milton, as also in the former books, have a beauty and effect which cannot be expressed; and, if a young lady wished to cull for her album a passage from all Pope's writings, which, without a trace of irritation or acrimony, should yet present an exquisite gem of independent beauty, she could not find another passage equal to the little story of the florist and the butterfly-hunter. They plead their cause separately before the throne of dulness; the florist telling how he had reared a superb carnation, which, in honour of the queen, he called Caroline, when his enemy, pursuing a butterfly which settled on the carnation, in securing his own object, had destroyed that of the plaintiff. The defendant replies with equal beauty; and it may certainly be affirmed, that, for brilliancy of colouring and the art of poetical narration, the tale is not surpassed by any in the language.

This was the last effort of Pope worthy of separate notice. He was now decaying rapidly, and sensible of his own decay. His complaint was a dropsy of the chest, and he knew it to be incurable. Under these circumstances, his behaviour was admirably philosophical. He employed himself in revising and burnishing all his later works, as those upon which he wisely relied for his reputation with future generations. In this task he was assisted by Dr Warburton, a new literary friend, who had introduced himself to the favourable notice of Pope about four years before, by a defence of the Essay on Man, which Crousaz had attacked, but in general indirectly and ineffectually, by attacking it through the blunders of a very faulty translation. This poem, however, still labours, to religious readers, under two capital defects. If man, according to Pope, is now so admirably placed in the universal system of things, that evil only could result from any change, then it seems to follow, either that a fall of man is inadmissible; or at least, that, by placing him in his true centre, it had been a blessing universally. The other objection lies in this, that if all is right already, and in this earthly station, then one argument for a future state, as the scene in which evil is to be redressed, seems weakened or undermined.

As the weakness of Pope increased, his nearest friends, Lord Bolingbroke, and a few others, gathered around him. The last scenes were passed almost with ease and tranquillity. He dined in company two days before he died; and on the very day preceding his death he took an airing on Blackheath. A few mornings before he died, he was found very early in his library writing on the immortality of the soul. This was an effort of delirium; and he suffered otherwise from this affection of the brain, and from inability to think in his closing hours. But his humanity and goodness, it was remarked, had survived his intellectual faculties. He died on the 30th of May 1744; and so quietly, that the attendants could not distinguish the exact moment of his dissolution.

We had prepared an account of Pope's quarrels, in which we had shown that, generally, he was not the aggressor; and often was atrociously ill used before he retorted. This service to Pope's memory we had judged important, because it is upon these quarrels chiefly that the erroneous opinion has built itself of Pope's fretfulness and irritability. And this unamiable feature of his nature, together with a proneness to petty manœuvring, are the main foibles that malice has been able to charge upon Pope's moral character. Yet, with no better foundation for their malignity than these doubtful propensities, of which the first perhaps was a constitutional defect, a defect of his temperament rather than his will, and the second has been much exaggerated, many writers have taken upon themselves to treat Pope as a man, if not absolutely unprincipled and without moral sensibility, yet as mean, little-minded, indirect, splenetic, vindictive, and morose. Now the difference between ourselves and these writers is fundamental. They fancy that in Pope's character a basis of ignoble qualities was here and there slightly relieved by a few shining spots; we, on the contrary, believe that in Pope lay a disposition radically noble and generous, clouded and overshadowed by superficial foibles, or, to adopt the distinction of Shakspeare, they see nothing but "dust a little gilt," and we "gold a little dusted." A very rapid glance we will throw over the general outline of his character.

As a friend, it is noticed emphatically by Martha Blount and other contemporaries, who must have had the best means of judging, that no man was so warm hearted, or so much sacrificed himself for others, as Pope; and in fact many of his quarrels grew out of this trait in his character. For once that he levelled his spear in his own quarrel, at least twice he did so on behalf of his insulted parents or his friends. Pope was also noticeable for the duration of his friendships;[1] some dropped him, but he never any throughout his life. And let it be remembered, that amongst Pope's friends were the men of most eminent talents in those days; so that envy at least, or jealousy of rival power, was assuredly no foible of his. In that respect how different from Addison, whose petty manœuvring against Pope proceeded entirely from malignant jealousy. That Addison was more in the wrong even than has generally been supposed, and Pope more thoroughly innocent as well as more generous, we have the means at a proper opportunity of showing decisively. As a son, we need not insist on Pope's pre-eminent goodness. Dean Swift, who had lived for months together at Twickenham, declares that he had not only never witnessed, but had never heard of anything like it. As a Christian, Pope appears in a truly estimable light. He found himself a Roman Catholic by accident of birth; so was his mother; but his father was so upon personal conviction and conversion, yet not without extensive study of the questions at issue. It would have laid open the road to preferment, and preferment was otherwise abundantly before him, if Pope would have gone over to the Protestant faith. And in his conscience he found no obstacle to that change; he was a philosophical Christian, intolerant of nothing but intolerance, a bigot only against bigots. But he remained true to his baptismal profession, partly on a general principle of honour in adhering to a distressed and dishonoured party, but chiefly out of reverence and affection to his mother. In his relation to women, Pope was amiable and gentlemanly; and accordingly was the object of affectionate regard and admiration to many of the most accomplished in that sex. This we mention especially because we would wish to express our full assent to the manly scorn with which Mr Roscoe repels the libellous insinuations against Pope and Miss Martha Blount. A more innocent connection we do not believe ever existed. As an author, Warburton has recorded that no man ever displayed more candour or more docility to criticisms offered in a friendly spirit. Finally, we sum up all in saying, that Pope retained to the last a true and diffusive benignity; that this was the quality which survived all others, notwithstanding the bitter trial which his benignity must have stood through life, and the excitement to a spiteful re-action of feeling which was continually pressed upon him by the scorn and insult which his deformity drew upon him from the unworthy.

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[1] We may illustrate this feature in the behaviour of Pope to Savage. When all else forsook him, when all beside pleaded the insults of Savage for withdrawing their subscriptions, Pope sent his in advance. And when Savage had insulted *him* also, arrogantly commanding him never "to presume to interfere or meddle in his affairs," dignity and self-respect made Pope obedient to these orders, except when there was an occasion of serving Savage. On his second visit to Bristol (when he returned from Glamorganshire), Savage had been thrown into the jail of the city. One person only interested himself for this hopeless profligate, and was causing an inquiry to be made about his debts at the time Savage died. So much Dr Johnson admits; but he *forgets* to mention the name of this long-suffering friend. *It was Pope.* Meantime, let us not be supposed to believe the lying legend of Savage; he was doubtless no son of Lady Macclesfield's, but an impostor, who would now be sent to the tread-mill.

But the moral character of Pope is of secondary interest: we are concerned with it only as connected with his great intellectual power. There are three errors which seem current upon this subject: *First*, that Pope drew his impulses from French literature; *secondly*, that he was a poet of inferior rank; *thirdly*, that his merit lies in superior "correctness." With respect to the first notion, it has prevailed by turns in every literature. One stage of society, in every nation, brings men of impassioned minds to the contemplation of manners, and of the social affections of man as exhibited in manners. With this propensity co-operates, no doubt, some degree of despondency when looking at the great models of the literature who have usually preoccupied the grander passions, and displayed their movements in the earlier periods of literature. Now it happens that the French, from an extraordinary defect in the higher qualities of passion, have attracted the notice of foreign nations chiefly to that field of their literature in which the taste and the unimpassioned understanding preside. But in all nations such literature is a natural growth of the mind, and would arise equally if the French literature had never existed. The wits of Queen Anne's reign, or even of Charles II.'s, were not French by their taste or their imitation. Butler and Dryden were surely not French; and of Milton we need not speak; as little was Pope French, either by his institution or by his models. Boileau he certainly admired too much; and, for the sake of a poor parallelism with a passage about Greece in Horace, he has falsified history in the most ludicrous manner, without a shadow of countenance from facts, in order to make out that we, like the Romans, received laws of taste from those whom we had conquered. But these are insulated cases and accidents, not to insist on his known and most profound admiration, often expressed, for both Chaucer, and Shakspeare, and Milton. Secondly, that Pope is to be classed as an inferior poet, has arisen purely from a confusion between the departments of poetry which he cultivated and the merit of his culture. The first place must undoubtedly be given for ever,—it cannot be refused,—to the impassioned movements of the tragic, and to the majestic movements of the epic muse. We cannot alter the relations of things out of favour to an individual. But in his own department, whether higher or lower, that man is supreme who has not yet been surpassed; and such a man is Pope. As to the final notion, first started by Walsh, and propagated by Warton, it is the most absurd of all the three; it is not from superior correctness that Pope is esteemed more correct, but because the compass and sweep of his performances lies more within the range of ordinary judgments. Many questions that have been raised upon Milton or Shakspeare, questions relating to so subtile a subject as the flux and reflux of human passion, lie far above the region of ordinary capacities; and the indeterminateness or even carelessness of the judgment is transferred by a common confusion to its objects. But waiving this, let us ask, what is meant by "correctness?" Correctness in what? In developing the thought? In connecting it, or effecting the transitions? In the use of words? In the grammar? In the metre? Under every one of these limitations of the idea, we maintain that Pope is *not* distinguished by correctness; nay, that, as compared with Shakspeare, he is eminently incorrect. Produce us from any drama of Shakspeare one of those leading passages that all men have by heart, and show us any eminent defect in the very sinews of the thought. It is impossible; defects there may be, but they will always be found irrelevant to the main central thought, or to its expression. Now turn to Pope; the first striking passage which offers itself to our memory, is the famous character of Addison, ending thus:

> Who would not laugh, if such a man there be,
> Who but must weep if Atticus were he?

Why must we laugh? Because we find a grotesque assembly of noble and ignoble qualities. Very well; but why then must we weep? Because this assemblage is found actually existing in an eminent man of genius. Well, that is a good reason for weeping; we weep for the degradation of human nature. But then revolves the question, why must we laugh? Because, if the belonging to a man of genius were a sufficient reason for weeping, so much we know from the very first. The very first line says "Peace to all such. But were there one whose fires *true genius kindles* and fair fame inspires." Thus falls to the ground the whole antithesis of this famous character. We are to change our mood from laughter to tears upon a sudden discovery that the character belonged to a man of genius; and this we had already known from the beginning. Match us this prodigious oversight in Shakspeare. Again, take the Essay on Criticism: it is a collection of independent maxims, tied together into a fasciculus by the printer, but having no natural order or logical dependency; generally so vague as to mean nothing: like the general rules of justice, &c. in ethics, to which every man assents; but when the question comes about any practical case, *is* it just? the opinions fly asunder far as the poles. And, what is remarkable, many of the rules are violated by no man so often as by Pope, and by Pope nowhere so often as in this very poem. As a single instance, he proscribes monosyllabic lines; and in no English poem of any pretensions are there so many lines of that class as in this. We have counted above a score, and the last line of all is monosyllabic.

Not therefore for superior correctness, but for qualities the very same as belong to his most distinguished brethren, is Pope to be considered a great poet; for impassioned thinking, powerful description, pathetic reflection, brilliant narration. His characteristic difference is simply that he carried these powers into a different field, and moved chiefly amongst the social paths of men, and viewed their characters as operating through their manners. And our obligations to him arise chiefly on this ground, that having already, in the persons of earlier poets, carried off the palm in all the grander trials of intellectual strength, for the majesty of the epopee and the impassioned vehemence of the tragic drama, to Pope we owe it that we can now claim an equal pre-eminence in the sportive and aërial graces of the mock heroic and satiric muse; that in the Dunciad we possess a peculiar form of satire, in which (according to a plan unattempted by any other nation) we see alternately her festive smile and her gloomiest scowl; that the grave good sense of the nation has here found its brightest mirror; and, finally, that through Pope the cycle of our poetry is perfected and made orbicular, that from that day we might claim the laurel equally, whether for dignity or grace. (w. w. w.)

POPERINGHEN, a large market-town of Belgium, in the province of West Flanders and circle of Ypres. It stands on the river Schipuor, and contains two churches, 1400 houses, and 9080 inhabitants, who are employed in making linen and woollen cloths, and thread-lace, and have several oil mills. It is celebrated for the growth of hops on the land around it, which is a valuable part of its trade.

POPERY, in *Ecclesiastical History*, is regarded by Roman Catholics as a term of reproach, but having been generally received amongst Protestants, now comprehends the religious doctrines and practices adopted and maintained by the church of Rome. The following summary, extracted chiefly from the decrees of the council of Trent, continued under Paul III., Julius III., and Pius IV., by successive sessions, from the year 1545 to 1563, and the creed of Pope Pius IV. subjoined to it, and bearing date November 1564, may not be unacceptable to the reader. One of the fundamental tenets strenuously maintained by Catholic writers, is the infallibility of the church of Rome; and though they are not agreed whether this privilege belongs to the pope or a general council, or to both united, yet they pretend that an infallible living judge is absolutely necessary to determine controversies, and to secure peace, in the Christian church. Protestants, however, allege that the claim of infallibility in any church is not justified by the authority of Scripture, much less does it appertain to the church of Rome; that it is inconsistent with the nature of religion, and the personal obligations of its professors; and that it has proved ineffectual to the end for which it is supposed to have been granted, since popes and councils have disagreed in matters of importance, and, with the advantage of this pretended infallibility, have been incapable of maintaining union and peace. Another essential article of the Catholic creed is the supremacy of the pope, or his sovereign power over the universal church.

Further, the doctrine of the seven sacraments is a peculiar and distinguishing doctrine of the church of Rome. These are baptism, confirmation, the eucharist, penance, extreme unction, holy orders, and matrimony. The council of Trent (sess. vii. can. 1) pronounces an anathema upon those who say that the sacraments are more or fewer than seven, or that any one of the above number is not truly and properly a sacrament. And yet it does not appear that they amounted to this number before the twelfth century, when Hugo de St Victoire and Peter Lombard, about the year 1144, taught that there were seven sacraments. The council of Florence, held in the year 1438, was the first council which determined this number. These sacraments confer grace, according to the decree of the council of Trent (sess. vii. can. 8) *ex opere operato*, that is, by the mere administration of them; three of them, viz. baptism, confirmation, and holy orders, are said (can. 9) to impress an indelible character, so that they cannot be repeated without sacrilege; and the efficacy of every sacrament depends upon the intention of the priest by whom it is administered (can. 11). Pope Pius expressly enjoins that all these sacraments should be administered according to the received and approved rites of the Catholic church. With regard to the eucharist in particular, we may here observe, that the church of Rome holds the doctrine of transubstantiation; the necessity of paying divine worship to Christ under the form of the consecrated bread, or host; and the propitiatory sacrifice of the mass, according to the Catholic ideas of which Christ is truly and properly offered as a sacrifice of propitiation as often as the priest says mass. It likewise practises solitary mass, in which the priest alone consecrates, communicates, and allows communion only in one kind, namely, the bread, to the laity. (Sess. 14.)

The doctrine of merits is another distinguishing tenet of Popery, with regard to which the council of Trent has expressly decreed (sess. vi. can. 32) that the good works of justified persons are truly meritorious, deserving not only an increase of grace, but eternal life, and an increase of glory; and it has anathematized all who deny this doctrine. Of the same kind is the doctrine of satisfaction, which supposes that penitents may truly satisfy, by the afflictions they endure under the dispensations of Providence, or by voluntary penances to which they submit, for the temporary penalties of sin, to which they are subject even after the remission of their eternal punishment. (Sess. vi. can. 30; and sess. xiv. can. 8 and 9.) In this connection we may mention the distinction of venial and mortal sins. The greatest evils arising from the former are the temporary pains of purgatory; but no man, it is said, can obtain the pardon of the latter without confessing to a priest, and performing the penances which he imposes.

The council of Trent (sess. xiv. can. 1) has expressly decreed, that every one is accursed who shall affirm that penance is not truly and properly a sacrament, instituted by Christ in the universal church, for reconciling those Christians to the divine majesty, who have fallen into sin after baptism. And this sacrament, it is declared, consists of two parts, the matter and the form; the matter being the act of the penitent, including contrition, confession, and satisfaction; the form, the act of absolution on the part of the priest. Accordingly it is enjoined, that it is the duty of every man who has fallen after baptism, to confess his sins, once a year at least, to a priest; that this confession is to be secret, for public confession is neither commanded nor expedient; and that it must be exact and particular, including every kind and act of sin, with all the circumstances attending it. When the penitent has so done, the priest pronounces an absolution, which is not conditional or declarative only, but absolute and judicial. This secret or auricular confession was first decreed and established in the fourth council of Lateran, under Pope Innocent III. in 1215 (cap. 21); and the decree of this council was afterwards confirmed and enlarged in the council of Florence and in that of Trent, which ordains, that confession was instituted by Christ, that by the law of God it is necessary to salvation, and that it has always been practised in the Christian church. As for the penances imposed on the penitent by way of satisfaction, they have been commonly the repetition of certain forms of devotion, as paternosters or avemarias, the payment of stipulated sums, pilgrimages, fasts, or various species of corporal discipline. But the most formidable penance, in the estimation of those who belong to the communion of the church of Rome, is the temporary pains of purgatory. Yet under all the penalties which are inflicted or threatened in that church, it has provided relief by its indulgences, and by its prayers or masses for the dead, performed professedly for relieving and rescuing the souls that are detained in purgatory.

Another article which has long been authoritatively enjoined and observed in the church of Rome, is the celibacy of her clergy. This was first enjoined at Rome by Gregory VII. about the year 1074, and established in England by Anselm archbishop of Canterbury about the year 1175; though his predecessor Lanfranc had imposed it upon the prebendaries and clergy who lived in towns. And though the council of Trent was repeatedly petitioned by several princes and states to abolish this restraint, yet the obligation of celibacy was rather established than relaxed by this council; for they decreed, that marriage contracted after a vow of continence is neither lawful nor valid, and thus deprived the church of the possibility of ever restoring marriage to the clergy. If marriage, after a vow, be in itself unlawful, the greatest authority upon earth cannot dispense with it, nor permit marriage to the clergy, who have already vowed continence.

To the doctrines and practices above recited may further be added the worship of images, of which Protestants accuse the Papists. But to this accusation the Papist replies, that he keeps images by him to preserve in his mind the memory of the persons represented by them, as people are wont to preserve the memory of their deceased friends by keeping their pictures. He is taught, he says, to use them so as to cast his eyes upon the pictures or images, and thence to raise his heart to the things represented, and there to employ it in meditation, love, thanksgiving, and desire of imitation, as the object requires. These pictures or images have this advantage, that they inform the mind by one glance, of what in reading might require a whole chapter; there being no other difference between them, than that reading represents leisurely and by degrees, whilst a picture does so at once. Hence he finds a convenience in saying his prayers with some devout pictures before him, the sight of which recalls his wandering thoughts to the right object, and as certainly brings something good into his mind, as an immodest picture disturbs his heart with unclean thoughts. And because he is sensible that these holy pictures and images represent and bring to his mind such objects as in his heart he loves, honours, and venerates, he cannot but on that account love, honour, and respect, the images themselves.[1]

The council of Trent likewise decreed, that all bishops and pastors who have the cure of souls, do diligently instruct their flocks that it is good and profitable to desire the intercession of saints reigning with Christ in heaven. And this decree the Papists endeavour to defend by many arguments. They confess that we have but one Mediator of redemption, but affirm that it is acceptable to God that we should have many mediators of intercession. Moses, say they, was such a mediator for the Israelites; Job for his three friends; Stephen for his persecutors. The Romans were thus desired by St Paul to be his mediators; so were the Corinthians and the Ephesians, so almost every sick man desires the congregation to be his mediators, by remembering him in their prayers. And so, too, the Papist desires the blessed in heaven to be his mediators, that is, that they would pray to God for him. But between these living and dead mediators there is no similarity. The living mediator is present, and certainly hears the request of those who desire him to intercede for them; the dead mediator is as certainly absent, and cannot possibly hear the requests of all those who at the same instant may be begging him to intercede for them, unless he be possessed of the divine attribute of omnipresence; and he who ascribes that attribute to any creature is unquestionably guilty of idolatry. Besides, as this decree is contrary to one of the first principles of natural religion, so it receives no countenance from Scripture, or any Christian writer of the first three centuries. Other practices peculiar to the Papists are the religious honour and respect that they pay to sacred relics, by which they understand not only the bodies and parts of the bodies of the saints, but any of those things that appertained to them, and which they had touched; and the celebration of divine service in an unknown tongue, in regard to which the council of Trent has denounced an anathema on any one who shall say that mass ought to be celebrated only in the vulgar tongue (session xxv. and session xxii. can. 9). Though the council of Lateran under Innocent III. in 1215, had (can. 9) expressly decreed, that as in several parts within the same city and diocese there are many people of different manners and rites mixed together, but of one faith, so the bishops of such cities or dioceses should provide fit men for celebrating divine offices, according to the diversity of tongues and rites, and for administering the sacraments.

We shall only add further, that the church of Rome maintains that unwritten traditions ought to be added to the holy Scriptures, in order to supply their defect, and should be regarded as of equal authority; that the books of the Apocrypha are canonical Scripture; that the vulgate edition of the Bible is to be deemed authentic; and that the Scriptures are to be received and interpreted according to that sense which the holy mother church, to whom it belongs to judge of the true sense, has held, and does hold, and according to the unanimous consent of the Fathers.

Such are the principal and distinguishing doctrines of Catholicism or Popery, most of which have received the sanction of the council of Trent, and that of the creed of Pope Pius IV. which is received, professed, and sworn to by every one who enters into holy orders in the church of Rome, as well as by all proselytes or converts: And at the close of this creed, we are told that the faith contained in it is so absolutely and indispensably necessary, that no man can be saved without it.

POPHAM, Sir John, lord chief justice of the common pleas in the reign of Queen Elizabeth, was the eldest son of Mr Edward Popham of Huntworth, in Somersetshire, and born in the year 1531. He was some time a student of Baliol College, Oxford; "being then," as Anthony Wood says, "given at leisure hours to many sports and exercises." After quitting the university, he established himself in the Middle Temple, where, during his novitiate, he is said to have indulged in that kind of dissipation to which youth and a vigorous constitution more naturally incline, than to the study of voluminous reports; but, satiated at length with what are called the pleasures of the town, he applied sedulously to the study of his profession, was called to the bar, and in 1568 became summer or autumn reader. He was soon afterwards made serjeant at law, and solicitor-general in 1579. In 1581 he was appointed attorney-general, and treasurer of the Middle Temple. In 1592 he was made lord chief justice of the king's bench, and the same year received the honour of knighthood. In the year 1601 his lordship was one of the council detained by the unfortunate Earl of Essex, when he formed the ridiculous project of defending himself in his own house; and, on the earl's trial, Sir John gave evidence against him relative to their detention. He died in the year 1607, aged seventy-six, and was buried in the south aisle of the church at Wellington in Somersetshire, where he generally resided as often as it was in his power to retire. He was thought somewhat severe in the execution of the law against capital offenders; but his severity had the happy effect of reducing the number of highway robberies. He wrote, 1. Reports and cases adjudged in the time of Queen Elizabeth; 2. Resolutions and judgments upon cases and matters agitated in all the courts at Westminster in the latter end of Queen Elizabeth's reign.

POPILIUS, Lænas, Roman ambassador to Antiochus, king of Syria. He was commissioned to order that monarch to desist from hostilities against Ptolemy, king of Egypt, ally of Rome. Antiochus attempted to elude him by evasive answers; but Popilius, with a stick in his hand, made a circle round him in the sand, and charged him, in the name of the Roman senate and people, not to go beyond it till he gave a decisive answer. This boldness intimidated Antiochus, who immediately withdrew his garrisons from Egypt, and desisted from his hostile attempts against Ptolemy.

POPLAR, a parish of the county of Middlesex, in the hundred of Ossulton. It stands on the banks of the river Thames, and was formerly a hamlet in the parish of Stepney. It is extensive, and comprehends the Isle of Dogs, which was formerly a rich marsh, but is now in part converted into docks and canals. The construction of the West India Docks has of late years tended very much to increase the population, which consists chiefly of persons directly or indirectly connected with shipping. In that part of the parish known by the name of Blackwall is the largest private establishment for ship-building in the kingdom. In it there are also many manufactories for rope-making, anchor-forging, and preparing the several other component parts of vessels. There is also a commodious hospital for persons who have been in the service of the East India Company. The population amounted in 1801 to 4493, in 1811 to 7708, in 1821 to 12,223, and in 1831 to 16,849.

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[1] See Gother's Papist Misrepresented and Represented.

POPO is the name of one of the states comprised in what is denominated the Slave Coast, on the western shores of Africa. In the strictest acceptation, the Slave Coast includes the states of Coto, Popo, Widah, and Ardra, the whole being subject to the king of Dahomey. The maritime flat country here is broader than that of the Gold Coast, and very fertile. The inhabitants are warlike, and addicted to cheating and thieving. This state is divided into the Great and Little Popo. The capital of the former stands on an island at the mouth of a river, which is rendered useless for the navigation of vessels, on account of a formidable bar at its mouth. The capital of Little Popo is situated on the shore near a small river or inlet of the sea. Poultry are here in uncommon abundance; and the flocks of bats are so numerous that they darken the air like dense clouds.

Popo *Isle*, an island or cluster of islands in the Eastern Seas, the chief of which is about fifty miles in circumference. They are distant five leagues from the islands of Bo, and exceed them in height. They are inhabited, and afford a supply of nuts and dried fish. Long. 130. 0. 15. E. Lat. 19. 14. S.

POPOCA, Mount, one of the volcanoes on the summits of the American Cordilleras. Its crater is said to be half a league in circumference.

POPPÆA, Sabina, a Roman matron, daughter of Titus Ollius. She was married and had a son to Rufus Crispinus, a Roman knight. Her beauty captivated Otho, one of Nero's favourites, who carried her off and married her; but he was not long permitted to retain her, for Nero, having heard her extolled for her accomplishments, sent Otho out of Italy, under pretence of presiding over one of the Roman provinces, shortly after which Nero repudiated his wife Octavia, and married Poppæa; but she did not long enjoy the imperial dignity, for Nero soon began to despise her, and treat her with great barbarity. She bore him a son; and when she was again far advanced in pregnancy, he struck her a blow with his foot, of which she died, about 65 A. D. It is said she was so anxious to preserve her beauty, that five hundred she-asses were kept to afford milk, in which she used daily to bathe.

POPULATION.

bject of he article.

THE population of the principal states, of which an account has been given in the course of this work, will be found under their proper heads. The object of this article is to explain the general laws which regulate the increase or decrease of population, and the manner in which they affect the state and condition of human society.

endency f all plants nd animals o increase n a geometrical progression.

In taking a view of animated nature, we cannot fail to be struck with a prodigious power of increase in plants and animals. Their capacity in this respect is indeed almost infinitely various, according with the endless variety of the works of nature, and the different purposes which they seem appointed to fulfil. But, whether they increase slowly or rapidly, if they increase by seed or generation, their natural tendency must be to increase in a geometrical ratio, that is, by multiplication; and at whatever rate they are increasing during any one period, if no further obstacles be opposed to them, they must proceed in a geometrical progression.

In the growth of wheat, a vast quantity of seed is unavoidably lost. When it is dibbled instead of being sown in the common way, two pecks of seed wheat will yield as large a crop as two bushels, and thus quadruple the proportion of the return to the quantity of seed put into the ground. In the Philosophical Transactions for 1768, an account is given of an experiment, in which, by separating the roots obtained from a single grain of wheat, and transplanting them in a favourable soil, a return was obtained of above 500,000 grains. But, without referring to peculiar instances or peculiar modes of cultivation, it is known that calculations have often been made, founded on positive experience, of the produce of wheat in different soils and countries, cultivated in an ordinary way, and making allowance for all ordinary destruction of seed.

Humboldt has collected some estimates of this kind, from which it appears that France, the north of Germany, Poland, and Sweden, taken generally, produce from five to six grains for one; some fertile lands in France produce fifteen for one; and the good lands in Picardy and the Isle of France from eight to ten grains for one. Hungary, Croatia, and Sclavonia, yield from eight to ten grains for one. In the Regno de la Plata, twelve grains for one are produced; near the city of Buenos Ayres, sixteen for one; in the northern part of Mexico seventeen; and in the equinoctial regions of Mexico twenty-four for one.[1]

Now, supposing that in any one country during a certain period, and under the ordinary cultivation, the return of wheat was six grains for one, it would be strictly correct to say that wheat had the capacity of increasing in a geometrical ratio, of such a nature as to sextuple itself every year. And it might safely be calculated hypothetically, that if, setting out from the produce of one acre, land of the same quality could be prepared with sufficient rapidity, and no wheat were consumed, the rate of increase would be such as completely to cover the whole earthy surface of our globe in fourteen years.

In the same manner, if it be found by experience that on land of a certain quality, and making allowance for the ordinary mortality and accidents, sheep will increase on an average so as to double their numbers every two years, it would be strictly correct to say, that sheep have the natural capacity of increasing in a geometrical progression, of which the common multiple is two, and the term two years; and it might safely be said, that if land of the same quality could be provided with sufficient rapidity, and no sheep were consumed, the rate of increase would be such, that if we were to begin with the full number which could be supported on an acre of land, the whole earthy part of the globe might be completely covered with sheep in less than seventy-six years.

If out of this prodigious increase of food, the full support of mankind were deducted, supposing them to increase as fast as they have ever yet increased in any country, the deduction would be comparatively inconsiderable; and the rate of increase would still be enormous, till it was checked, either by the natural want of will on the part of mankind to make efforts for the increase of food beyond what they could possibly consume, or, after a certain period, by their absolute want of power to prepare land of the same quality, so as to allow of the same rate of progress.

Owing to these two causes combined, we see that, notwithstanding this prodigious power of increase in vegetables and animals, their actual increase is extremely slow; and it is obvious, that, owing to the latter cause alone, and long before a final stop was put to all further progress, their actual rate of increase must of necessity be very greatly retarded; as it would be impossible for the most enlightened human efforts to make all the soil of the earth equal in fertility to the average quality of land now in use; while the practicable approaches towards it would require so much time as to occasion, at a very early period, a constant and great check upon what their increase would be if they could exert their natural powers.

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[1] *Nouvelle Espagne*, liv. iv. c. ix. p. 98.

Elevated as man is above all other animals by his intellectual faculties, it is not to be supposed that the physical laws to which he is subjected should be essentially different from those which are observed to prevail in other parts of animated nature. He may increase slower than most other animals, but food is equally necessary to his support; and if his natural capacity of increase be greater than can be permanently supplied with food from a limited territory, his increase must be constantly retarded by the difficulty of procuring the means of subsistence.

The power of producing food limited by the quantity and nature of the soil.

The main peculiarity which distinguishes man from other animals, in the means of his support, is the power which he possesses of very greatly increasing these means. But this power is obviously limited by the scarcity of land, by the great natural barrenness of a very large part of the surface of the earth, and by the decreasing proportion of produce which must necessarily be obtained from the continual additions of labour and capital applied to land already in cultivation.

It is, however, specifically with this diminishing and limited power of increasing the produce of the soil, that we must compare the natural power of mankind to increase, in order to ascertain whether, in the progress to the full cultivation and peopling of the globe, the natural power of mankind to increase must not of absolute necessity be constantly retarded by the difficulty of procuring the means of subsistence, and if so, what are likely to be the effects of such a state of things.

The natural rate of increase applicable to mankind.

In an endeavour to determine the natural power of mankind to increase, as well as their power of increasing the produce of the soil, we can have no other guide than past experience.

The great check to the increase of plants and animals, we know from experience, is the want of room and nourishment; and this experience would direct us to look for the greatest actual increase of them in those situations where room and nourishment were the most abundant.

On the same principle, we should expect to find the greatest actual increase of population in those situations where, from the abundance of good land, and the manner in which its produce is distributed, the largest portion of the necessaries of life is actually awarded to the mass of the society.

Of the countries with which we are acquainted, the United States of America, formerly the North American colonies of Great Britain, answer most nearly to this description. In the United States not only is there an abundance of good land, but, from the manner in which it has been distributed, and the market which has been opened for its produce, there has been a greater and more constant demand for labour, and a larger portion of necessaries has been awarded to the labourer, than in any of those other countries which possess an equal or greater abundance of land and fertility of soil.

Here, then, we should expect to find that the natural power of mankind to increase, whatever it may be, would be most distinctly marked; and here, in consequence, it appears that the actual rate of the increase of population has been more rapid than in any known country, although, independently of the abundance of good land, and the great demand for labour, it is distinguished by no other circumstances which appear to be peculiarly favourable to the increase of numbers.

It has been stated that all animals, according to the known laws by which they are produced, must have a capacity of increasing in a geometrical progression. And the question with regard to man is, what is the rate of this geometrical progression?

Fortunately, in the country to which we should naturally turn our eyes for an exemplification of the most rapid rate of increase, there have been four enumerations of the people, each at the distance of ten years; and though the estimates of the increase of population in the North American colonies at earlier periods were of sufficient authority, in the absence of more certain documents, to warrant most important inferences, yet as we now possess such documents, and as the period they involve is of sufficient length to establish the point in question, it is no longer necessary to refer to earlier times.

Increase of population in the United States of America

According to a regular census made by order of Congress in 1790, which there is every reason to think is essentially correct, the white population of the United States was found to be 3,164,148. By a similar census in 1800, it was found to have increased to 4,312,841. It had increased, then, during the ten years from 1790 to 1800, at a rate equal to 36·3 per cent., a rate which, if continued, would double the population in twenty-two years and about four months and a half.

According to a third census, in 1810, the white population was found to be 5,862,092,[1] which, compared with the population of 1800, gives an increase in the second ten years at the rate of nearly thirty-six per cent., which, if continued, would double the population in about twenty-two years and a half.

According to the fourth census, in 1820, the white population was found to be 7,861,710,[2] which, compared with the population of 1810, gives an increase in the third ten years at a rate per cent. of 34·1, which, if continued, would double the population in twenty-three years and seven months.

If we compare the period of doubling according to the rate of increase in the most unfavourable ten years of this series, with twenty-five years, we shall find the difference such as fully to cover all the increase of population which would have taken place from emigration.

Amount of emigration.

It appears from a reference to the most authentic documents which can be collected on both sides of the Atlantic, that the emigration to the United States, during the last twenty-five years, falls decidedly short of an average of 10,000 a year. Dr Seybert, the best authority on the other side of the water, states that, from 1790 to 1810, it could not have been so much as 6000 a year. Our official accounts of the number of emigrants to the United States from England, Ireland, and Scotland, during the ten years from 1812 to 1821 inclusive, give an average of less than 7000, although the period includes the extraordinary years 1817 and 1818, in which the emigrations to the United States were much greater than they were ever known to be before or since. The official American accounts, as far as they go, which is only for two years from the 30th September 1819, tend to confirm this average;[1] and, allowing fully for the emigrants from other European countries, the general average will still be under the ten thousand.

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[1] These numbers are taken from Dr Seybert's Statistical Annals, p. 23.

[2] This number is taken from the American National Calendar for 1822, and has since been compared with the original census as published for the use of the members of Congress.

A new mode was, however, some time ago suggested of estimating the amount of increase in any country derived from emigration.[2] It has been justly stated, that when a census is taken every ten years, and the population is distinguished into those above and those below ten years of age, all above ten years of age, exclusive of emigrants, must have existed in the census immediately preceding, and, consequently, after having made a proper allowance for the mortality during these ten years, the excess above the remaining number must be attributed to emigration. If we had the means of estimating with accuracy the loss which would be sustained in America in ten years by a population not increased by additional births, this mode of estimating the amount of emigration would be unobjectionable, and often very useful.

But unfortunately the means are deficient. Even the annual mortality in the United States is not known. It was supposed by Dr Price (vol. ii. p. 50, 7th edit.) to be one in fifty; by Mr Barton, in the Transactions of the Society at Philadelphia (vol. iii. No. 7), one in forty-five; and it is stated by Mr Bristed, in his work on America and her Resources (p. 20), that the annual deaths average throughout the United States one in forty, in the healthiest districts one in fifty-six, and in the most unhealthy one in thirty-five.

If, however, we could ascertain accurately the average annual mortality, we should still be unable to ascertain the amount of the loss in question; as, under any given law of mortality, it would depend so very much upon the rate at which the population was increasing. The truth of this observation will be placed in a striking light by the following short table, with which we have been favoured by a very able calculator, Mr Milne, author of a well-known Treatise on Annuities and Assurances. It is constructed on the supposition that the population, in each case, is always subject to the same law of mortality as that which prevailed in all Sweden and Finland during the five years ended with 1805, and that the number of births in the present year living in each case is 10,000.

	The Population constantly the same.	The Population increasing in geometrical progression for more than a hundred years, so as to double itself every	
		Fifty Years	Twenty-five Years.
Total population ten years since	393,848	230,005	144,358
Total above ten years of age now	320,495	195,566	126,176
Died during the term of ten years, out of those living at its commencement	73,353	34,439	18,182
Being one of	5·3692	6·6786	7·9396

We see from this table, that under the same law of mortality, the difference of loss sustained in ten years, by a people not increased by fresh births, would in the three cases supposed, of a stationary population, a population doubling in fifty years, and a population doubling in twenty-five years, be as one in 5·3692, one in 6·6786, and one in 7·9396; and that when the population is doubling itself in twenty-five years, the loss would be very little more than one eighth.

But the censuses must be allowed to form a *prima facie* evidence that the population of the United States has, for a considerable time, been going on doubling itself in twenty-five years; and assuming this evidence to be true, which we are warranted in doing till better evidence is produced on the other side, it will appear that the amount of immigration, deduced from the rule here referred to, is less than 10,000 a year.

Thus the white population of the United States in 1800 was 4,312,841.[3] This population, without further accession of births, would in 1810 be diminished one eighth, or reduced to 3,773,736. In 1810 the population above ten years of age was 3,845,389; and, subtracting the former number from the latter, the difference, or amount of emigration, will be 71,653, or 7165 a year.

Again, the white population of 1810 was 5,862,092, which, diminished by one eighth in ten years, would be 5,129,331. The population above ten years of age in 1820 was 5,235,940.[4] Subtracting the former from the latter, the difference, or amount of emigration, is 106,608, or 10,660 a year; showing, as we should expect, a greater amount of emigration from 1810 to 1820 than from 1800 to 1810, but, even in the latter ten years, and including emigrations from Canada, as well as all other countries, little exceeding 10,000.

Altogether, then, we can hardly err in defect, if we allow 10,000 a year for the average increase from emigration during the twenty-five years from 1795 to 1820; and applying this number to the slowest period of increase, when the rate was such as to double the population in twenty-three years and seven months, it may be easily calculated, that in the additional year and five months a population of 5,862,000 would have increased to an amount much more than sufficient to cover an annual emigration of 10,000 persons, with the increase from them at the same rate.

Such an increase from them, however, would not take place. It appears from an account in the National Calendar of the United States for the year 1821, that of the 7001 persons who had arrived in America from the 30th of September 1819 to the 30th of September 1820, 1959 only were females, and the rest, 5042, were males; a proportion which, if it approaches towards representing the average, must very greatly reduce the number from which any increase ought to be calculated.

If, however, we omit these considerations; if we suppose a yearly emigration from Europe to America of 10,000 persons for the twenty-five years from 1795 to 1820, the greatest part of which time Europe was involved in a most extensive scene of warfare, requiring all its population; and further, if we allow for an increase of all the emigrants during the *whole period*, at the fullest rate; the remaining numbers will still be sufficient to show a doubling of the population in less than twenty-five years.

The white population of 1790 was 3,164,148. This population, according to the rate at which it was increasing, would have amounted to about 3,694,100 in 1795; and supposing it to have just doubled itself in the twenty-five years from 1795 to 1820, the population in 1820 would have been 7,388,200. But the actual white population of 1820 appears, by the census then taken, to be 7,861,710, showing an excess of 473,510; whereas an emigration of 10,000 persons annually, with the increase from them at three per cent., a rate which would double a population in less than twenty-four years, would only amount to 364,592.

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[1] American National Calendar for 1821, p. 237; and North American Review for October 1822, p. 304.

[2] This mode was suggested by Mr Booth, in Mr Godwin's Answer to Mr Malthus.

[3] Seybert's Statistical Annals, p. 23.

[4] American National Calendar for 1822, p. 246.

But the most striking confirmation of the censuses of the United States, and the most remarkable proof of the rate of increase being occasioned almost exclusively by procreation, have been furnished to us by Mr Milne. In his work on Annuities and Assurances, which contains much valuable and interesting information on the subject of population, he had noticed the effects of the frequent pressure of want on the labouring classes of Sweden, which, by increasing the proportion of deaths, rendered the law of mortality so accurately observed in that country by Professors Wargentin and Nicander inapplicable to other countries more favourably circumstanced. But the law of mortality was observed to be gradually improving from the time that Dr Price constructed his Swedish table; and the period from 1800 to the end of 1805 was so free from scarcities and epidemics, and the healthiness of the country had been further so much improved by the introduction of vaccination, that he justly thought the law of mortality, as observed during these five years, might suit countries where the condition of the people was known to be much better than it had generally been in Sweden. On these grounds he applied the Swedish law of mortality, during the term mentioned, to the hypothesis of a population which had been increasing by procreation, in geometrical progression, for more than a hundred years, so as to double every twenty-five years. Assuming this population to be one million, he distributed it, by a process well known to persons conversant with these subjects, into the different ages referred to in the American censuses, and then compared them with the same number of persons distributed according to the actual returns of the ages in the American censuses for the three periods of 1800, 1810, and 1820. The results are as follows:

Distribution of a Population of 1,000,000 *Persons in the under-mentioned intervals of Age.*

Between the Ages of	According to			
		United States.		
	The Hypothesis.	Census of 1800.	Census of 1810.	Census of 1820.
0 and 10	337,592	334,556	344,024	333,995
10 and 16	145,583	154,898	156,345	154,913
16 and 26	186,222	185,046	189,227	198,114
26 and 45	213,013	205,289	190,461	191,139
45 and 100	117,590	120,211	119,943	121,839
0 and 100	1,000,000	1,000,000	1,000,000	1,000,000
Under 16	483,175	489,454	500,369	488,908
Above 16	516,825	510,546	499,631	511,092

The general resemblance in the distribution of the ages in the three different censuses to each other, and to the hypothesis, clearly proves,

1*st*, That the distribution of the ages in the different enumerations must be made with some care, and may, therefore, be relied on as in the main correct.

2*dly*, That the law of mortality assumed in the hypothesis cannot deviate essentially from the law of mortality which prevails in the United States; and,

3*dly*, That the actual structure of the American population differs very little from what it would be if it were increasing regularly from procreation only, in geometrical progression, so as to double itself every twenty-five years; and that we may, therefore, safely infer that it has been very little disturbed by immigration.

If to these proofs of the rapid increase of population which has actually taken place, we add the consideration that this rate of increase is an average applying to a most extensive territory, some parts of which are known to be unhealthy; that some of the towns of the United States are now large; that many of the inhabitants must be engaged in unwholesome occupations, and exposed to many of those checks to increase which prevail in other countries; and further, that in the western territories, where these checks do not occur, the rate of increase is beyond comparison more rapid than the general average, after making the fullest allowance for immigration; it must appear certain, that the rate at which the population of the whole of the United States has actually increased for the last thirty years must fall very decidedly short of the actual capacity of mankind to increase under the most favourable circumstances.

The rate of increase in the United States confirmed by that of other countries.

The best proof that can be obtained of the capacity of mankind to increase at a certain rate, is their having really increased at that rate. At the same time, if any peculiarly rapid increase which had appeared to take place in a particular country were quite unsupported by other evidence, we might be disposed to attribute it to error or accident, and might scarcely be justified in founding important conclusions upon it. But this is far from being the case in the present instance. The rate of increase which has at times taken place in other countries, under the operation of great and obvious checks to the progress of population, sufficiently shows what might be expected if these checks were removed.

Increase of population in New Spain.

The countries most resembling the United States of America are those territories of the new world which lately belonged to Spain. In abundance and fertility of soil they are indeed superior; but almost all the vices in the government of the mother country were introduced into her colonial possessions, and particularly that very unequal distribution of landed property which takes place under the feudal system. These evils, and the circumstance of a very large part of the population being Indians in a depressed state, and inferior in industry and energy to Europeans, necessarily prevent that rapid increase of numbers which the abundance and fertility of the land would admit of. But it appears, from the instructive and interesting account of New Spain which M. Humboldt has not long since given to the public, that for the last half of the eighteenth century the excess of the births above the deaths, and the progress of the population, have been very great. The following are the proportions of burials to baptisms in the registers of eleven villages, the details of which were communicated to M. Humboldt by the curates.

	Burials.	Baptisms.
At Dolores	100	253
Singuilucan	100	234
Calymaya	100	202
Guanaxuato	100	201
St Anne	100	195
Marsil	100	194
Queretaro	100	188
Axapuzco	100	157
Yguala	100	140
Malacatepec	100	130
Panuco	100	123

The mean proportion is 100 to 183.

But the proportion which M. Humboldt considers as best suited to the whole of the population is 100 to 170.

In some of the villages above mentioned, the proportion of the births to the population is extraordinarily great, and the proportion of deaths very considerable; showing, in a striking point of view, the early marriages and early deaths of a tropical climate, and the more rapid passing away of each generation.[1]

At Queretaro, it appears that the baptisms were to the population as one to fourteen, and the burials as one to twenty-six.

At Guanaxuato, including the neighbouring mines of St Anne and of Marsil, the baptisms were to the population as one to fifteen, and the burials as one to twenty-nine.

The general result from all the information which could be collected was, that the proportion of births to the population, for the whole of the kingdom of New Spain, was as one to seventeen, and of the deaths as one to thirty. These proportions of births to deaths, if they were continued, would double the population in twenty-seven and a half years.

M. Humboldt further observes, that the information which he had collected respecting the proportions of the births to the deaths, and of these to the whole population, proves, that if the order of nature were not interrupted by some extraordinary and disturbing causes, the population of New Spain ought to double itself every nineteen years.[2]

It is known, however, that these causes do occur in the actual state of things; consequently we cannot consider the actual rate of the increase of population in New Spain as greater than according to the former calculation. But a rate of increase such as to double the population in twenty-seven and a half years, in spite of all the obstacles enumerated by M. Humboldt, is very extraordinary. It is next to the increase of the United States, and greatly superior to any that can be found in Europe.

Yet in Europe, the tendency to increase is always very strongly marked, and the actual increase for periods of some length is sometimes much greater than could be expected beforehand, considering the obstacles to be overcome.

It appears from Sussmilch,[3] that the population of Prussia and Lithuania, after the great plague in 1709 and 1710, doubled itself in about forty-four years, from the excess of the births above the deaths enumerated in the registers.

In Russia, the whole population in 1763 was estimated, by enumeration and calculation, at twenty millions, and in 1796 at thirty-six millions.[4] This is a rate of increase which would occasion a doubling in less than forty-two years.

In 1695, the population of Ireland was estimated at 1,034,000. According to the returns in 1821, it had increased to the prodigious amount of 6,846,949;[5] and it is thought that when the deficiencies have been supplied by the final returns of the enumerators, it will be upwards of seven millions. This is an example of an actual increase for 125 years together, at a rate which would double the population in about forty-five years; and this has taken place under the frequent pressure of great distress among the labouring classes of society, and the practice of frequent and considerable emigration.

But for the proof of the power of population to increase under great obstacles of the preventive, as well as of the positive kind, we need not go out of Great Britain. The rate of increase since our enumerations have commenced has been very remarkable for a country which was considered as well peopled before, and some of the details accompanying the returns tend strikingly to illustrate the principle of population.

Increase of population in Great Britain from 1800 to 1821.

The population of Great Britain, according to the enumerations of 1821 and 1811, was, respectively, 10,942,646 and 12,596,803.[6] This is a rate of increase, during the ten years, of rather above fifteen per cent., a rate which, if continued, would double the population in between forty-nine and fifty years.

By the enumeration of 1821, it appears that the population was 14,391,631,[7] which, compared with the population of 1811, gives a rate of increase during the ten years of 14·25 per cent., a rate which would double the population in about fifty-two years.

According to these numbers, the rate of increase during the last ten years was slower than that of the first; but it appears, from the excess of the number of males above females in the enumeration of 1811, so opposite to the state of the population in 1801 and 1821, when the females exceeded the males, particularly at the latter period, that of the large number added to the population for the army, navy, and registered merchant ships in 1811, a considerable proportion must have been foreigners. On this account, and on account of the further difficulty of knowing what part of this number might properly belong to Ireland, it has been proposed to estimate the rate per cent. at which the population has increased in each of the ten years by the females only; and, according to this mode of computation, the population increased during the first period at the rate of 14·02 per cent., and during the second at the rate of 15·82. (Preliminary Observations, p. 8.) This last rate of increase would double the population in less than forty-eight years.

The only objection to this mode of computation is, that it does not take into consideration the greater destruction of the males during the war. In 1801, the females exceeded the half of the population by 21,031, and in 1821 by 63,890, while, at the intermediate period, owing to the causes above mentioned, the females fell short of the half of the males by 35,685.

When, however, a proper distribution has been made of the army and navy among the resident population, and taking England and Wales alone, it appears that from 1801 to 1811 the population increased at the rate of fourteen and a half per cent., and from 1811 to 1821, at the rate of sixteen and one third per cent. (Preliminary Observations, p. 32.) At the former of these rates, the period of doubling would be rather above fifty years; at the latter, under forty-six years; and, taking the whole period, the time of doubling would be about forty-eight years. Yet in Great Britain there is a much larger proportion of the population living in towns, and engaged in occupations considered as unhealthy, than in any other known country of the same extent. There are also the best reasons for believing that in no other country of the same extent is there to be found so great a proportion of late marriages, or so great a proportion of persons remaining unmarried, as in Great Britain. It is further known that the number of emigrants from Great Britain greatly exceed those who come into the country. And if, under these circumstances, a demand for labour and an increase of the funds for its maintenance could for twenty years together occasion such a rate of increase as, if continued, would double the population in forty-eight years, and quadruple it in ninety-six years, it is in the highest degree probable, that if the encouragements to marriage and the means of supporting a family were as great as in America, the period of doubling in Great Britain would not be more than twenty-five years, even in spite of her great towns and manufactories; and would be decidedly less if these obstacles were removed.

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[1] The details which M. Humboldt has given of the population of New Spain are highly interesting, as they are the first of any consequence which the public has yet received of a tropical climate. The peculiarities which mark them are exactly of the kind which might have been expected, though the proportion of births is still greater than we could have ventured to suppose.

[2] *Essai Politique sur le Royaume de la Nouvelle Espagne*, liv. ii. chap. iv. pp. 330 *et seq.* vol. i. Oct.

[3] *Gottliche Ordnung*, vol. i. table xxi.

[4] Malthus on Population, vol. i. p 439, 5th edit.

[5] Report of the Preliminary Proceedings under Population Act, 58th Geo. III. p. 28.

[6] Population Abstract, 1821; Preliminary Observations, p. 8.

[7] Ibid.

The lowest rate of increase that can be assumed for the natural progress of population.

Taking therefore into consideration the actual rate of increase which appears from the best documents to have taken place over a very large extent of country in the United States of America, very variously circumstanced as to healthiness and rapidity of progress; considering, further, the rate of increase which has taken place in New Spain, and also in many countries of Europe, where the means of supporting a family, and other circumstances favourable to increase, bear no comparison with those of the United States; and adverting particularly to the great increase of population which has taken place in this country during the last twenty years, under the formidable obstacles to its progress which must press themselves upon the attention of the most careless observer; it must appear, that the assumption of a rate of increase such as would double the population in twenty-five years, as representing the natural progress of population, when not checked by the difficulty of procuring the means of subsistence, or other peculiar causes of premature mortality, must be very decidedly within the truth.

It may be safely asserted, therefore, that population, when unchecked, increases in a geometrical progression of such a nature as to double itself every twenty-five years.

Different character of the rate of increase in the food of a limited territory.

It would be unquestionably desirable to have the means of comparing the natural rate of the increase of population when unchecked, with the possible rate of the increase of food, in a limited territory, such as that in which man is actually placed; but the latter estimate is much more difficult and uncertain than the former. If the rate of the increase of population at a particular period of some little extent can be ascertained with tolerable exactness, we have only to suppose the continuance of the same encouragements to marriage, the same facility of supporting a family, the same moral habits, with the same rate of mortality; and the increase of the population at the same rate, after it had reached a thousand millions, would be just as probable as at any intermediate and earlier period; but it is quite obvious that the increase of food in a limited space must proceed upon a principle totally different. It has been already stated, that while land of good quality is in great abundance, the rate at which food might be made to increase would far exceed what is necessary to keep pace with the most rapid increase of population which the laws of nature in relation to human kind permit. But if society were so constituted as to give the fullest scope possible to the progress of cultivation and population, all such lands, and all lands of moderate quality, would soon be occupied; and when the future increase of the supply of food came to depend upon the taking of very poor land into cultivation, and the gradual and laborious improvement of the land already cultivated, the rate of the increase of food would certainly have a greater resemblance to a decreasing geometrical ratio than an increasing one. The yearly increment of food would, at any rate, have a constant tendency to diminish, and the amount of the increase of each successive ten years would probably be less than that of the preceding.

Practically, however, great uncertainty must take place. An unfavourable distribution of produce, by prematurely diminishing the demand for labour, might retard the increase of food at an early period, in the same manner as if cultivation and population had been further advanced; while improvements in agriculture, accompanied by a great demand for labour and produce, might for some time occasion a rapid increase of food and population at a later period, in the same manner as if cultivation and population had been in an earlier stage of their progress. These variations, however, obviously arise from causes which do not impeach the general tendency of a continued increase of produce in a limited territory to diminish the power of its increase in future.

Supposition respecting the power of increasing food.

Under this certainty with regard to the general tendency, and uncertainty in reference to particular periods, it must be allowable, if it throws light on the subject, to make a supposition respecting the increase of food in a limited territory, which, without pretending to accuracy, is clearly more favourable to the power of the soil to produce the means of subsistence for an increasing population, than any experience which we have of its qualities will warrant.

If, setting out from a tolerably well-peopled country, such as England, France, Italy, or Germany, we were to suppose that, by great attention to agriculture, its produce could be permanently increased every twenty-five years by a quantity equal to that which it at present produces, it would be allowing a rate of increase decidedly beyond any probability of realization. The most sanguine cultivators could hardly expect that, in the course of the next two hundred years, each farm in this country on an average would produce eight times as much food as it produces at present, and still less that this rate of increase could continue, so that each farm would produce twenty times as much as at present in five hundred years, and forty times as much in a thousand years. Yet this would be but an arithmetical progression, and would fall short, beyond all comparison, of the natural increase of population in a geometrical progression, according to which the inhabitants of any country, in five hundred years, instead of increasing to twenty times, would increase to above a million times their present numbers.

It will be said, perhaps, that many parts of the earth are as yet very thinly peopled, and, under proper management, would allow of a much more rapid increase of food than would be possible in the more fully inhabited states of Europe. This is unquestionably true. Some parts of the earth would no doubt be capable of producing food at such a rate as to keep pace for a few periods with an unrestricted increase of population. But to put this capacity fully into action, is of all things the most difficult. If it is to be accomplished by the improvement of the actual inhabitants of the different parts of the earth in knowledge, in government, in industry, in arts, and in morals, it is scarcely possible to say how it ought to be commenced with the best prospect of success, or to form a conjecture as to the time in which it could be effected.

Insufficiency of emigration.

If it is to be accomplished by emigration from the more improved parts of the world, it is obvious that it must involve much war and extermination; besides all the difficulties usually attendant upon new settlements in uncivilized countries; and these alone are so formidable, and for a long time so destructive, that, combined with the unwillingness which people must always naturally feel to quit their own country, much distress would be suffered at home before relief would be sought for in emigration.

But, supposing for a moment that the object could be fully accomplished, that is, supposing that the capacity of the earth to produce the necessaries of life could be put fully into action, and that they were distributed in the proportions most favourable for the growth of capital and the effective demand for labour, the increase of population, whether arising from the increase of the inhabitants of each country, or from emigrants issuing from all those countries which were more advanced in cultivation, would be so rapid, that, in a period comparatively quite short, all the good lands would be occupied, and the rate of the possible increase of food would be reduced much below the arithmetical ratio above supposed.

If, merely during the short period which has elapsed since our Revolution of 1688, the population of the earth had increased at its natural rate when unchecked, supposing the number of people at that time to have been only eight hundred millions, all the land of the globe, without making allowance for deserts, forests, rocks, and lakes, would on an average be equally populous with England and Wales at present. This would be accomplished in five doublings, or a hundred and twenty-five years; and one or two doublings more, or a period less than that which has elapsed since the beginning of the reign of James I., would produce the same effect from the overflowings of the inhabitants of those countries where, owing to the further progress of cultivation, the soil had not the capacity of producing food so as to keep pace with the increase of an unrestricted population.

Whatever temporary and partial relief, therefore, may be derived from emigration by particular countries in the actual state of things, it is quite obvious, that, considering the subject generally and largely, emigration may be fairly said not in any degree to touch the difficulty. And, whether we exclude or include emigration, whether we refer to particular countries, or to the whole earth, the supposition of a future capacity in the soil to increase the necessaries of life every twenty-five years by a quantity equal to that which is at present produced, must be decidedly beyond the truth.

Effect of the two different rates of increase when brought together.

But if the natural increase of population, when unchecked by the difficulty of procuring the means of subsistence, or other peculiar causes, be such as to continue doubling its numbers in twenty-five years; and the greatest increase of food, which, for a continuance, could possibly take place on a limited territory like our earth in its present state, be at the most only such as would add every twenty-five years an amount equal to its present produce; it is quite clear that a powerful check on the increase of population must be almost constantly in action.

By the laws of nature man cannot live without food. Whatever may be the rate at which population would increase if unchecked, it never can actually increase in any country beyond the food necessary to support it. But, by the laws of nature in respect to the powers of a limited territory, the additions which can be made in equal periods to the food which it produces must, after a short time, either be constantly decreasing, which is what would really take place; or, at the very most, must remain stationary, so as to increase the means of subsistence only in an arithmetical progression. Consequently, it follows necessarily that the average rate of the *actual* increase of population over the greatest part of the globe, obeying the same laws as the increase of food, must be totally of a different character from the rate at which it would increase if *unchecked*.

The great question, then, which remains to be considered, is the manner in which this constant and necessary check upon population practically operates.

General character of the checks to population.

If the soil of any extensive well-peopled country were equally divided amongst its inhabitants, the check would assume its most obvious and simple form. Perhaps each farm in the well-peopled countries of Europe might allow of one, or even two doublings, without much distress, but the absolute impossibility of going on at the same rate is too glaring to escape the most careless thinker. When, by extraordinary efforts, provision had been made for four times the number of persons which the land can support at present, what possible hope could there be of doubling the provision in the next twenty-five years?

Yet there is no reason whatever to suppose that any thing besides the difficulty of procuring in adequate plenty the necessaries of life, should either indispose this greater number of persons to marry early, or disable them from rearing in health the largest families. But this difficulty would of necessity occur, and its effect would be either to discourage early marriages, which would check the rate of increase by preventing the same proportion of births; or to render the children unhealthy from bad and insufficient nourishment, which would check the rate of increase by occasioning a greater proportion of deaths; or, what is most likely to happen, the rate of increase would be checked, partly by the diminution of births, and partly by the increase of mortality.

The first of these checks may, with propriety, be called the *preventive check* to population; the second, the *positive check;* and the absolute necessity of their operation in the case supposed is as certain and obvious as that man cannot live without food.

Taking a single farm only into consideration, no man would have the hardihood to assert that its produce could be made permanently to keep pace with a population increasing at such a rate as it is observed to do for twenty or thirty years together at particular times and in particular countries. He would, indeed, be compelled to acknowledge, that if, with a view to allow for the most sanguine speculations, it has been supposed that the additions made to the necessaries produced by the soil in given times might remain constant, yet that this rate of the increase of produce could not possibly be realized; and that, if the capacity of the soil were at all times put properly into action, the additions to the produce would, after a short time, and independently of new inventions, be constantly decreasing, till, in no very long period, the exertions of an additional labourer would not produce his own subsistence.

But what is true in this respect in reference to a single farm, must necessarily be true of the whole earth, from which the necessaries of life for the actual population are derived. And what would be true in respect to the checks to population if the soil of the earth were equally divided among the different families which inhabit it, must be true under the present unequal division of property and variety of occupations. Nothing but the confusion and indistinctness arising from the largeness of the subject, and the vague and false notions which prevail respecting the efficacy of emigration, could make persons deny in the case of an extensive territory or the whole earth, what they could not fail to acknowledge in the case of a single farm, which may be said fairly to represent it.

It may be expected, indeed, that in civilized and improved countries the accumulation of capital, the division of labour, and the invention of machinery, will extend the bounds of production; but we know from experience that the effects of these causes, which are quite astonishing in reference to some of the conveniences and luxuries of life, are very much less efficient in producing an increase of food; and although the saving of labour and an improved system of husbandry may be the means of pushing cultivation upon much poorer lands than could otherwise be worked, yet the increased quantity of the necessaries of life so obtained can never be such as to supersede, for any length of time, the operation of the preventive and positive checks to population. And not only are these checks as absolutely necessary in civilized and improved countries, as they would be if each family had a certain portion of land allotted to it, but they operate almost exactly in the same way. The distress which would obviously arise in the most simple state of society, from the natural tendency of population to increase faster than the means of subsistence in a limited territory, is brought home to the higher classes of an improved and populous country, in the difficulty which they find in supporting their families in the same rank of life with themselves; and to the labouring classes, which form the great mass of society, in the insufficiency of the real wages of common labour to bring up a large family.

If in any country the yearly earnings of the commonest labourers, determined, as they always will be, by the state of the demand and the supply of necessaries compared with labour, be not sufficient to bring up in health the largest families, one of the three things before stated must happen; either the prospect of this difficulty will prevent some and delay other marriages; or the diseases arising from bad nourishment will be introduced, and the mortality be increased; or the progress of population will be retarded, partly by one cause and partly by the other.

Of the effect of private property on the progress of population.

According to all past experience, and the best observations which can be made on the motives which operate upon the human mind, there can be no well-founded hope of obtaining a large produce from the soil, but under a system of private property. It seems perfectly visionary to suppose that any stimulus short of that which is excited in man by the desire of providing for himself and family, and of bettering his condition in life, should operate on the mass of society with sufficient force and constancy to overcome the natural indolence of mankind. All the attempts which have been made since the commencement of authentic history to proceed upon a principle of common property, have either been so insignificant that no inference can be drawn from them, or have been marked by the most signal failures; and the changes which have been effected in modern times by education do not seem to advance a single step towards making such a state of things more probable in future. We may therefore safely conclude, that while man retains the same physical and moral constitution which he is observed to possess at present, no other than a system of private property stands the least chance of providing for such a large and increasing population as that which is to be found in many countries at present.

But though there is scarcely any conclusion which seems more completely established by experience than this, yet it is unquestionably true that the laws of private property, which are the grand stimulants to production, do themselves so limit it, as always to make the actual produce of the earth fall very considerably short of the *power* of production. On a system of private property no adequate motive to the extension of cultivation can exist, unless the returns are sufficient, not only to pay the wages necessary to keep up the population, which, at the least, must include the support of a wife and two or three children, but also afford a profit on the capital which has been employed. This necessarily excludes from cultivation a considerable portion of land, which might be made to bear corn. If it were possible to suppose that man might be adequately stimulated to labour under a system of common property, such land might be cultivated, and the production of food and the increase of population might go on, till the soil absolutely refused to grow a single additional quarter, and the whole of the society was exclusively engaged in procuring the necessaries of life. But it is quite obvious that such a state of things would inevitably lead to the greatest degree of distress and degradation. And if a system of private property secures mankind from such evils, which it certainly does in a great degree, by securing to a portion of the society the leisure necessary for the progress of the arts and sciences, it must be allowed that such a check to the increase of cultivation confers on society a most signal benefit.

But it must perhaps also be allowed, that, under a system of private property, cultivation is sometimes checked in a degree and at a period not required by the interest of society. And this is particularly likely to happen when the original divisions of land have been extremely unequal, and the laws have not given sufficient facility to a better distribution of them. Under a system of private property, the only effectual demand for produce must come from the owners of property; and though it be true that the effectual demand of the society, whatever it may be, is best supplied under the most perfect system of liberty, yet it is not true that the tastes and wants of the effective demanders are always, and necessarily, the most favourable to the progress of national wealth. A taste for hunting and the preservation of game among the owners of the soil will, without fail, be supplied, if things be allowed to take their natural course; but such a supply, from the manner in which it must be effected, would inevitably be most unfavourable to the increase of produce and population. In the same manner, the want of an adequate taste for the consumption of manufactured commodities among the possessors of surplus produce, if not fully compensated by a great desire for personal attendance, which it never is, would infallibly occasion a premature slackness in the demand for labour and produce, a premature fall of profits, and a check to cultivation.

It makes little difference in the actual rate of the increase of population, or the necessary existence of checks to it, whether that state of demand and supply which occasions an insufficiency of wages to the whole of the labouring classes be produced prematurely by a bad structure of society and an unfavourable distribution of wealth, or necessarily by the comparative exhaustion of the soil. The labourer feels the difficulty nearly in the same degree, and it must have nearly the same results, from whatever cause it arises; consequently, in every country with which we are acquainted, where the yearly earnings of the labouring classes are not sufficient to bring up in health the largest families, it may be safely said that population is actually checked by the difficulty of procuring the means of subsistence. And, as we well know that ample wages, combined with full employment for all who choose to work, are extremely rare, and scarcely ever occur, except for a certain time, when the knowledge and industry of an old country is applied, under favourable circumstances, to a new one; it follows that the pressure arising from the difficulty of procuring subsistence is not to be considered as a remote one, which will be felt only when the earth refuses to produce any more, but as one which not only actually exists at present over the greatest part of the globe, but, with few exceptions, has been almost constantly acting upon all the countries of which we have any account.

It is unquestionably true, that, in no country of the globe have the government, the distribution of property, and the habits of the people, been such as to call forth, in the most effective manner, the resources of the soil. Consequently, if the most advantageous possible change in all these respects could be supposed at once to take place, it is certain that the demand for labour and the encouragement to production might be such as for a short time in some countries, and for rather a longer in others, to lessen the operation of the checks to population which have been described. It is specifically this truth constantly obtruding itself upon our attention which is the great source of delusion on this subject, and creates the belief that man could always produce from the soil much more than sufficient to support himself and family. In the actual state of things this power has perhaps always been possessed. But for it we are indebted wholly to the ignorance and bad government of our ancestors. If they had properly called forth the resources of the soil, it is quite certain that we should now have but scanty means left of further increasing our food. If merely since the time of William the Conqueror all the nations of the earth had been well governed, and if the distribution of property, and the habits both of the rich and the poor, had been the most favourable to the demand for produce and labour, though the amount of food and population would have been prodigiously greater than at present, the means of diminishing the checks to population would unquestionably be less. That difficulty in procuring the necessaries of life which is now felt in the comparatively low wages of labour almost all over the world, and is occasioned partly by the necessary state of the soil, and partly by a premature check to the demand for produce and labour, would then be felt in a greater degree, and would less admit of any relaxation in the checks to population, because it would be occasioned wholly and necessarily by the state of the soil.

The laws f nature esponsible or the necessity of hecks to opulation.

It appears, then, that what may be called the proportionate amount of the necessary checks to population depends very little upon the efforts of man in the cultivation of the soil. If these efforts had been directed from the first in the most enlightened and efficient manner, the checks necessary to keep the population on a level with the means of subsistence, so far from being lightened, would in all probability be operating with greater force; and the condition of the labouring classes, so far as it depends on the facility of procuring the means of subsistence, instead of being improved, would in all probability be deteriorated.

It is to the laws of nature, therefore, and not to the conduct and institutions of man, that we are to attribute the necessity of a strong check on the natural increase of population.

Man reponsible or the revailing haracter f these hecks.

But though the laws of nature which determine the rate at which population would increase if unchecked, and the very different rate at which the food required to support population could be made to increase in a limited territory, are undoubtedly the causes which render necessary the existence of some great and constant check to population, yet a vast mass of responsibility remains behind on man and the institutions of society.

In the first place, they are certainly responsible for the present scanty population of the earth. There are few large countries, however advanced in improvement, the population of which might not have been doubled or tripled, and there are many which might be ten, or even a hundred times as populous, and yet all the inhabitants be as well provided for as they are now, if the institutions of society and the moral habits of the people had been for some hundred years the most favourable to the increase of capital, and the demand for produce and labour.

Secondly, though man has but a trifling and temporary influence in altering the proportionate amount of the checks to population, or the degree in which they press upon the actual numbers, yet he has a great and most extensive influence on their character and mode of operation.

It is not in superseding the necessity of checks to population, in the progress of mankind to the full peopling of the earth (which may with truth be said to be a physical impossibility), but in directing these checks in such a way as to be the least prejudicial to the virtue and happiness of society, that government and human institutions produce their great effect. Here we know, from constant experience, that they have great power. Yet even here it must be allowed that the power of government is rather indirect than direct, as the object to be attained depends mainly upon such a conduct on the part of individuals as can seldom be directly enforced by laws, though it may be powerfully influenced by them.

This will appear if we consider more particularly the nature of those checks which have been classed under the general heads of Preventive and Positive.

It will be found that they are all resolvable into *moral restraint*, *vice*, and *misery*. And if, from the laws of nature, some check to the increase of population be absolutely inevitable, and human institutions have any influence upon the extent to which each of these checks operates, a heavy responsibility will be incurred, if all that influence, whether direct or indirect, be not exerted to diminish the amount of vice and misery.

These checks resolvable into moral restraint, vice, and misery.

Moral restraint, in application to the present subject, may be defined to be, abstinence from marriage, either for a time or permanently, from prudential considerations, with a strictly moral conduct towards the sex in the interval. And this is the only mode of keeping population on a level with the means of subsistence, which is perfectly consistent with virtue and happiness. All other checks, whether of the preventive or the positive kind, though they may greatly vary in degree, resolve themselves into some form of vice or misery.

The remaining checks of the preventive kind, are the sort of intercourse which renders some of the women of large towns unprolific; a general corruption of morals with regard to the sex, which has a similar effect; unnatural passions, and improper arts to prevent the consequences of irregular connections. These evidently come under the head of vice.

The positive checks to population include all the causes which tend in any way prematurely to shorten the duration of human life; such as unwholesome occupations, severe labour and exposure to the seasons, bad and insufficient food and clothing, arising from poverty, bad nursing of children, excesses of all kinds, great towns and manufactories, the whole train of common diseases and epidemics, wars, infanticide, plague, and famine. Of these positive checks, those which appear to arise from the laws of nature may be called exclusively misery; and those which we bring upon ourselves, such as wars, excesses of all kinds, and many others, which it would be in our power to avoid, are of a mixed nature. They are brought upon us by vice, and their consequences are misery.

Some of these checks, in various combinations, and operating with various force, are constantly in action in all the countries with which we are acquainted, and form the immediate causes which keep the population on a level with the means of subsistence.

Mr Malthus, in his work on this subject, has taken a view of the checks of population in most of the countries of which we have the best accounts. His object was evidently to trace in each country those checks which appeared to be most effective in repressing population; and to endeavour to answer the question generally which had been applied particularly to New Holland by Captain Cook, namely, By what means is the population of this country kept down to the number which it can subsist?

Prudential restraint on marriage.

It was hardly to be expected, however, that the general accounts of countries which are to be met with should contain a sufficient number of details of the kind required to enable us to ascertain what portion of the natural increase of population each individual check which could be traced had the power to overcome. In particular, it was not to be expected, that any accounts could inform us of the degree in which moral restraint prevails when taken in its strictest sense. It is necessary, therefore, to attend chiefly to the greater or smaller number of persons who remain unmarried, or marry late; and the delay of marriage, owing to the difficulty of providing for a family, when the degree of irregularity to which it may lead cannot be ascertained, may be usefully called the prudential restraint on marriage and population. And this will be found to be the chief mode in which the preventive check practically operates.

But if the preventive check to population, that check which can alone supersede great misery and mortality, operates chiefly by a prudential restraint on marriage, it will be obvious, as was before stated, that direct legislation cannot do much. Prudence cannot be enforced by laws, without a great violation of natural liberty, and a great risk of producing more evil than good. But still the very great influence of a just and enlightened government, and the perfect security of property in creating habits of prudence, cannot for a moment be questioned. The principal causes and effects of these habits are thus stated in Mr Malthus's last work.[1]

Causes which principally affect the habits of the labouring classes.

"From high wages, or the power of commanding a large portion of the necessaries of life, two very different results may follow; one, that of a rapid increase of population, in which case the high wages are chiefly spent in the maintenance of large and frequent families; and the other, that of a decided improvement in the modes of subsistence, and the conveniences and comforts enjoyed, without a proportionate acceleration in the rate of increase.

"In looking to these different results, the causes of them will evidently appear to be the different habits existing among the people of different countries, and at different times. In an inquiry into the causes of these different habits, we shall generally be able to trace those which produce the first result to all the circumstances which contribute to depress the lower classes of the people, which make them unable or unwilling to reason from the past to the future, and ready to acquiesce, for the sake of present gratification, in a very low standard of comfort and respectability; and those which produce the second result, to all the circumstances which tend to elevate the character of the lower classes of society, which make them approach the nearest to beings who "look before and after," and who, consequently, cannot acquiesce patiently in the thought of depriving themselves and their children of the means of being respectable, virtuous, and happy.

"Among the circumstances which contribute to the character first described, the most efficient will be found to be despotism, oppression, and ignorance; among those which contribute to the latter character, civil and political liberty, and education.

"Of all the causes which tend to encourage prudential habits among the lower classes of society, the most essential is unquestionably civil liberty. No people can be much accustomed to form plans for the future, who do not feel assured that their industrious exertions, while fair and honourable, will be allowed to have free scope; and that the property which they either possess or may acquire will be secured to them by a known code of just laws impartially administered. But it has been found by experience, that civil liberty cannot be permanently secured without political liberty; consequently political liberty becomes almost equally essential, and, in addition to its being necessary in this point of view, its obvious tendency to teach the lower classes of society to respect themselves, by obliging the higher classes to respect them, must contribute greatly to all the good effects of civil liberty."

"With regard to education, it might certainly be made general under a bad form of government, and might be very deficient under one in other respects good; but it must be allowed that the chances, both with regard to its quality and its prevalence, are greatly in favour of the latter. Education alone could do little against insecurity of property; but it would powerfully assist all the favourable consequences to be expected from civil and political liberty, which could not indeed be considered as complete without it."

The varying prevalence of these habits, owing to the causes above referred to, combined with the smaller or greater mortality occasioned by other customs, and the varying effects of soil and climate, must necessarily produce great differences in different countries, and at different periods, in the character of the predominant checks to population, and the force of each. And this inference, which inevitably follows from theory, is fully confirmed by experience.

The positive chec to population predominate in ancien times.

It appears, for instance, from the accounts we have received of ancient nations, and of the less civilized parts of the world, that war and violent diseases were the predominant checks to their population. The frequency of wars, and the dreadful devastations of mankind occasioned by them, united with the plagues, famines, and mortal epidemics of which there are records, must have caused such a consumption of the human species, that the exertion of the utmost power of increase must, in many cases, have been insufficient to supply it; and we see at once the source of those encouragements to marriage, and efforts to increase population, which, with inconsiderable exceptions, distinguished the legislation and general policy of ancient times. Yet there were some few men of more extended views, who, when they were looking to the settlement of a society in a more improved state, were fully aware, that under the most beautiful form of government which their imagination could conceive, the greatest poverty and distress might be felt from a too rapid increase of population. And the remedies which they proposed were strong and violent in proportion to the greatness of the evil which they apprehended. Even the practical legislators who encouraged marriage, seemed to think that the supplies of children might sometimes follow too rapidly for the means of supporting them; and it appears to have been with a view to provide against this difficulty, and of preventing it from discouraging marriage, that they frequently sanctioned the inhuman practice of infanticide.

Under these circumstances, it is not to be supposed that the prudential restraint on marriage should have operated to any considerable extent. Except in a few cases where a general corruption of morals prevailed, which might act as a preventive check of the most vicious kind, a large portion of the procreative power was called into action, the occasional redundancy from which was checked by violent causes. These causes will be found resolvable almost wholly into vice and misery; the first of which, and a large portion of the second, it is always in the power of man to avoid.

Prudent restraint the pred minant check to populati in mode times.

In a review of the checks to population in the different states of modern Europe, it appears that the positive checks to population have prevailed less, and the preventive checks more, than in ancient times, and in the more uncultivated parts of the world. The destruction occasioned by war has unquestionably abated, both on account of its occurring, on the whole, less frequently, and its ravages not being so fatal, either to man or the means of his support, as they were formerly. And although, in the earlier periods of the history of modern Europe, plagues, famines, and mortal epidemics were not unfrequent, yet, as civilization and improvement have advanced, both their frequency and their mortality have been greatly reduced, and in some countries they are now almost unknown. This diminution of the positive checks to population, as it has been certainly much greater in proportion than the actual increase of food and population, must necessarily have been accompanied by an increasing operation of the preventive checks; and probably it may be said with truth, that in almost all the more improved countries of modern Europe, the principal check which at present keeps the population down to the level of the actual means of subsistence, is the prudential restraint on marriage.

Yet in comparing together the accounts and registers of the different countries of modern times, we shall still find a vast difference in the character and force of the checks which are mainly in action; and it is precisely in this point

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[1] Principles of Political Economy, c. iv. sect. 2.

Difference in the character and force of the checks in different countries.

of view that these accounts afford the most important instruction. Some parts of Europe are yet in an unimproved state, and are still subject to frequent plagues and mortal epidemics. In these countries, as might be expected, few traces are to be found of the prudential restraint on marriage. But even in improved countries, the circumstances may be such as to occasion a great mortality. Large towns are known to be unfavourable to health, particularly to the health of young children; and the unwholesomeness of marshy situations may be such as in some cases to balance the principle of increase, even when nearly the whole of the procreative power is called into action, which is seldom the case in large towns.

Thus, in the registers of twenty-two Dutch villages given by Sussmilch,[1] and quoted by Mr Malthus, the mortality (occasioned, as may be supposed, chiefly by the natural unhealthiness of the country) was as high as one in twenty-two or twenty-three, instead of the more common proportion of one in thirty-five or forty; and the consequence was, that the marriages, instead of being in the usual proportion of one in about 108 of the population, were in the extraordinary high proportion of one in sixty-four;[2] showing a most unusual frequency of marriage, while, on account of the great mortality, the number of inhabitants was nearly stationary, and the births and deaths about equal.

On the other hand, in Norway, where the climate and modes of living seem to be extremely favourable to health, and the mortality was only one in forty-eight, the prudential restraint on marriage was called more than usually into action, and the marriages were only one in 130 of the population.

Gradual diminution in the proportion of marriages.

These may be considered as extreme cases, but the same result in different degrees is observable in the registers of all countries; and it is particularly to be remarked, that in those countries where registers of births, deaths, and marriages have been kept for a considerable time, the progressive diminution or mortality occasioned by the introduction of habits more favourable to health, and the consequent diminution of plagues and mortal epidemics, have been accompanied invariably by a smaller proportion of marriages and births. Sussmilch has given some striking instances of the gradual diminution in the proportion of the number of marriages during a part of the last century.[3]

In the town of Leipsic, in the year 1620, the annual marriages were to the population as 1 to 82; from the year 1741 to 1756, they were as 1 to 120.

In Augsburg, in 1510, the proportion of marriages to the population was 1 in 86; in 1750 as 1 to 123.

In Dantzic, in the year 1705, the proportion was as 1 to 89; in 1745, as 1 to 118.

In the dukedom of Magdeburg, in 1700, the proportion was as 1 to 87; from 1752 to 1755, as 1 to 125.

In the principality of Halberstadt, in 1690, the proportion was as 1 to 88; in 1756, as 1 to 112.

In the dukedom of Cleves, in 1705, the proportion was as 1 to 83; in 1755, as 1 to 100.

In the churmark of Brandenburg, in 1700, the proportion was as 1 to 76; and in 1755, as 1 to 108.

Instances of this kind are numerous, and they tend to show the dependence of the marriages on the deaths in all old countries. A greater mortality almost invariably produces a greater number of marriages; and it must be equally certain, that except where the means of subsistence can be adequately increased, a greater proportion of marriages must occasion a greater mortality.

Dependence of the births and marriages on the deaths.

The proportion of yearly births to the whole population must evidently depend principally on the proportion of marriages; and it appears, consequently, from registers, that in countries which will not admit of any considerable increase of population, the births, as well as the marriages, are mainly influenced by the deaths. When an actual decrease of population is not taking place, the births will always supply the vacancies made by death, and exactly so much more as the increasing wealth of the country and the demand for labour will admit. Everywhere in the intervals of plagues, epidemics, and destructive wars, the births considerably exceed the deaths; but while from these and other causes the mortality in different countries is extremely various, it appears from registers that, with the exception above stated, the births vary in the same proportion.[4]

Thus, in 39 villages of Holland, where the deaths, at the time to which the registers refer, were about 1 in 23, the births were also 1 in 23. In 15 villages round Paris, the births bore the same or even a greater proportion to the whole population, on account of a still greater mortality, the births being 1 in $22\frac{7}{10}$ths, and the deaths the same. In the small towns of Brandenburg, which were in an increasing state, the mortality was 1 in 29, and the births 1 in $24\frac{7}{10}$ths. In Sweden, where the mortality was about 1 in $34\frac{1}{2}$, the births were 1 in 28. In 1056 villages of Brandenburg, in which the mortality was about 1 in 39 or 40, the births were about 1 in 30. In Norway, where the mortality was 1 in 48, the births were 1 in 34.

In all these instances the births are evidently measured by the deaths, after making a proper allowance for the excess of births which the state of each country will admit. In such a country as Russia, this allowance must be great; as, although the mortality might perhaps be taken as low as 1 in 48 or 50, the births were as high as 1 in 26, owing to the increasing resources of the country, which admit of a rapid increase of the population.

Dependence of the births on the deaths illustrated in Switzerland.

Of all the countries which Mr Malthus has reviewed, there is none which so strikingly illustrates the most important fact of the dependence of the proportions of marriages and births on the deaths, and the general principles of population, as Switzerland. It appears, that between 1760 and 1770, an alarm prevailed respecting the continued depopulation of the country; and, to ascertain the point, M. Muret, minister of Vevay, made a very laborious and careful search into the registers of different parishes from the time of their first establishment. He compared the number of births which had taken place during three different periods of seventy years each, the first ending in 1620, the second in 1690, and the third in 1760. And finding by this comparison, that the number of births was less in the second period than in the first, and less in the third period than in the second, he considered the evidence of a continued depopulation of the country from the year 1055 as incontrovertible.[5] But the accounts which he himself produces clearly show, that, in the earlier periods to which he refers, the mortality was very much greater than in the latter; and that the greater *number* of births found in the registers formerly, was not owing to a greater population, but to the greater *proportion* of births which always accompanies a greater mortality.

It appears from accounts which are entirely to be depended on, that during the last period the mortality was extraordinarily small, and the proportion of children reared from infancy to puberty extraordinarily great. At the time when M. Muret wrote his paper, in 1766, the proportion of deaths to the population in the Pays de Vaud was 1 in 45, of births 1 in 36, and of marriages 1 in 140. These are all very small proportions of births, deaths, and marriages, compared with other countries; but the state of things must have been totally different in the sixteenth and seventeenth centuries. M. Muret gives a list of all the plagues which had prevailed in Switzerland from 1520, from which it appears that this dreadful scourge desolated the country at short intervals during the whole of the first period, and extended its occasional ravages to within twenty-two years of the termination of the second. We may safely conclude, that, in these times, the average mortality was very much greater than at present. But what puts the question beyond a doubt, is the great mortality which prevailed in the neighbouring town of Geneva in the sixteenth century, and its gradual diminution in the seventeenth and eighteenth. It appears from calculations, published in the *Bibliothèque Britannique* (tom. iv. p. 328), that in the sixteenth century the probability of life, or the age to which half of the born lived, was only 4·883, or under four years and eleven months; and the mean life, or the average number of years due to each person, 18·511, or about eighteen years and a half. In the seventeenth century, the probability of life in Geneva was 11·607, about eleven years and seven months; the mean life 23·358, or twenty three years and four months. In the eighteenth century, the probability of life had increased to 27·183, twenty-seven years and two months; and the mean life to thirty-two years and two months.

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[1] *Gottliche Ordnung*, vol. i. c. iv. s. 57, p. 128. Malthus' Essay on Population, b. ii. c. iv. p. 444 of vol. i. fifth edition.

[2] This very large proportion of marriages could not all have been supplied from the births in the country, but must have been occasioned in part by the influx of strangers.

[3] *Gottliche Ordnung*, vol. i. p. 134 *et seq.*

[4] Sussmilch, *Gottliche Ordnung*, vol. i. p. 225. Essay on Population, vol. i. p. 456, fifth edition.

[5] *Mémoires, &c. par la Société Economique de Berne*, 1766, pp. 15 *et seq.* Essay on Population, vol. i. pp. 464 *et seq.* fifth edition.

There can be no doubt, from the prevalence of the plague, and its gradual extinction, as noticed by M. Muret, that a diminution of mortality of the same kind, though not perhaps to the same extent, must have taken place in Switzerland; but if, with a mortality which could not have been less than one in thirty or thirty-two, the proportion of births had been what it was when M. Muret wrote, it is quite evident that the country would have been rapidly depopulated. But as it is known, from the actual amount of births found in the registers, that this was not the case, it follows as a necessary consequence, that the greater mortality of former times was accompanied by a greater proportion of births. And this at once shows the error of attempting to determine the actual population, either of different countries, or of different periods in the same country, by the amount of the births; and the strong tendency of population to fill up all vacancies, and very rarely to be limited by any other cause than the difficulty of supporting a family.

Swizerland and the Pays de Vaud afford other most striking instances of the dependence of the births on the deaths; and the accounts of them are perhaps more to be depended upon, as they appear to contradict the preconceived opinions of the person who collected them.

Speaking of the want of fruitfulness in the Swiss women, M. Muret says, that Prussia, Brandenburg, Sweden, France, and indeed every country the registers of which he had seen, give a greater proportion of baptisms to the number of inhabitants than the Pays de Vaud, where this proportion is only as 1 to 36. He adds, that from calculations lately made in the Lyonnois, it appeared that in Lyons itself the proportion of baptisms was 1 in 28, in the small towns 1 in 25, and in the villages 1 in 23 or 24. What a prodigious difference, he exclaims, between the Lyonnois and the Pays de Vaud, where the most favourable proportion, and that only in two small parishes of extraordinary fecundity, is not above 1 in 26, and in many parishes it is considerably less than 1 in 40. The same difference, he remarks, takes place in the mean life. In the Lyonnois it is little above 25 years; while in the Pays de Vaud, the lowest mean life, and that only in a single marshy and unhealthy parish, is $29\frac{1}{2}$ years, and in many places it is above 45 years.

"But whence comes it," he says, "that the country where children escape the best from the dangers of infancy, and where the mean life, in whatever way the calculation is made, is higher than in any other, should be precisely that in which the fecundity is the smallest? How comes it, again, that, of all our parishes, the one which gives the mean life the highest should also be the one where the tendency to increase is the smallest?"[1]

To resolve this question, M. Muret says, "I will hazard a conjecture, which, however, I give only as such. Is it not that, in order to maintain in all places a proper equilibrium of population, God has wisely ordered things in such a manner as that the force of life in each country should be in the inverse ratio of its fecundity? In fact, experience verifies my conjecture. Leyzin, a village in the Alps, with a population of 400 persons, produces but a little above eight children a year. The Pays de Vaud, in general, in proportion to the same number of inhabitants, produces eleven, and the Lyonnois sixteen. But if it happen, that at the age of twenty years, the eight, the eleven, and the sixteen are reduced to the same number, it will appear that the force of life gives in one place what fecundity does in another. And thus the most healthy countries, having less fecundity, will not over-people themselves, and the unhealthy countries, by their extraordinary fecundity, will be able to sustain their population."

These facts and observations are full of the most important instruction, and strikingly illustrate the principle of population. The three gradations in the proportions of births which are here so distinctly presented to our view, may be considered as representing that variety in the proportion of births which is known to take place in different countries and at different periods; and the practical question is, whether, when this variety prevails without a proportionate difference in the rate of increase, which is almost universally the case, we are to suppose, with M. Muret, that a special providence is called into action to render women less prolific in healthy countries, and where improved habits of cleanliness have banished plagues and mortal epidemics; or to suppose, as experience warrants, that the smaller mortality of healthy and improved countries is balanced by the greater prevalence of the prudential restraint on marriage and population.

The subject is seen with particular clearness in Switzerland, on account of the population of some of the districts being stationary. The number of inhabitants on the Alps was supposed to have diminished. This was probably an error; but it is not improbable that they should have remained stationary, or nearly so. There is no land so little capable of providing for an increasing population as mountainous pastures. When they have been once fully stocked with cattle, little more can be done; and if there be neither emigration to take off the superabundant numbers, nor manufactures wherewith to purchase an additional quantity of food, the deaths must equal the births.

This was the case with the Alpine parish of Leyzin before referred to, where, for a period of thirty years, the mortality and the proportion of births almost accurately kept pace with each other; and where, in consequence, if the positive checks to population had been unusually small, the preventive checks must have been unusually great. In the parish of Leyzin, according to M. Muret, the probability of life was as high as sixty-one years;[2] but it is obvious that this extraordinary degree of healthiness could not *possibly* have taken place under the actual circumstances of the parish with respect to the means of subsistence, if it had not been accompanied by a proportionate action of the prudential restraint on marriage; and accordingly the subsisting marriages, being late and unprolific, yielded only one birth to every twelve; the births were only one in forty-nine, and the number of persons below sixteen was only one fourth of the population.

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[1] *Mémoires, &c. par la Société Economique de Berne*, 1766, pp. 48 *et seq.*

[2] *Ibid.* table v. p. 65 of the tables.

There can be little doubt that in the present case the extreme healthiness of the people, arising from their situation and employments, had more effect in producing the prudential check to population than the prudential check in producing the extreme healthiness; yet it is quite certain that they must constantly act and re-act upon each other, and that if, when the circumstances are such as to furnish no adequate means for the support of an increased population, and no relief in emigration, the prudential check does not prevail, no degree of natural healthiness could prevent an excessive mortality. Yet to occasion such a mortality, a much greater degree of poverty and misery must have taken place than in districts less favourably circumstanced with regard to health; and we see at once the reason why, in countries of mountainous pasture, if there be no vent in emigration, the necessity of the prudential check should be more strongly forced on the attention of the inhabitants, and should in consequence prevail to a greater degree.

Differences in the registers of different countries.

Taking countries in general, there will necessarily be differences as to natural healthiness in all the gradations, from the most marshy habitable situations to the most pure and salubrious air. These differences will be further increased by the nature of the employments of the people, their habits of cleanliness, and their care in preventing the spread of epidemics. If in no country was there any difficulty in obtaining the means of subsistence, these different degrees of healthiness would make a great difference in the progress of population; and as there are many countries naturally more healthy than the United States of America, we should have instances of a more rapid increase than that which has there taken place. But as the actual progress of population is, with very few exceptions, determined by the relative difficulty of procuring the means of subsistence, and not by the relative natural powers of increase, it is found by experience that, except in extreme cases, the actual progress of population is little affected by unhealthiness or healthiness; but that these circumstances show themselves most powerfully in the character of the checks which keep the population down to the level of the means of subsistence, and occasion that sort of variety in the registers of different countries which was noticed in the instances mentioned by M. Muret.

Thus the population of two or three countries may be increasing at nearly the same rate, but one may be increasing chiefly from a great proportion of births, another from a small proportion of deaths, and a third from a more common proportion of both, in which three different cases the structure of the population, and the registers of births, deaths, and marriages, will be essentially different.

The rate at which the population of Sweden and Norway was increasing, at the time referred to by Mr Malthus, was not far from the same; but their registers differed in almost all points. While the births in Sweden were 1 in 28 of the population, the births in Norway were only 1 in 34; while the marriages in Sweden were 1 in 112, in Norway they were only 1 in 130; and while the mortality in Sweden was 1 in $34\frac{1}{2}$, in Norway it was only 1 in 48.[1] These different proportions of births, deaths, and marriages, must essentially alter the whole structure of the population. The proportion of persons living at different ages would be essentially different; the generations in one country would pass away sooner than the generations in the other; and Sweden might be said to increase principally from the large proportion of its births, and Norway from the small proportion of its deaths, or its small mortality.

A large proportion of births, when they have room to expand themselves, is the most powerful element of increase, and is absolutely necessary in order to effect the shortest period of doubling with which we are acquainted; but two countries may have nearly the same proportion of births, and yet the population of one be quite stationary, while the population of the other is increasing with the greatest known rapidity. The proportion of births in the Dutch villages first noticed approaches towards that of the United States of America; yet in the one case the population did not increase at all, and in the other it has increased so fast as to be taken as a specimen of the natural progress of population when interrupted by the fewest checks to which human society is subject. In this case, though the proportions of births and marriages to the whole population might not be very unlike, and possibly no very great difference might appear in the proportion of marriages to births, the other points in the registers would be in the opposite extremes. While the mortality in the Dutch villages was as high as 1 in 22, it would probably be 1 in 41, or less, in the United States. While the births and deaths in the Dutch villages were in the ratio of equality, in the United States they would be nearly in the proportion of 41 to 19.

In the same manner, two countries might have nearly the same mortality, and yet, in other points, be very different; and while one was increasing most rapidly, the other might be increasing very slowly. The proportion of deaths to the population in the Pays de Vaud is not very essentially different from that of the United States, but the proportion of births and the structure of the population present the most striking contrasts. The proportion of births for the whole of the Pays de Vaud was, according to M. Muret, 1 in 36, in many parishes it was considerably less than 1 in 40, and in one parish as low as 1 in 49; while, in the United States, it must be somewhere between 1 in 19 and 1 in 20. The structure of the population was different accordingly. In the whole of the Pays de Vaud, the proportion of the population under sixteen was one third; in many parts, and in the whole of the Canton of Berne, one fourth; while in the United States, it is as high as one half.

Variations in the age to which half of the born live in different countries.

We have seen, that, according to M. Muret, the probability of life, or the age to which half the born live, was, in the extraordinary parish of Leyzin, as high as 61 years. On the same authority, it appears that in nine other parishes of the Alps it was as high as 47; in 41 parishes of the Pays de Vaud and Jura 42; in 12 corn parishes 40; in 18 parishes among the great vineyards 37, in one marshy parish 24.[2] From other authorities we learn, that in country villages and parishes, the age to which half of the born live is such, that the major part will probably live to marry.[3] In the parish of Ackworth, in Yorkshire, it appears from an exact account kept by Dr Lee, of the ages at which all died there for twenty years from 1747 to 1767, that half the inhabitants live to the age of 46 (Price, vol. ii. p. 35, 7th edit.); and if the same account had been kept in many of the other healthy parishes in England, where the yearly mortality, instead of being 1 in 47 as in Ackworth, was 1 in 60, 1 in 66, and even 1 in 75 (vol. ii. p. 224), half of the born would be found to have lived to above 50 or 55. In the whole of Sweden, where the annual mortality, at the time referred to by Dr Price, was greater than 1 in 35, it appears from his tables, that half of the born must have lived to above 33 (vol. ii. p. 413, 7th edit.); and in Great Britain generally, where the mortality at present, after making due allowance for the omissions in the deaths, appears to be less than 1 in 51, it cannot be doubted that there is scarcely a village in the country tolerably well situated, where half of the born do not live till above 40. In towns the case is very different. According to the data collected by Dr Price, one half of the born died in London under three years of age, in Vienna and Stockholm under two, in Manchester under five, in Northampton under ten (vol. ii. p. 33); and although in most of these towns, particularly those in England, a great improvement has taken place in their healthiness of late years, yet still they will always fall far short of the healthiness of country situations.

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[1] See Malthus on Population, chapters i. and ii. of book ii.

Mémoires, &c. par la Société Economique de Berne, 1766, table viii. p. 92 of the tables. As these calculations seem all to have been made from mortuary registers, they are all too low, except where the population was absolutely stationary.

[3] Graunt's and Short's Observations, &c. referred to by Dr Price, vol. ii. pp. 41, 42, &c. 7th edition.

The age to which half the born live appears, therefore, to vary in different countries and places, and under different circumstances, in the very extraordinary degree of from 3 to 60.[1]

Variations in the expectation of life in different countries.

The mean age of death, or the expectation of life, must necessarily be more steady; yet it appears to vary from about 16 or 17 to 50.

In Stockholm, according to a table calculated by Dr Price, from the medium of three different enumerations in 1757, 1760, and 1763, the expectation of life for males at birth was 14·25, and for females 18·10.[2] Taken together, the expectation of life was a little above 16. In Vienna, as appears from another table, it was 16½.[3] While, according to M. Muret, at Leyzin, the expectation of life at birth was, about the same period, 50 years.[4]

Variations in the annual mortality.

The annual mortality, which is different, both from the age to which half of the born live, and the mean age of death, is found to vary in different places and countries, from about 1 in 19 to about 1 in 70. In Stockholm, the annual mortality was but 1 in 19 (Price's Observations, vol. ii. p. 136); and in some of the villages in England, even at the time that Dr Price wrote, it was as low as 1 in 70 and 1 in 75.

Proportion of births to the population.

The proportion of births to the population appears to vary in different countries and under different circumstances, from about 1 in 17 to 1 in 49. In New Spain, according to Humboldt, it was 1 in 17. In New Jersey, according to the rate of increase determined by the census taken in 1738 and seven years afterwards, the proportion of births must have been about 1 in 18. (Price, vol. ii. p. 50.) At present, as far as can be collected from scattered facts and inferences, the proportion of births in the whole of the United States is about 1 to 19. In the table for Prussia and Lithuania given by Sussmilch, it appears, that after the great plague of 1709 and 1710, and omitting the extraordinary year immediately subsequent, the proportion of births in the five years ending with 1716 was 1 in less than 17;[5] while, according to M. Muret, in the parish of Leyzin, the proportion of births was only 1 in 49 of the population.

Variations in the number of subsisting marriages to one annual birth.

The number of subsisting marriages which yields one annual birth appears to vary from 12 to 4, and the two extreme cases occur in what may be called the same country, and are both noticed by M. Muret; the one in the parish of Leyzin, which presents all the symptoms of the prudential check to population in the greatest excess, and where twelve subsisting marriages yield only one annual birth; and the other in the parish of St Cergue, in the Jura, where marriage is encouraged by the habit of emigration, and four subsisting marriages are sufficient to yield one annual birth.

Different proportions of th populatio under 16.

The proportion of the population under 16 years of age to that above 16 seems to vary in different countries and places, and under different circumstances, from one half to one fourth. In the United States, it appears by the late census that it is one half; while in the canton of Berne it is not much more than one fourth, and in the parish of Leyzin not more than one fourth.[6]

Variation in the mo tality under 15.

The mortality under the age of 15 varies in different places and circumstances, from above two thirds to one fifth. It appears from a table of Dr Price, that in Stockholm above two thirds died under 15 (vol. ii. p. 418); while, according to M. Muret, the proportion of the deaths under the age of 15 was, in the whole of the Pays de Vaud, one third, in many parishes of the Alps one fourth, and in the extraordinary parish of Leyzin only one fifth.[7]

Under these very great variations in the registers of different countries and places, and in the structure of their population, it is obvious that we might fall into the grossest possible errors, by applying the registers of one country to the population of another. Even if we could find a country which was near to a just mean between these opposite extremes, and the registers of which were kept with the greatest accuracy, we could not apply such registers to any other country with a view to any important inferences, unless we knew that the two countries nearly resembled each other, not only in one or two particulars, but in all the main points relating to the structure of their population and the character of the prevailing checks to it.

First tabl of mortality form from the registers towns.

When attention was first directed to tables of mortality with a view to assurances on lives and survivorships, these tables were almost universally formed from the registers of towns, and of the neighbouring villages influenced by them. Buffon, calculating the probability of life from the registers of three parishes in Paris, and twelve country parishes in the neighbourhood, collected by M. Dupré de St Maur, makes it appear that half of the born died under eight years of age. The parishes in Paris seemed to be healthier than the villages in the neighbourhood, which was occasioned by the custom of sending the children from the city to be nursed in the country. Other calculations from the registers of Breslau by Dr Halley, of London by Mr Simpson, and subsequently of Northampton, Warrington, Chester, Norwich, &c. by Dr Price and other writers, all concurred to convey the impression that more than half of the born die under the age of puberty; and though Dr Price, in his two volumes of Observations on Reversionary Payments, takes frequent opportunities of dwelling upon the prodigious difference in the mortality of towns and of country situations, and produces abundance of evidence to show that, taken together, in the actual state of things, half of the born live much beyond the age of puberty; yet, among some persons who have not attended to the subject, the former impression seems still to have remained; and, what is more strange, it has been lately asserted that this must happen from the constitution and course of human nature (Godwin's Answer to Malthus); which is going very much further than to say that it happens under the poverty, distress, and unhealthy occupations which are known to affect the mortality of a considerable body of people in all the nations with which we are acquainted.

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[1] This last number, stated by M. Muret for the parish of Leyzin, on the Alps, is so very extraordinary, that possibly it may not be correct.

[2] Observations on Reversionary Payments, vol. ii. p. 421, 7th edition.

[3] *Ibid.* vol. ii. p. 128.

[4] *Mémoires, &c. par la Société Economique de Berne*, 1766, table v. p. 65.

[5] *Gottliche Ordnung*, vol. i. table xxi. p. 83 of the tables. Malthus, vol. ii. p. 168, 5th edition.

[6] *Mémoires, &c. par la Société Economique de Berne*, 1766, pp. 11 and 12.

[7] *Ibid.* table xiii. p. 12.

The constitution and course of human nature determinable only by experience.

The constitution and course of human nature can only be determined by experience, and the analogies derived from it; and the kind of experience necessary to determine the point in question is to be obtained only by a reference to registers which inform us of the ages at which the born have died. Now, from the evidence of registers of this kind which have been carefully kept in country parishes, it appears that the age to which half of the born live is much nearer to forty than to the age of puberty. Even in Sweden, where the general mortality is unquestionably very great, owing to the poverty of the labouring classes, and the diseases brought upon them by bad and insufficient food during seasons of scarcity, the age to which half of the born live is, as before stated, above thirty-three;[1] in the whole of the Pays de Vaud it is forty-one; in many particular parishes forty-seven; in a parish in England not so healthy as many others, forty-seven; and as the expectation of life appears, by the late returns from the parish registers of Great Britain, to be as high as in Switzerland, there is little reason to doubt, from the evidence of registers, that the age to which half of the born live in this country can fall but little short of what it is in the Pays de Vaud, that is, it must be somewhere near forty. But it will hardly be contended that there is no premature mortality in Great Britain occasioned by the pressure of poverty, and the effect of large towns and unwholesome occupations. Consequently, unless we are prepared to say that agricultural employments, airy and moderately-sized towns, cleanliness, healthy occupations, and prudence, are against the constitution and course of nature, as applied to reasonable beings, we must acknowledge, that if the constitution and course of nature were carefully observed, and the admonitions which they give properly attended to, half of the born would, in healthy climates, live on an average to forty-five. Taking things, however, as they are, it is obvious that, according to the testimony of the best registers, more than half of the born might live to marry in most countries, even if the average age of marriage was so late as thirty.

Immediate causes of the increase of population.

The immediate cause of the increase of population is the excess of the births above the deaths; and the rate of increase, or the period of doubling, depends upon the proportion which the excess of the births above the deaths bears to the population.

The excess of births is occasioned by, and proportioned to, three causes: 1*st*, the prolificness of the marriages; 2*dly*, the proportion of the born which lives to marry; and, 3*dly*, the earliness of these marriages compared with the expectation of life, or the shortness of a generation by marriage and birth, compared with the passing away of a generation by death.

In order that the full power of increase should be called into action, all these circumstances must be favourable. The marriages must be prolific, owing to their being contracted early; the proportion of the born living to marry must be great, owing both to the tendency to marriage, and the great proportion of births rising to the age of puberty; and the interval between the average age of marriage and the average age of death must be considerable, owing to the great healthiness of the country, and the expectation of life being high. Probably these three causes, each operating with the greatest known force, have never yet been found combined. Even in the United States, though the two first causes operate very powerfully, the expectation of life, and consequently the distance between the age of marriage and the average age of death, is not so favourable as it might be. In general, however, the excess of births which each country can admit being very far short of the full power of increase, the causes above mentioned contribute to the required supply in very various proportions, according to the different circumstances and habits of each state.

Inferences drawn from registers.

It would be very desirable to know something of these proportions, with a view to their influence on the happiness of society. Our main sources of information on this subject are registers of births, deaths, and marriages; but in order to draw just inferences from them, we must consider well what they imply. The following observations and rules, modified from Mr Malthus's chapter on the fruitfulness of marriages, may be useful for this purpose.

Proportion of births to a marriage.

If we suppose a country where the population is stationary, where there are no emigrations, immigrations, or illegitimate children, and where the registers are accurate, then the proportion of the annual births to the annual marriages will accurately express both the number of children born to each marriage, including second and third marriages, and also the proportion of the born which lives to marry once or oftener, while the annual mortality will accurately express the expectation of life.

But if the population be either increasing or decreasing, and the births, deaths, and marriages increasing or decreasing in the same ratio, such a movement will necessarily disturb all the proportions, because the events which are contemporary in the registers are not contemporary in the order of nature.

In the first place, the births of any year cannot, in the order of nature, have come from the contemporary marriages, but must have been derived principally from the marriages of preceding years.

If we were to cut off a period of thirty years in the registers of any country some time ago, and inquire what was the number of births which had been produced by all the marriages included in the period cut off, it is evident, that with the marriages at the beginning of the period will be arranged a number of births proceeding from marriages anterior to it; and at the end a number of births produced by the marriages included in the period will be found arranged with the marriages of a succeeding period. Now, if we could subtract the former number, and add the latter, we should obtain exactly all the births produced by the marriages of the period, and thus ascertain the real prolificness of marriages. If the population had been stationary, the number of births to be added would exactly equal the number to be subtracted, and the proportion of births to marriages, as found in the registers, would exactly represent the real prolificness of marriages. But if the population be increasing, the number to be added would be greater than the number to be subtracted, and of course the proportion of births to marriages, as found in the registers, would always be too small to represent the true prolificness of marriages. A contrary effect would take place in a decreasing population. The question therefore is, what we are to add, and what to subtract, when the births and deaths are not equal.

The average proportion of births to marriages in Europe, as taken from registers, is about four to one. Let us suppose, for the sake of illustration, that each marriage yields four children, one every other year. In this case, wherever the period in the registers is begun, the marriages of the preceding eight years will only have produced half their births, and the other half will be arranged with the marriages within the period, and ought to be subtracted from them. In the same manner the marriages of the last eight years of the period will only have produced half their births, and the other half ought to be added. But half the births of any eight years may be considered as nearly equal to all the births of the succeeding three years and three quarters. In instances of the most rapid increase it will rather exceed the births of the next three years and a half, and in cases of slow increase approach towards the births of the next four years. The mean, therefore, may be taken at three years and three quarters. Consequently, if we subtract the births of the first three years and three quarters, and add the births of the three years and three quarters subsequent to the period, we shall have a number of births nearly equal to the number of births produced by all the marriages included in the period, and, of course, the prolificness of marriages. But if the population of a country be increasing regularly, and the births, deaths, and marriages continue always to bear the same proportion to each other and to the whole population, it is evident that all the births of any period will bear the same proportion to all the births of any other period of the same extent taken a certain number of years later, as the births of any single year to the births of a single year taken the same number of years later. And, consequently, to estimate the prolificness of marriages, we have only to compare the marriages of the present, or any other year, or the mean of five years, with the births of a subsequent year, or the mean of five years taken three years and three quarters later.

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[1] We allude to the registers and tables referred to by Dr Price. Since his time the health of the country has increased, like that of most of the countries in Europe, and the proportions of both the births and deaths have decidedly diminished.

It has been supposed, in the present instance, that each marriage yields four births; but the proportion of births to marriages apparent in the registers of most of the countries of Europe is four to one, and as the population of most of the countries of Europe is known to be increasing, the prolificness of marriages must be greater than four. If, allowing for this circumstance, we take the distance of four years instead of three years and three quarters, we shall still be sure of not erring in excess. And though undoubtedly the period which we take, whatever it may be, will not answer exactly in different countries, yet its application generally will not be so incorrect as we might at first imagine, because, in countries where the marriages are more prolific, the births generally follow at shorter intervals, and where they are less prolific, at longer intervals; and, with different degrees of prolificness, the length of the period might still remain the same.

Probably, however, the period here assumed, which is the one taken by Mr Malthus, is too short. If, as he says, there is reason to think, that, in almost all registers, the omissions in the births and deaths are greater than in the marriages, there ought to be a greater number of births to each marriage, in which case it would take a longer time to have them in; and if, further, it is probable that a birth every other year is too rapid a succession for those countries where the marriages are frequently late, it may be thought that the births at the distance of five years will more nearly represent the prolificness of marriages than at the distance of four years. But this matter must be left to the judgment of the reader.

At all events, it will follow, from what has been said, that the more rapid is the increase of population, the more will the real prolificness of marriages exceed the proportion of births to marriages in the registers.

The rule which has here been laid down attempts to estimate the prolificness of marriages, taken as they occur; but this prolificness should be carefully distinguished from the prolificness of first marriages, and of married women, and still more from the natural prolificness of women in general, taken at the most favourable age. It is probable that the natural prolificness of women is nearly the same in most parts of the world; but the prolificness of marriages is liable to be affected by a variety of circumstances peculiar to each country, and particularly by the number of second, and third, and late marriages. In all countries the second and third marriages alone form a most important consideration, and materially influence the average proportions. According to Sussmilch, in all Pomerania, from 1748 to 1756 both included, the number of persons who married were 56,956, and of these 10,586 were widows and widowers.[1] According to Busching, in Prussia and Silesia, for the year 1781, out of 29,308 persons who married, 4841 were widows and widowers;[2] and, consequently, the proportion of marriages will be given fully one sixth too much. In estimating the prolificness of married women, the number of illegitimate births would tend, though in a slight degree, to counterbalance the overplus of marriages; and as it is found that the number of widowers who marry again is greater than the number of widows, the whole of the correction should not, on this account, be applied; but in estimating the proportion of the born which lives to marry, which is what we are now about to proceed to, the whole of this correction is always necessary.

Proportio of the bo which liv to marry.

To find the proportion of the born which lives to marry, from registers, we must consider that the marriages of any year can never be contemporary with the births from which they have resulted, but must always be at such a distance from them as is equal to the average age of marriage.

If the population be increasing, the marriages of the present year have resulted from a smaller number of births than the births of the present year; and, of course, the marriages, compared with the contemporary births, will always be too few to represent the proportion of the born which lives to marry, and the contrary will take place if the population be decreasing; and to find this proportion, after having first made the proper correction for second and third marriages, we must compare the marriages of any year with the births of a previous year at the distance of the average age of marriage.[3]

Expecta- tion of li

The third principal object which it is desirable to attain, and of which some estimate may be formed from registers, is the expectation of life. It has before been stated, that, in a country where the births and deaths are equal, the rate of the annual mortality will express the expectation of life, or the average age of death. But if the population be increasing, the actual population of any one year will be greater than would belong to the contemporary deaths, supposing the births equal to the deaths, and less than would belong to the contemporary births, supposing the deaths equal to the births. Consequently, if we divide the actual population by the number of contemporary deaths in an increasing country, the result will be too high to express the average age of death belonging to any given number of births. If we divide the actual population by the number of births, the result will be too low to express this average, or, in other words, to express the expectation of life. And, in order to approximate to the true proportion, we are directed by Dr Price (vol. ii. p. 39, seventh edition), in the absence of better data, to divide the actual population by a mean between the proportions of deaths and births. Consequently, when we know the proportion of births to deaths in any country, and the proportions which they usually bear to the whole population, we may form some estimate of the expectation of life, or the average age of death.

If we attend to these observations in drawing our inferences from registers, we shall generally be able to form an approximating estimate of the prolificness of marriages, the proportion of the born living to marry, and the expectation of life, in different countries and places, and under different circumstances; or if we cannot do this satisfactorily, owing to the varying rate of increase, and the inaccuracy of the registers, we shall at least guard ourselves against drawing incorrect inferences from them in their present state, and reconcile many of the difficulties with which they appear to be accompanied.

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[1] *Gottliche Ordnung*, vol. i. tables, p. 98.

[2] It is a shorter and more obvious process to compare the marriages at once with the births of the earlier period, than with the deaths, as Mr Malthus has done.

[3] Malthus, vol. ii. p. 140.

rolific- ess of arriages Eng- nd.

Thus, to estimate the prolificness of marriages in England, the proportion of the marriages to the births, according to the parochial returns ending with 1820, was 100 to 369; adding one sixth for the omissions in the births, or on the present occasion only one seventh, in order to make full allowance for illegitimate births, the proportion of marriages to births will be as 100 to 422. These births, at the rate at which the population was increasing in England and Wales from 1810 to 1820, would, in about four years and a half, increase ·07, which, added to 4·22, makes 4·51. Consequently, the prolificness of marriages, taken as they occur, and including second and third marriages, would be 4·51. If we wish to estimate the prolificness of married women, we must subtract from the marriages those which consist of widows who have married again. According to some tables of Sussmilch, this would be little less than one sixth, according to others one eighth. If we take one seventh, and deduct it from the marriages, the proportion will be 1 to 5·26, that is, each married woman will have 5·26 births. But of these married women, some have married at above forty-five years of age, and many more above thirty-five, so that there can be little doubt that, if the births could be collected from all the marriages in which the age of the woman did not exceed thirty-five, nor the age of the man forty-five, the births would appear to be nearly six; and this number would be still further increased if the average age of marriage for males was twenty-two, and for females twenty. These conclusions are fully confirmed by some accurate observations of M. Muret. At Vevay, where the proportion of marriages to births, in the registers, was as ten to thirty-nine, he found that 375 mothers had had 2093 children born alive, by which it appears that each mother had produced 5·55 births. But these, M. Muret observes, were all mothers, which is not the case of all married women. Allowing, however, for the usual proportion of barren wives at Vevay, which was about twenty out of 478, it appears that the married women, one with another, must have had above 5·3 births. Yet this was in a town where he intimates that the inhabitants do not enter into the marriage state at the time when nature calls them, nor, when married, always have as many children as they might have. It is evident, therefore, that the proportions of marriages to births, to be found in registers, require considerable and important corrections, in order to deduce from them just estimates of the prolificness of marriages, the prolificness of married women, and the prolificness of women marrying at the most favourable age. The instance here given is sufficient to illustrate the mode in which the rule should be applied.

roportion f the born ving to arry in ngland.

If we wish to apply the rule for estimating the proportion of the born living to marry in England, we must first take the proportion of marriages to births in the registers. This proportion, as before stated, was, during the ten years ending with 1820, as 100 to 369; which, increased by one sixth, the supposed omissions in the registers of births will be as 100 to 430. But the marriages of the present year must have resulted, not from the births of the present year, but from the births at such an earlier period in the registers as is equal to the average age of marriage. Suppose this age to be twenty-eight, then, at the rate at which the population was increasing, the present marriages must have resulted from a number of births equal to about two thirds of the present number, so as to be to the present marriages in the proportion of 286 instead of 430 to 100. But of the 200 persons forming the 100 marriages, more than one sixth have been married before. Deducting, therefore, one sixth from the marriages, the proportion of the marriages to the births from which they have resulted will be as 100 to 343; or, out of 343 births, 200 have lived to be married once or oftener; from which it would appear, that on account of the late increase in the healthiness of the country, a greater proportion had lived to marry than when Mr Malthus last estimated it; which, together with a slight increase in the prolificness of marriages apparent in the latter registers, may account for the more rapid increase of the population from 1810 to 1820. It should be recollected, however, that as the rate of increase which prevailed from 1810 to 1820 had by no means prevailed during the whole twenty-eight years, the births, from which 200 person had lived to marry in 1820, were decidedly more than 343.

It will be observed how very important the correction for second and third marriages is. Supposing each marriage to yield four births, and the births and deaths to be equal, it might at first be thought necessary, that in order to keep up the population, half of the born should live to marry; but if, on account of the second and third marriages, we subtract one sixth from the marriages, and then compare them with the births, the proportion will be as five to twenty-four; and it will appear, that instead of one half, it will only be necessary, that out of twenty-four births, ten should live to marry. Upon the same principle, if the births were to the marriages as four to one, and exactly half of the born lived to marry, it might be supposed at first that the population would be stationary; but if we subtract one sixth from the marriages, and then compare them with the births, it will be obvious that, on the supposition of half the born living to marry, the births at the earlier period in the registers, at the distance of the age of marriage, must be to the present births as five to six, which would imply a moderate rate of increase.

To estimate the proportion of male births living to marry, we must subtract full one fifth from the marriages; and, according to this correction, if each marriage yielded four births, it would only be necessary that two male children out of five should live to marry, in order to keep up the population. It is necessary, also, in estimating the proportion of male births living to marry, to make allowance for the greater number of males born.

The foregoing illustrations and remarks show the error of supposing that a country must be in a precarious state when the proportion of births to marriages in the registers is less than four to one. If, indeed, this observation were just, the population of many countries in Europe would be in a precarious state, as in many countries the proportion is less than this. But it has been shown in what manner this proportion in the registers should be corrected, in order to make it a just representation of the prolificness of marriages; and if a large part of the born live to marry, and the age of marriage be considerably earlier than the expectation of life, such a proportion in the registers is by no means inconsistent with a rapid increase of population.

In Russia, the proportion of births to marriages is less than four to one; yet, on account of the large proportion of the born living to marry, the early age of marriage, and the high expectation of life, it is one of the countries in Europe which increases the fastest. In England, the population increases much more rapidly than in France; yet in England the proportion of births to marriages in the registers, when allowance has been made for omissions, was, from 1800 to 1810, four to one, while in France it was four and four fifths to one. (Malthus, vol. ii. p. 161. 5th edit.)

In England, indeed, for the ten years from 1810 to 1821, the proportion of births to marriages seems slightly to have exceeded the former proportion, being about 4·22 to 1; but this excess has been accompanied by such a rapidity of increase as would double the population in less than forty-six years; and comparing this rapid rate of increase with the slow increase of France, where the births were to the marriages as four and four fifths to one, and in Sweden, where these proportions were as four and one fourth to one, it follows that the two other causes of the excess of births above the deaths, besides the prolificness of marriages, must have very great power, and that the proportion of births to marriages, as found in registers, when taken alone, is a most uncertain criterion of increase.

Expectation of life in England.

To apply the rule for estimating the average age of death, or the expectation of life, in England, we must first ascertain from the registers the proportions which the births and deaths bear to the whole population. The annual average of the births for the ten years from 1810 to 1821 was 325,506, of the deaths 200,999. Adding one sixth to the births, and one twelfth to the deaths, for the omission in the registers, the births will be 379,757, and the deaths 217,749. The population of England and Wales, according to the census taken in 1810, was 10,502,500, in 1821, 12,218,500,[1] the mean of which is 11,360,500. The average births and deaths, compared with the mean population, give $\frac{1}{29\cdot9}$ as the proportion of the births, and $\frac{1}{52\cdot17}$ as the proportion of the deaths; and, according to Dr Price, the mean between them, which in this case is forty-one, will give the expectation of life. This rule, however, is only a rough approximation, and, in the few cases where sufficient data have been obtained in progressive countries for calculating the expectation of life more accurately, it has turned out to be much nearer to the annual mortality than to the mean here referred to; while, according to the more correct estimates before adverted to, the annual mortality might, with the same expectation of life, be in different countries 1 in 39·38, 1 in 41·97, or 1 in 41·09, according as the population was stationary, or progressive at various rates.

This appears in the table which Dr Price himself calculated for Sweden (vol. ii. p. 410, 7th edit.), founded on data which he considered as quite satisfactory. It also appears in the table for Sweden and Finland, subsequently calculated by Mr Milne from similar data, in his Treatise on Annuities and Assurances, vol. ii. p. 569; and, further, in a table for Sweden and Finland, published in this work, under the head MORTALITY. We have also seen a calculation by Mr Milne, by which it appears that the difference between the annual mortality and the expectation of life goes on increasing with the rate of the increase of the population to a certain point, but afterwards, owing to the increasing proportion of young children included in the population, diminishes; and is less when the population doubles in twenty-five years, than when it doubles in fifty years. Thus, on the three different suppositions of a stationary population, a population doubling in fifty years, and a population doubling in twenty-five years (all subjected to the same law of mortality as that which prevailed in Sweden and Finland during the five years ended with 1805), in the first case, both the expectation of life and the annual mortality would be 39·388, and, of course, the expectation of life would be the same in all the cases; but in the second case, the annual mortality would be 1 in 41·971; and, in the third, 1 in 41·096. It would be difficult, however, or at least premature, without further data, to lay down a general rule, with a view to determine correctly the expectation of life at birth, in countries progressive at various rates. But, from what has been stated, it may safely be concluded, that the expectation of life lies very much nearer the annual mortality, particularly in cases of very rapid increase, than to the mean proposed by Dr Price; and that both the expectation of life, and the age to which half of the born live, are, in most countries, and especially in England, at the present time, considerably higher than they have generally been estimated.

It may be remarked here, in reference to England during the ten years from 1810 to 1821, that the omissions assumed in the births and deaths do not give such proportions as to make the increase of population, from the excess of births above the deaths, answer to the increase determined by the two censuses; an agreement which must necessarily take place if both the enumerations and the registers are accurate, and no external causes disturb the result. An addition of one sixth to the births, and one twelfth to the deaths, seemed to answer correctly for the interval from 1800 to 1810; but to produce the same coincidence under the more rapid increase of the subsequent ten years, either a greater allowance must be made for omissions in the births, or a less allowance for the omissions in the deaths. If we add one fifth instead of one sixth to the births, retaining one twelfth for the deaths, the excess of births above deaths in the ten years will be 1,728,587, the excess according to the censuses being 1,716,000; if we add only one thirtieth to the deaths, retaining one sixth for the births, the excess will be 1,720,502, within 4502 of the excess, as shown by the censuses; whereas, under the actual allowances which have been made for omissions, the excess will be only 1,620,800, leaving a difference of 95,200, and on the wrong side. On account of the almost incredible healthiness, considering our great towns and manufactories, which would be implied by supposing the deaths to be only deficient one thirtieth, an increased omission in the births might be thought more probable; but it is believed, that since 1812 the omissions in the births have been diminished rather than increased; and under this uncertainty it has been thought better to leave the question as it stands at present, rather than attempt to determine it on insufficient data. It should always be remembered, however, that if the increase of population by the enumerations is different from the increase of population by the registers, one or the other must be incorrect.

Expectation of life at birth, and annual mortality, not the same when the population is progressive.

On the supposition that the omissions in the deaths were only one thirtieth, the average mortality, compared with the average population, would be 1 in 54·7; and the proportion of births, with the addition of one sixth, being, as before stated, 1 in 29·9, the expectation of life, according to Dr Price's rule, would be 42·3. On the other supposition, of an omission of one fifth of the births and one twelfth of the deaths, the births would be 1 in 29, and the deaths 1 in 52·17, and the expectation of life would be 40·58.

It appears, then, that when the population of a country is progressive, it would be erroneous to estimate its healthiness by the proportion which the annual mortality bears to the whole population. Healthiness must be measured by the expectation of life; and if, with the same expectation of life, the annual mortality is affected by the rate of increase, it is obvious that the healthiness of different countries may be different, with the same rate of annual mortality.

Mortuary registers fallacious.

But whilst it is evidently necessary that we should be cautious in inferring that a country is healthy just in proportion to the smallness of its annual mortality, we should be still more cautious in inferring that it is unhealthy at all the ages under puberty, on account of the number which appear to die in mortuary registers under that age. Here, as in the preceding case, but in a much greater degree, the excess of the births above the deaths has a powerful effect, but exactly in the opposite direction. When we compare the annual mortality of an increasing country with its actual population, we compare with it a number of deaths which may be said, properly speaking, to belong to an earlier and smaller number of births, and must necessarily represent the country as more healthy than it really is. On the other hand, when, in a mortuary register, we compare the deaths under puberty with those above, if the population be increasing, we evidently compare the deaths belonging to a much greater number of births than those which have furnished the deaths above the age of puberty; and, consequently, these proportions must represent the country as much less healthy than it really is.[1] According to the mortuary registers of Sweden for twenty-one years from 1755 to 1776, more than half of the deaths were under fifteen, but it was by no means true that half of the born died under fifteen.[2] In the tables of mortality for Sweden during the same period, constructed by Dr Price, it appears that half of the born lived to above thirty-three years.[3]

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[1] Preliminary Observations to Population Abstracts, p. 32.

In the same manner, in drawing inferences from an abstract of the mortuary registers of the principal cities in America, Baltimore, Boston, New York, and Philadelphia, given by Dr Seybert,[4] we must take care not to conclude that the proportions of the deaths which take place under twenty years of age represent the proportions of any given number of births in these cities which die under twenty. As, on account of the excess of the births above the deaths, all the early ages of the population are more numerous in proportion than the other, there will necessarily be a greater proportion of the deaths at these ages than would naturally belong to a given number of births, if each infant born were traced to the age of its death.

In the present case, the abstract is only for a year, and no safe conclusions therefore can be drawn from it; but, so far as it goes, as even, notwithstanding the increase of population, these mortuary registers show that considerably less than half of the deaths take place under twenty (on an average only about 45½ per cent.), it would appear, that in the early ages of life, even the towns of America are more healthy than the whole of Sweden from 1755 to 1776. It should, however, be considered, that though the towns in America may be increasing fast by procreation, they are increasing still faster by the influx of inhabitants from the country; and as these inhabitants generally come to the towns after the age of sixteen, this accession diminishes the proportion of persons in the earlier ages of life so much, that there is probably a larger proportion of mortality at these ages in the country than in the towns.

riterion 'the pre- alence of rudential straint.

One of the most interesting and useful points of view in which registers can be considered, is in the proofs which they afford of the varying prevalence of the prudential check to marriage and population in different countries and places. It has been not an uncommon opinion, and has even been strongly expressed of late years, although the subject has been much better understood than formerly, that the labouring classes of people, under the circumstances in which they are placed, cannot reasonably be expected to attend to prudential considerations in entering upon the marriage state. But that this opinion does them great injustice, is not only obvious to common observation, by which we can scarcely fail to see that numbers delay marriage beyond the period when the passions most strongly prompt to it, but is proved by the registers of different countries, which clearly show, either that a considerable number of persons of a marriageable age never marry, or that they marry comparatively late, and that their marriages are consequently less prolific than if they had married earlier. As the prudential restraint on marriage may show itself in either of these ways, it may prevail nearly in the same degree with a different proportion of the whole population. But on the supposition of the same natural prolificness in the women of most countries, the smallness of the proportion of births will generally indicate, with tolerable correctness, the degree in which the prudential check to population prevails, whether arising principally from late, and consequently unprolific marriages, or from a large proportion of the population dying unmarried.

Referring, then, to the different proportions of births in different countries as the best criterion of the different degrees in which the prudential restraint on marriage operates, it will be recollected that these proportions vary from about one in thirty-six to about one in nineteen or even seventeen, in different countries, and in a much greater degree in different parishes or districts.

A particular parish in the Alps has already been mentioned, where the births were only a forty-ninth part of the population; and it appears by the late returns of the parish registers of England and Wales, that the births in the county of Monmouth are only one in forty-seven, and in Brecon one in fifty-three;[5] which, after making ample allowance for omissions, would show the prevalence of the prudential restraint on marriage in a high degree.

Effect of the absence of prudential restraint.

If in any country all were to marry at twenty or twenty-one, the proportion of the births would probably be more than one in nineteen; and this result would be still more certain if the resources of the country could not support an accelerated rate of increase, than if the means of subsistence were in the greatest abundance, and the demand for labour as effectual as it has ever been in the United States. Of the latter supposition, taking the births at one nineteenth, and the expectation of life the same as it is in England, the effect would be to occasion a most rapid increase of population; and the period of doubling, instead of being about forty-six or forty-eight years, would be less than in America. On the other hand, if the resources of the country could not support a more rapid increase than that which has taken place in England and Wales during the ten years previous to the census of 1821, the effect would be a great diminution in the expectation of life. If the births were one in nineteen instead of one in nearly thirty, the same rate of increase would take place as at present if the annual mortality were increased to about one in twenty-six and a half; and in that case the expectation of life would be reduced in the proportion of from forty-one, or, as is more probable, from above forty-five, to less than twenty-six.[6] This is the kind of effect which must inevitably follow the absence of the prudential check to marriage and population; and it cannot be doubted, that a considerable part of the premature mortality which is found to take place in all parts of the world is occasioned by it. The laws of nature, in application to man as a reasonable being, show no tendency to destroy half of the human race under the age of puberty. This is only done in very particular situations, or when the constant admonitions which these laws give to mankind are obstinately neglected.

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[1] In the first case, the effect is, in a considerable degree, counteracted by the large proportion of children under four years old, which a rapid increase occasions. In the second case, the effect has no such drawback.

[2] Price's Observations, vol. ii. p. 405, 7th edit.

[3] *Ibid.* table xlv. vol. ii. p. 413.

[4] Statistical Annals, p. 48.

[5] Preliminary Observations, p. 27.

[6] If, as it has appeared, the expectation of life, though by no means the same, does not differ very much from the annual mortality, and the annual mortality in this country during the ten years from 1810 to 1820, after every abatement, appears to be not more than one in fifty-one, the expectation of life cannot be less than forty-five, and is probably greater.

Objection to the principle of population arising from the mortality it must occasion.

It has been said that a tendency in mankind to increase at such a rate as would double the population in twenty-five years, and, if it had full scope, would fill the habitable globe with people in a comparatively short period, cannot be the law of nature, as the very different rate of increase which is actually found to take place must imply such an excessive degree of mortality and destruction of life as to be quite irreconcileable with actual facts and appearances. But the peculiar advantage of a law of increase in a geometrical progression is, that though its power be absolutely immense if it be left unchecked, yet, when this becomes impossible, it may be restrained by a comparatively moderate force. It can never of course happen that any considerable part of that prodigious increase which might be produced by an uninterrupted geometrical progression, should exist, and then be destroyed. The laws of nature, which make food necessary to the life of man, as well as of plants and animals, prevent the continued existence of an excess which cannot be supported, and thus either discourage the production of such an excess, or destroy it in the bud, in such a way as to make it scarcely perceptible to a careless observer. It has been seen, that in some countries of Europe where the actual progress of the population is slower than in many others, as in Switzerland and Norway, for instance, the mortality is considerably less. Here, then, the necessity of a greater check to the natural progress of population produces no increase of mortality. And it appears farther, that even the degree of mortality which in each year would be sufficient to destroy that excess of births which would naturally be produced if all married young, and all could be supported, might take place, and often does take place in particular situations, and yet is very little noticed. About the middle of last century, the mortality in Stockholm and London was about one in nineteen and one in twenty. This is a degree of mortality which would probably keep the births on a level with the deaths, even though all married at twenty. And yet numbers resorted both to Stockholm and London from choice, the greater part probably not aware that, by so doing, they would shorten their own lives and those of their children; and the rest thinking that the difference was not worth attending to, or was at least balanced by the advantages of society and employment which the town presented. There is nothing, therefore, in the actual state of the mortality observed to take place in different countries and situations, which, in the slightest degree, contradicts the supposition of a natural tendency to increase quite as great as that which has been stated.

Objection that mere tendencies are not to be considered.

It has been further remarked, that as, in point of fact, it very rarely happens that mankind continue to increase in a geometrical progression of any kind, and only in a single instance in such a one as to double the population in twenty-five years, it is useless and absurd to lay any stress upon tendencies which never for any length of time together produce their natural effects. But it might really as well be said, that we are not to estimate the natural rate of increase in wheat or sheep, as it is quite certain that their natural tendency to increase has never practically continued to develope itself for so long a time together as that of mankind. Both as a physical and even economical question, it is curious and desirable to know the natural law of increase which prevails among the most important plants and animals. In the same view, it must be still more interesting to know the natural law of increase with respect to man. It may be said, indeed, with truth, that the actual appearances all around us,—the varying rate of increase in different countries, its very slow progress or stationary state in some, and its very rapid progress in others,—must be a mass of anomalies, and quite contrary to the analogies of all the rest of animated nature; if the natural tendency of mankind to increase be not at the least as great as that which is developed under the most favourable circumstances, while in all others it is kept down by the varying difficulties which the state of the soil and other obstacles oppose to it. But the question, as it applies to man, assumes at once a tenfold importance, in reference to the moral and political effects which must result from those checks to increase, the existence and operation of which, in some form or other, no human exertions can by possibility prevent. A field is here opened for the most interesting inquiries which can engage the friends of human happiness.

But, as a preliminary to these inquiries, it is obvious that we must know the degree of force to be overcome, and the varying character of the checks which, in the different countries of the world, are practically found to overcome it; and, for this purpose, the first step must be an endeavour to ascertain the natural law of population, or the rate at which mankind would increase under the fewest known obstacles. Nor can this tendency to increase ever safely be lost sight of in the subsequent inquiries, which have for their object the improvement of the moral condition of man in society.

Right of the poor to full support considered.

The existence of a tendency in mankind to increase, if unchecked, beyond the possibility of an adequate supply of food in a limited territory, must at once determine the question as to the natural right of the poor to full support in a state of society where the law of property is recognised. The question, therefore, resolves itself chiefly into a question relating to the necessity of those laws which establish and protect private property. It has been usual to consider the right of the strongest as the law of nature among mankind as well as among brutes; yet, in so doing, we at once give up the peculiar and distinctive superiority of man as a reasonable being, and class him with the beasts of the field. In the same language, it may be said that the cultivation of the earth is not natural to man. It certainly is not to man, considered merely as an animal without reason. But to a reasonable being, able to look forward to consequences, the laws of nature dictate the cultivation of the earth, both as the means of affording better support to the individual, and of increasing the supplies required for increasing numbers; the dictates of those laws of nature being thus evidently calculated to promote the general good, and increase the mass of human happiness. It is precisely in the same way, and in order to attain the same object, that the laws of nature dictate to man the establishment of property and the absolute necessity of some power in the society capable of protecting it. So strongly have the laws of nature spoken this language to mankind, and so fully has the force of it been felt, that nothing seems to be thought so absolutely intolerable to reasonable beings as the prevalence in the same society of the right of the strongest; and the history of all ages shows, that if men see no other way of putting an end to it, than by establishing arbitrary power in an individual, there is scarcely any degree of tyranny, oppression, and cruelty, which they will not submit to from some single person and his satellites, rather than be at the mercy of the first stronger man who may wish to possess himself of the fruit of their labour. The consequence of this universal and deeply-seated feeling, inevitably produced by the laws of nature, as applied to reasonable beings, is, that the almost certain consequence of anarchy is despotism.

Allowing, then, distinctly, that the right of property is the creature of positive law, yet this law is so early and so imperiously forced on the attention of mankind, that if it cannot be called a natural law, it must be considered as the most natural as well as the most necessary of all positive laws; and the foundation of this pre-eminence is its obvious tendency to promote the general good, and the obvious tendency of the absence of it to degrade mankind to the rank of brutes.

As property is the result of positive law, and the ground on which the law which establishes it rests is the promotion of the public good and the increase of human happiness, it follows, that it may be modified by the same authority by which it was enacted, with a view to the more complete attainment of the objects which it has in view. It may be said, indeed, that every tax for the use of the government, and every country or parish rate, is a modification of this kind. But there is no modification of the law of property having still for its object the increase of human happiness, which must not be defeated by the concession of a right of full support to all that might be born. It may be safely said, therefore, that the concession of such a right, and a right of property, are absolutely incompatible, and cannot exist together.

To what extent assistance may be given even by law to the poorer classes of society when in distress, without defeating the great object of the law of property, is essentially a different question. It depends mainly upon the feelings and habits of the labouring classes of society, and can only be determined by experience. If it be generally considered as so discreditable to receive parochial relief, that great exertions are made to avoid it, and few or none marry with a certain prospect of being obliged to have recourse to it, there is no doubt that those who were really in distress might be adequately assisted, with little danger of a constantly increasing proportion of paupers; and in that case a great good would be attained, without any proportionate evil to counterbalance it. But if, from the numbers of the dependent poor, the discredit of receiving relief is so diminished as to be practically disregarded, so that many marry with the almost certain prospect of becoming paupers, and the proportion of their numbers to the whole population is in consequence continually increasing, it is certain that the partial good attained must be much more than counterbalanced by the general deterioration in the condition of the great mass of the society, and the prospect of its daily growing worse; so that, though, from the inadequate relief which is in many cases granted, the manner in which it is conceded, and other counteracting causes, the operation of poor-laws such as they exist in England might be very different from the effects of a full concession of the right, and a complete fulfilment of the duties resulting from it, yet such a state of things ought to give the most serious alarm to every friend to the happiness of society, and every effort consistent with justice and humanity ought to be made to remedy it. But whatever steps may be taken on this subject, it will be allowed, that with any prospect of legislating for the poor with success, it is necessary to be fully aware of the natural tendency of the labouring classes of society to increase beyond the demand for their labour, or the means of their adequate support, and of the effect of this tendency to throw the greatest difficulties in the way of permanently improving their condition.

It would lead far beyond the limits which must be prescribed to this article, to notice all the various objections which have been made by different writers to the principles which have been here explained. Those which contain in them the slightest degree of plausibility have been answered by Mr Malthus in various parts of the late editions of his work, and particularly in the appendix to the fifth edition, to which we refer the reader. We will only, therefore, further notice the objection which has been made by some persons on religious grounds; for, as it is certainly of great importance that the answer which has been given to it should be kept in mind, we cannot refuse a place to a condensed statement of it at the end of this article.

Religious objection considered.

It has been thought that a tendency in mankind to increase beyond the greatest possible increase of food which could be produced in a limited space, impeaches the goodness of the Deity, and is inconsistent with the letter and spirit of the Scriptures. If this objection were well founded, it would certainly be the most serious one which has been brought forward; but the answer to it appears to be quite satisfactory, and it may be compressed into a very small compass.

First, It appears that the evils arising from the principle of population are exactly of the same kind as the evils arising from the excessive or irregular gratification of the human passions in general, and may equally be avoided by moral restraint. Consequently, there can be no more reason to conclude, from the existence of these evils, that the principle of increase is too strong, than to conclude, from the existence of the vices arising from the human passions, that these passions are all too strong, and require diminution or extinction, instead of regulation and direction.

Secondly, It is almost universally acknowledged, that both the letter and spirit of revelation represent this world as a state of moral discipline and probation. But a state of moral discipline and probation cannot be a state of unmixed happiness, as it necessarily implies difficulties to be overcome, and temptations to be resisted. Now, in the whole range of the laws of nature, not one can be pointed out which so especially accords with this scriptural view of the state of man on earth; as it gives rise to a greater variety of situations and exertions than any other, and marks, in a more general and stronger manner, and nationally as well as individually, the different effects of virtue and vice, of the proper government of the passions, and the culpable indulgence of them. It follows, then, that the principle of population, instead of being inconsistent with Revelation, must be considered as affording strong additional proofs of its truth.

Lastly, It will be acknowledged, that in a state of probation, those laws seem best to accord with the views of a benevolent Creator, which, while they furnish the difficulties and temptations which form the essence of such a state, are of such a nature as to reward those who overcome them with happiness in this life as well as in the next. But the law of population answers particularly to this description. Each individual has the power of avoiding the evil consequences to himself and society resulting from it, by the practice of a virtue dictated to him by the light of nature, and sanctioned by revealed religion. And as there can be no question that this virtue tends greatly to improve the condition and increase the comforts both of the individuals who practise it, and through them of the whole society, the ways of God to man with regard to this great law are completely vindicated.

Subjoined are two tables, which may assist the reader in calculating the rate of increase in different countries, under different circumstances, and from different data. The first is the table calculated by Euler, and printed in Mr Malthus's work, at the end of his chapter on the Fruitfulness of Marriage; and the second has been calculated by Mr Bridge of Cambridge, well known as an able mathematician, and most useful elementary writer.

The first is to be used when it is wished to estimate the rate of increase by the proportions of the births to the deaths, and of these to the whole population. The yearly increase of people, independently of immigration, is the yearly excess of the births above the deaths; and the yearly rate of increase is measured by the proportion which this excess bears to the whole population. The fraction expressing the deaths must therefore be subtracted from the fraction expressing the births, and the remainder will be the fraction expressing the yearly rate of increase; opposite to which will be found the number of years in which the population will double itself, supposing the yearly rate of increase to continue the same for a sufficient length of time.

The second table is to be used when it is wished to know the period of doubling, resulting from a given per centage increase in ten years, determined by enumeration. An estimate of population from births and deaths is always liable to much uncertainty, on account of the varying proportions which they bear to the population. The only remedy for this uncertainty is a census; and as the useful custom of taking a census of the population every ten years has latterly prevailed in some countries, the second table is constructed to show the period of doubling, or general rate of increase, which results from any given per centage increase in ten years. The first column represents the per centage increase in ten years determined by two enumerations; and the second column the number of years in which the population will double itself, supposing it to proceed at the same rate. (Y. Y. Y. Y.)

TABLE I.

The Proportion of the Excess of Births above the Deaths to the whole of the Living.	Periods of Doubling in Years and Ten Thousandth Parts.	The Proportion of the Excess of Births above the Deaths to the whole of the Living.	Periods of Doubling in Years and Ten Thousandth Parts.
1 : 10	7·2722	1 : 110	76·5923
11	7·9659	120	83·5230
12	8·6595	130	90·4554
13	9·3530	140	97·3868
14	10·0465	150	104·3183
15	10·7400	160	111·2598
16	11·4333	170	118·1813
17	12·1266	180	125·1128
18	12·8200	190	132·0443
19·	13·5133	200	138·9757
20	14·2066		
1 : 21	14·9000	1 : 210	145·9072
22	15·5932	220	152·8387
23	16·2864	230	159·7702
24	16·9797	240	166·7017
25	17·6729	250	173·6332
26	18·3662	260	180·5647
27	19·0594	270	187·4961
28	19·7527	280	194·4275
29	20·4458	290	201·3590
30	21·1391	300	208·2905
1 : 32	22·5255	1 : 310	215·2220
34	23·9119	320	222·1535
36	25·2983	330	229·0850
38	26·6847	340	236·0164
40	28·0711	350	242·9479
42	29·4574	360	249·8794
44	30·8438	370	256·8109
46	32·2302	380	263·7425
48	33·6161	390	270·6740
50	35·0029	400	277·6055
1: 55	38·4687	1: 410	284·5370
60	41·9345	420	291·4685
65	45·4003	430	298·4000
70	48·8661	440	305·3314
75	52·3318	450	312·2629
80	55·7977	460	319·1943
85	59·2634	470	326·1258
90	62·7292	480	333·0573
95	66·1950	490	339·9888
100	69·6607	500	346·9202
		1: 1000	693·49

TABLE II.

Per Centage Increase in Ten Years.	Period of Doubling.	Per Centage Increase in Ten Years.	Period of Doubling.
	Years.		Years.
1·	696·60	23·5	32·83
1·5	465·55	24·	32·22
2·	350·02	24·5	31·63
2·5	280·70	25·	31·06
3·	234·49	25·5	30·51
3·5	201·48	26·	29·99
4·	176·73	26·5	29·48
4·5	157·47	27·	28·99
5·	142·06	27·5	28·53
5·5	129·46	28·	28·07
6·	118·95	28·5	27·65
6·5	110·06	29·	27·22
7·	102·44	29·5	26·81
7·5	95·84	30·	26·41
8·	90·06		
8·5	84·96	30·5	26·03
9·	80·43	31·	25·67
9·5	76·37	31·5	25·31
10·	72·72	32·	24·96
		32·5	24·63
10·5	69·42	33·	24·30
11·	66·41	33·5	23·99
11·5	63·67	34·	23·68
12·	61·12	34·5	23·38
12·5	58·06	35·	23·09
13·	56·71	35·5	22·81
13·5	54·73	36·	22·54
14·	52·90	36·5	22·27
14·5	51·19	37·	22·01
15·	49·59	37·5	21·76
15·5	48·10	38·	21·52
16·	46·70	38·5	21·28
16·5	45·38	39·	21·04
17·	44·14	39·5	20·82
17·5	42·98	40·	20·61
18·	41·87		
18·5	40·83	41·	20·17
19·	39·84	42·	19·76
19·5	38·91	43·	19·37
20·	38·01	44·	19·00
		45·	18·65
20·5	37·17	46·	18·31
21·	36·36	47·	17·99
21·5	35·59	48·	17·68
22·	34·85	49·	17·38
22·5	34·15	50·	17·06
23·	33·48		

For the population of the British Islands, see the articles ENGLAND, SCOTLAND, and IRELAND.

POPULATION OF GREAT BRITAIN
For 1841.

COMPARATIVE STATEMENT
OF THE
POPULATION IN 1801, 1811, 1821, 1831, & 1841,
SHOWING THE INCREASE OR DECREASE IN EACH COUNTY.

ENGLAND.

COUNTIES.	1801.	Increase per Cent.	1811.	Increase per Cent.	1821.	Increase per Cent.	1831.	Increase per Cent.	1841.
Bedford	63,393	11	70,213	19	83,716	14	95,483	13·	107,937
Berks	109.215	8	118,277	11	131,977	10	145,389	10·2	160,226
Buckingham	107.444	9	117.650	14	134,068	9	146,529	6·4	155,989
Cambridge	89,346	13	101,109	20	121,909	18	143.955	14·2	164.509
Chester	191.751	18	227,031	19	270,098	24	334,391	18·4	395,300
Cornwall	188.269	15	216,667	19	257.447	17	300,938	13·3	341,269
Cumberland	117.230	14	133.744	17	156,124	10	169,681	4·8	177,912
Derby	161.142	15	185,487	15	213,333	11	237.170	14·7	272.202
Devon	343.001	12	383.308	15	439,040	13	494.478	7·8	533,731
Dorset	115.319	8	124.693	16	144,499	10	159.252	9·7	174,743
Durham	160,361	11	177,625	17	207,673	22	253,910	27·2	324,277
Essex	226,437	11	252,473	15	289,424	10	317,507	8·6	344,995
Gloucester	250.809	12	285 514	18	335 843	15	387,019	11·4	431,307
Hereford	89,191	5	94.073	10	103.243	7	111,211	2·	114,438
Hertford	97.577	14	111,654	16	129,714	10	143,341	9·6	157,237
Huntingdon	37.568	12	42,208	15	48.771	9	53,192	10·3	58,699
Kent	307.624	21	373.095	14	426 016	12	479,155	14·4	548,161
Lancaster	672,731	23	828.309	27	1,052 859	27	1,336,854	24·7	1,667,064
Leicester	130.081	16	150.419	16	174.571	13	197,003	9·5	215,855
Lincoln	208.557	14	237.891	19	283.058	12	317,465	11·1	362,717
Middlesex	818,129	17	953,276	20	1,144,531	19	1,358,330	16·	1,576,616
Monmouth	45.582	36	62,127	15	71,833	36	98,130	36·9	134,349
Norfolk	273.371	7	291,999	18	344.368	13	390,054	5·7	412,621
Northampton	131.757	7	141,353	15	162.483	10	179,336	10·9	199.061
Northumberland	157.101	9	172.161	15	198.965	12	222,912	12·2	250,268
Nottingham	140.350	16	162,900	15	186,873	20	225,327	10·8	249,773
Oxford	109,620	9	119.191	15	136,971	11	152,156	6·1	161,573
Rutland	16.356	. .	16,380	13	18 487	5	19,385	10·	21,340
Salop	167,639	16	194,298	6	206,153	8	222.938	7·2	239.014
Somerset	273,750	12	303,180	17	355,314	13	404,200	7·8	436,002
Southampton (Hants)	219,656	12	245,080	15½	283.298	11	314.280	12·9	354.940
Stafford	239.153	21	295.153	17	345.895	19	410 512	24·2	510,206
Suffolk	210.431	11	234,211	15	270,542	9	296.317	6·3	315,129
Surrey	269,043	20	323.851	23	398,658	22	486,334	19·7	582,613
Sussex	159.311	19	190.083	22	233.019	17	272,340	10·	299,770
Warwick	208,190	10	228.735	20	274,392	23	336,610	19·4	402,121
Westmoreland	41.617	10	45,922	12	51,359	7	55,041	2·5	56,469
Wilts	185.107	5	193,828	15	222,157	8	240.156	8·2	260,007
Worcester	139 333	15	160,546	15	184.424	15	211,365	10·4	233.484
York (East Riding)	110.992	16	134 437	14	154,010	10	168,891	14·6	193.676
City of York and Ainstey	24,393	12	27,304	12	30,451	17	35.362	8·3	38,322
York (North Riding)	158,225	7	169.391	11	187,452	2	190,756	7·2	204.662
York (West Riding)	565,282	16	655,042	22	801,274	22	976,350	18·2	1,154,924
England	8,331,434	14½	9,538,827	17½	11,261,437	16	13,091,005	14·5	14,995,508

WALES.

COUNTIES.	1801.	Increase per Cent.	1811.	Increase per Cent.	1821.	Increase per Cent.	1831.	Increase per Cent.	1841.
Anglesey	33,806	10	37,045	21	45,063	7	48.325	5·3	50,890
Brecon	31,633	19	37,735	16	43,603	10	47,763	11·8	53,295
Cardigan	42.956	17	50,260	15	57,784	10	64.780	5·5	68,380
Carmarthen	67,317	15	77,217	17	90.239	12	100,740	6·	106,482
Carnarvon	41,521	19	49,336	17	57,958	15	66,448	22·	81,068
Denbigh	60,352	6	64.240	19	76,511	8	83,629	6·7	89,291
Flint	39,622	17	46,518	15	53,784	11	60,012	10·8	66.547
Glamorgan	71,525	18	85,067	19	101,737	24	126,612	37·	173,462
Merioneth	27,506	4	30,924	11	34,382	3	35,315	11·1	39,238
Montgomery	47.978	8	51,931	15	59,899	9	66,482	4·1	69,220
Pembroke	56,280	7	60,615	22	74,009	9	81,425	7·9	88.262
Radnor	19,050	9	20,900	7	22,459	9	24,651	2·1	25,186
Wales	541,546	13	611,788	17	717,438	12	806,182	13·	911,321

POPULATION FOR 1841.

SCOTLAND.

COUNTIES.	1801.	Increase per Cent.	1811.	Increase per Cent.	1821.	Increase per Cent.	1831.	Increase or Decrease per Cent. 1841.		1841.
								Increase.	Decrease.	
Aberdeen . . .	123.082	10	135.075	15	155.387	14	177,657	8·2	. .	192 283
Argyll . . .	71.859	19	85.585	14	97.316	4	100.973	. .	3·9	97.140
Ayr	84 306	23	103.954	22	127.299	14	145,055	13·4	. .	164.522
Banff . . .	35.807	2	36.668	19	43 561	12	48,604	3·	. .	50 076
Berwick . . .	30,621	1	30.779	8	33,385	2	34,048	1·1	. .	34.427
Bute	11,791	2	12,033	15	13,797	3	14,151	10·9	. .	15,695
Caithness . . .	22,609	4	23,419	29	30.238	14	34.529	4·8	. .	36,197
Clackmannan . .	10,858	11	12,010	10	13.263	11	14,729	29·7	. .	19,116
Dumbarton . . .	20.710	17	24.189	13	27.317	22	33,211	33·3	. .	44,295
Dumfries . . .	54.597	15	62,960	13	70,878	4	73.770	. .	1·3	72,825
Edinburgh . . .	122.954	21	148.607	29	191.514	15	219.345	2·8	. .	225.623
Elgin (Moray) . .	26.705	5	28.108	11	31 162	10	34.231	2·2	. .	34.994
Fife	93.743	8	101.272	13	114.556	12	128,839	8·9	. .	140,310
Forfar . . .	99.127	8	107,264	6	113.430	23	139,606	22·	. .	170.400
Haddington . . .	29,986	4	31,164	13	35,127	3	36,145	. .	1·	35,781
Inverness . .	74.292	5	78.336	15	90,157	5	94.797	3·	. .	97,615
Kincardine . . .	26,349	4	27,439	6	29,118	8	31.431	5·1	. .	33,052
Kinross . . .	6.725	8	7,245	7	7,762	17	9 072	. .	3·5	8,763
Kirkcudbright . .	29.211	15	33,684	15	38.903	4	40,590	1·2	. .	41.099
Lanark . . .	146.699	31	191.752	27	244,387	30	316 819	34·8	. .	427,113
Linlithgow . . .	17,844	9	19,451	17	22.685	3	23,291	15·2	. .	26,848
Nairn	8,257	. .	8.251	9	9.006	4	9.354	. .	1·4	9,218
Orkney and Shetland .	46.824	. .	46.153	15	53.124	10	58,239	4·3	. .	60,796
Peebles . . .	8.735	14	9.935	1	10.046	5	10.578	. .	·5	10,520
Perth	126,366	7	135,093	3	139,050	3	142.894	. .	3·4	138,151
Renfrew . . .	78 056	19	92,596	21	112.175	19	133,443	15·9	. .	154.755
Ross and Cromarty .	55,343	10	60,853	13	68,828	9	74,820	5·5	. .	78,980
Roxburgh . . .	33.682	11	37.230	10	40.892	7	43,663	5·3	. .	46,003
Selkirk	5.070	16	5.889	13	6,637	2	6.833	16·9	. .	7,989
Stirling . . .	50 825	14	58,174	12	65,376	11	72,621	13·1	. .	82.179
Sutherland . . .	23.117	2	23.629	. .	23.840	7	25,518	. .	3·4	24,666
Wigton . . .	22,918	17	26.891	23	33,240	9	36,258	8·	. .	39,179
Scotland . .	1,599,068	14	1,805,688	16	2,093,456	13	2,365,114	10·8	. .	2,620,610

ISLANDS IN THE BRITISH SEAS.

ISLANDS.	1801.	Increase per Cent.	1811.	Increase per Cent.	1821.	Increase per Cent.	1831.	Increase per Cent.	1841.
Jersey	. .	. .	. .	. .	28,600	27·9	36,582	30·	47,556
Guernsey, Alderney, Sark, Herm, and Jethou	. .	. .	. .	. .	20,827	25·4	26,128	9·2	28,538
Man	. .	. .	. .	. .	40,081	2·2	41.000	17·	47,985
Total . . .	. .	. .	. .	. .	89,508	15·8	103,710	19·6	124,079

SUMMARY.

GREAT BRITAIN, AND ISLANDS IN THE BRITISH SEAS.

COMPARATIVE POPULATION.*

	1801.	Increase per Cent.	1811.	Increase per Cent.	1821.	Increase per Cent.	1831.	Increase or Decrease per Cent. 1841.		1841.
								Increase.	Decrease.	
England . . .	8,331,434	14½	9,538.827	17½	11,261,457	16	13,091,005	14·5	. .	14,995,508
Wales	541,546	13	611 788	17	717,438	12	806,182	13·	. .	911,321
Persons ascertained to have been travelling by Railways and Canals during the night of June 6, 1841 .	. .	. .	. .	. .	. .	. .	. .	. .	. .	4,896
England and Wales	8,872,980	14	10,150,615	17	11 978.875	16	13.897,187	14·5	. .	15,911,725
Scotland . . .	1,599,068	14	1,805,688	16	2,093,456	13	2,365,114	10·8	. .	2,620,610
Islands in the British Seas . . .	. .	.	.	. .	89,508	15·8	103,710	19·6	. .	124,079
Great Britain	10,472,048	14·2	11,956,303	17·6†	14,161,829	15·5	16,366,011	14·	. .	18,656,414

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* This Return includes only such part of the Army, Navy, and Merchant Seamen as were at the time of the Census within the Kingdom on shore.

† For the purposes of comparison with the total of 1811, the Population of the Channel Islands, as taken in 1821, has been omitted.

POPULATION FOR 1841.

POPULATION WITHIN EACH PARLIAMENTARY BOUNDARY IN SCOTLAND IN 1841.

NAME OF CITIES OR ROYAL AND PARLIAMENTARY BURGHS.	PERSONS.		
	Males.	Females.	Totals.
CITIES returning *Two* Members each :—			
Edinburgh	58,642	75,050	133,692
Glasgow	126,494	140,969	267,463
CITIES and TOWNS returning *One* Member each :—			
Aberdeen	27.277	35,623	62,900
Dundee	29,210	34,615	63,825
Greenock*	17.440	18,481	35,921
Paisley*	22,064	26,061	48,125
Perth	8,498	9,783	18.281
COMBINED BURGHS, and TOWNS or DISTRICTS. returning *One* Member :—			
Ayr District—			
Ayr, and Newton upon Ayr	7,148	8,699	15,847
Irvine	1,937	2,657	4,594
Campbeltown	2,902	3,885	6,787
Inverary	547	593	1,140
Oban*	604	794	1,398
Total	13,138	16,628	29,766
Dumfries District—			
Annan	1,519	1,802	3,321
Dumfries and Maxwelltown	5.847	7,506	13.353
Kirkcudbright	1,072	1,534	2.606
Lochmaben	621	707	1.328
Sanquhar	804	915	1,719
Total	9,863	12,464	22,327
Elgin District—			
Banff and Macduff	2,354	2,965	5,319
Cullen	711	853	1,564
Elgin	2,259	2,957	5.216
Inverury	832	899	1,731
Kintore	219	245	464
Peterhead*	2,465	3,293	5,758
Total	8,840	11,212	20,052
Falkirk District—			
Airdrie*	6,681	5,735	12,416
Falkirk*	3,999	4.210	8 209
Hamilton*	4,074	4,650	8,724
Lanark	2,140	2.346	4,486
Linlithgow	2 092	1,932	4,024
Total	18.986	18,873	37,859
Haddington District—			
Dunbar	1,360	1,627	2,987
Haddington	1,796	1,981	3,777
Jedburgh	1,518	1,759	3.277
Lauder	578	570	1,148
North Berwick	470	551	1,021
Total	5,722	6,488	12,210
Inverness District—			
Forres	1,299	1,899	3,198
Fortrose	409	542	951
Inverness	5,009	6,583	11,592
Nairn	1,032	1,356	2,388
Total	7,749	10,380	18,129
Kilmarnock District—			
Dumbarton	2,163	2.239	4,402
Kilmarnock*	9,189	10,209	19,398
Renfrew	949	1,064	2,013
Rutherglen	2.816	2,806	5,622
Port Glasgow*	3,134	3,804	6,938
Total	18,251	20,122	38,373
Kirkaldy District—			
Burntisland	811	1,048	1,859
Dysart	3,228	3,830	7,058
Kinghorn	666	889	1,555
Kirkaldy	2,634	3,070	5,704
Total	7,339	8,837	16,176
Leith District—			
Leith*	11,979	14,047	26,026
Portobello*	1,403	2,184	3,587
Musselburgh*	2,958	3,408	6,366
Total	16,340	19,639	35,979
Montrose District—			
Aberbrothwick or Arbroath	6,781	7,810	14,591
Brechin	2,675	3.232	5,907
Forfar	3,659	4,340	7.999
Inverbervie or Bervie	424	440	864
Montrose	6,130	7,681	13,811
Total	19,669	23,503	43,172
St. Andrews District—			
Anstruther, Easter	448	566	1,014
Anstruther, Wester	148	191	339
Crail	520	707	1,227
Cupar	2,341	2,821	5,162
Kilrenny	791	928	1,719
Pittenweem	576	733	1,309
St. Andrews	1,947	2,518	4,465
Total	6,771	8,464	15,235
Stirling District—			
Culross	237	365	602
Dunfermline	6,741	6,582	13,323
Inverkeithing	840	987	1,827
Queensferry	589	644	1,233
Stirling	5,022	5,723	10,745
Total	13,429	14,301	27,730
Wick District—			
Cromarty*	809	1,130	1,939
Dingwall	764	962	1,726
Dornoch	201	250	451
Kirkwall	1,222	1.819	3,041
Tain	839	1,028	1,867
Wick	2,595	2,927	5,522
Total	6,430	8,116	14,546
Wigton District—			
New Galloway	212	218	430
Stranraer	2,166	2,723	4,889
Whithorn	681	832	1.513
Wigtown	848	1,022	1,870
Total	3,907	4,795	8,702

* Burghs which have a Parliamentary Representation, but are not Royal Burghs.

GREAT BRITAIN, AND ISLANDS IN THE BRITISH SEAS.

COMPARATIVE STATEMENT OF HOUSES.

	1831.			1841.		
	Inhabited Houses.	Uninhabited Houses.	Building.	Inhabited Houses.	Uninhabited Houses.	Building.
England	2,326,022	113.885	23.462	2,753 295	162,756	25.882
Wales	155,522	6,036	1.297	188,196	10,133	1,769
England and Wales	2,481.544	119.915	24.759	2,941,491	172.889	27,651
Scotland	369,393	12,719	2,568	503.451	24,295	2,763
Islands in the British Seas	15,658	697	226	19,159	865	220
Great Britain	2,866,595	133,331	27,553	3,464,101	198,049	30,634

POPULATION OF THE UNITED STATES,

ACCORDING TO SIX ENUMERATIONS.

From the Official Revision.

STATES.	1790.	1800.	1810.	1820.	1830.	1840.
Maine	96,540	151,719	228,705	298,335	399,955	501,793
New Hampshire	141,899	183,762	214,360	244.161	269,328	284,574
Vermont	85,416	154,465	217,713	235,764	280,652	291,948
Massachusetts	378,717	423,245	472,040	523,287	610,408	737,699
Rhode Island	69,110	69,122	77,031	83,059	97,199	108,830
Connecticut	238,141	251,002	262,042	275,202	297,665	309,978
New York	340,120	586.756	959,949	1,372,812	1,918,608	2,428,921
New Jersey	184,139	211.949	249,555	277,575	320,823	373.306
Pennsylvania	434,373	602,365	810,091	1,049.458	1,348,233	1,724,033
Delaware	59.098	64,273	72,674	72,749	76,748	78,085
Maryland	319,728	341,548	380,546	407,350	447,040	469.232
Virginia	748,308	880,200	974,622	1,065,379	1,211,405	1,239,797
North Carolina	393,751	478,103	555,500	638,829	737,987	753,419
South Carolina	249.073	345,591	415,115	502,741	581,185	594,398
Georgia	82,548	162,101	252.433	340,987	516,823	691,392
Alabama	. .	. .	20,845	127,901	309,527	590,756
Mississippi	. .	8,850	40,352	75,448	136,621	375,651
Louisiana	. .	. .	76,556	153,407	215,739	352,411
Arkansas	. .	. .	. .	14,273	30,388	97,574
Tennessee	35,791	105,602	261,727	422,813	681,904	829.210
Kentucky	73,077	220.955	406,511	564.317	687,917	779,828
Ohio	. .	45,365	230,760	581,434	937,903	1,519,467
Michigan	. .	. .	4,762	8,896	31,639	212,267
Indiana	. .	4,875	24,520	147,178	343,031	685,866
Illinois	. .	. .	12,282	55,211	157,455	476,183
Missouri	. .	. .	20,845	66,586	140,445	383.702
District of Columbia	. .	14,093	24,023	33,039	39,834	43,712
Florida Territory	. .	. .	. .	. .	34,730	54,477
Wisconsin do.	. .	. .	. .	. .	. .	30,945
Iowa do.	. .	. .	. .	. .	. .	43,112
Total	3,929,827	5,305,925	7,239,814	9,638,131	12,866,920	17,062,566

SLAVES IN THE UNITED STATES,

ACCORDING TO SIX ENUMERATIONS.

STATES.	1790.	1800.	1810.	1820.	1830.	1840.
Maine	0	0	0	0	0	0
New Hampshire	158	8	0	0	0	1
Vermont	17	0	0	0	0	0
Massachusetts	0	0	0	0	0	0
Rhode Island	952	381	103	48	17	5
Connecticut	2,759	951	310	97	25	17
New York	21,324	20,343	15,017	10,088	75	4
New Jersey	11,423	12,422	10,851	7,657	2,254	674
Pennsylvania	3,737	1,706	795	211	403	64
Delaware	8,887	6,153	4,177	4,509	3,292	2,605
Maryland	103,036	105,635	111,502	107.398	102,294	89,495
Virginia	203,427	345,796	392,518	425,153	469,757	448,987
North Carolina	100,572	133,296	168.824	295,017	245,601	245,817
South Carolina	107,094	146.151	196,365	258,475	315,401	327,038
Georgia	29,264	59,404	105,218	149,656	217,531	280,944
Alabama	. .	. .	. .	41.879	117,549	253,532
Mississippi	. .	3,489	17,088	32,814	65,659	195,211
Louisiana	. .	. .	34,660	69,064	109,588	168,452
Arkansas	. .	. .	. .	1,617	4,576	19,935
Tennessee	3,417	13,584	44,535	80,107	141,603	183,059
Kentucky	11,830	40,343	80,561	126,732	165,213	182,258
Ohio	. .	. .	. .	. .	0	3
Michigan	. .	. .	24	. .	32	. .
Indiana	. .	135	237	190	0	3
Illinois	. .	. .	168	917	*747	331
Missouri	. .	. .	3,011	10,222	25,081	58.240
District of Columbia	. .	3,244	5,395	6,377	6,119	4,694
Florida Territory	. .	. .	. .	. .	15,501	25,717
Wisconsin do.	. .	. .	. .	. .	. .	11
Iowa do.	. .	. .	. .	. .	. .	16
Total	697,897	893,041	1,191,364	1,538,064	2,009,031	2,487,113

* Not slaves, but " indented coloured servants."

PORCELAIN.

Porcelain.

Porcelain, in its more general signification, comprehends all kinds of earthen ware, which are white, semitransparent, and have some degree of a vitreous texture. Hence, in this extensive meaning of the term, it includes all kinds of pottery, stoneware, delft ware, &c. But in a more limited sense, the word *Porcelain* is employed to denote only the finer kinds of earthen ware; and because this kind of ware has been, from time immemorial, manufactured in the greatest degree of perfection in China, it has obtained the name of *Chinese Porcelain*, or *China Ware*.

Derivation of the name.

In the Chinese language, porcelain is denoted by the word *tse-ki*, so that the derivation of the term is not to be sought for in that language; and hence it is supposed to be of European extraction, and to be derived from the Portuguese, in which language the word *porcellano* signifies a cup or vessel.

Porcelain first brought from Japan and China.

The first porcelain which was seen in Europe was brought from Japan and China. Its whiteness, transparency, and fineness of texture, with its elegance and beautiful colours, soon introduced it as an ornament of the tables of the rich and powerful, whilst, at the same time, it excited the admiration and industry of the European manufacturer. Attempts were accordingly made to imitate this kind of ware, in different countries of Europe. The first European porcelains were made in Saxony. The manufacture was afterwards introduced into France, and successively into England, Germany, and Italy, where it has arrived at various degrees of perfection, according to the nature of the materials which can be obtained, and the industry and ingenuity of the artist who superintends and directs it. But after all, to whatever degree of perfection the manufacture of this ware has attained in Europe, it must still yield, in excellence and perfection, to the porcelain of eastern countries.

Antiquity of the Chinese manufacture.

Of the antiquity of the manufacture of porcelain in China, little precise information can be expected from a people who have always shown themselves so extremely averse to the freedom of intercourse with other nations. But it is said that the village or town of King-te-ching has furnished the emperors of China with porcelain since the year 442 of the Christian era; and that it is an object of so much attention to the Chinese government, that the manufacture is carried on under the superintendence of one or two mandarins sent from court.

1. *History of the Manufacture of Porcelain in China.*

The fullest account which has as yet been received in Europe of the manufacture of Chinese porcelain, has been given by Father D'Entrecolles, a Catholic missionary, who lived for some time in the village or town where the principal manufactory was established. The account which has been given by the Jesuit of this village, and of the manufacture of porcelain, is extremely interesting.

This village or town, which is celebrated as producing the best porcelain of China, is in the province of Kiang-si, and is said to be a league and a half in length, containing not less than 1,000,000 of inhabitants. Other manufactories, indeed, have been established in different parts of the Chinese empire, and particularly in those places which are convenient for the European trade, as in the provinces of Fo-kien and Canton; but the porcelain produced at these is said to be held in inferior estimation. A Chinese emperor wishing to have a manufacture of porcelain under his own inspection at Pekin, ordered workmen to be collected for the purpose, with all the necessary materials and implements; but after erecting furnaces and other expensive operations, the attempt failed, so that, in the time of D'Entrecolles, King-te-tching continued to be the most celebrated place in China for beautiful porcelain; and from this it was transported to all parts of the world.

Materials employed in its composition.

The chief ingredients which enter into the composition of fine porcelain are petuntse and kaolin, two kinds of earth from the mixture of which the paste is obtained. The petuntse is of a pure white, and, when fully prepared, is in the form of an impalpable powder, so that it is very fine to the touch. The kaolin, he observes, is intermixed with small shining particles. These materials are carried to the manufactory in the shape of bricks. The petuntse originally consists of the fragments of rock dug out from certain quarries, and reduced to powder; and the colour of the stone which answers the purpose best, according to the Chinese, inclines somewhat to green. The fragments of rock are broken to pieces with a large iron club; they are then put into mortars, and by means of levers headed with hard stone, strongly secured with iron, they are reduced to the state of fine powder. The levers, it is scarcely necessary to observe, are moved either by the labour of men, or by water. The powder, which is afterwards collected, is then thrown into a large vessel full of water, which is strongly agitated with an iron shovel. When this mixture has been allowed to settle for some time, a substance resembling cream rises to the top, which is skimmed off, and poured into another vessel also filled with water. The water in the first vessel is again agitated, and the frothy substance which rises to the surface is collected as before, and the same operation is repeated till it appear that nothing remains but a coarse sediment which falls to the bottom by its own weight. This sediment is then carefully collected, and again subjected to the process of pulverization.

The fluid in the second vessel is allowed to remain at rest till a sediment is produced, forming a kind of crust at the bottom; and when the water above seems to be quite transparent, it is poured off by gently inclining the vessel, that the sediment may not be disturbed. The paste is then put into large moulds, and allowed to dry slowly; but before it becomes quite hard, it is divided into small square cakes, which are sold by the hundred. This is the substance which is called by the Chinese *petuntse*, and the name is said to be derived from the colour and form of this paste.

The kaolin, the other substance which is employed in the fabrication of porcelain, requires fewer operations in its preparation than the former, as it is found in nature in a state almost ready for the manufacturer. Of this substance it is said, that there are extensive mines in certain mountains, the external strata of which are composed of a kind of red earth. The kaolin is found in these mines in small lumps, and it is formed into bricks by being subjected to a similar process with the petuntse.

Nature of the finer porcelain.

The fine porcelain, it has been observed, derives its fabric and texture from the kaolin. It is to this that the qualities which it possesses of resisting the most powerful heat is owing; whilst its strength and consistency is obtained by fusion with the petuntse, which enables it to resist the action of the more powerful agents. D'Entrecolles relates an anecdote which he received from a rich Chinese merchant, that the English and Dutch having purchased a quantity of petuntse, conveyed it to Europe for the purpose of manufacturing porcelain; but having procured none of the kaolin, the attempt failed. They wanted, added the Chinese with a smile, to form a body, the flesh of which would support itself without bones.

Substitute for kaolin.

It is said that the Chinese have latterly discovered a new substance which may be employed in the composition of porcelain. This stone is called *hoa-chè*, the first part of the word signifying glutinous, because it is of a saponaceous quality. Porcelain made with this substance is very rare, and bears a much higher price than any other. The grain is extremely fine, and the painting with which it is ornamented, when compared with that of common porcelain, appears to exceed it as much as vellum surpasses paper. This variety of porcelain, it is added, is also remarkable for its lightness. It is besides much more brittle, and it is found very difficult to hit upon the proper degree of heat for tempering it. This substance, we are farther informed, is but rarely employed in the fabrication of the body of the porcelain; the reason of which perhaps is, the scarcity and high price of this precious article, in consequence of which the workman is contented with making it into a fine size, into which the vessel is immersed when it is dry, that it may receive a coat before it is painted and glazed; and by this process he finds that he can commmunicate to the ware a very high degree of beauty. The previous processes employed in the preparation of this substance are similar to those which are followed in the preparation of kaolin. When hoa-chè is extracted from the mine, it is washed in rain or river water, for the purpose of separating a yellowish earth with which it is contaminated. It is then reduced to powder, thrown into a vessel filled with water, and then formed into cakes. The hoa-chè prepared in this manner, without the addition of any other earth, is said to be alone sufficient in the fabrication of porcelain. It is employed, as has already been noticed, as a substitute for kaolin; but, on account of its scarcity, it is much dearer. The price of the former is three times that of the latter, and from this circumstance the value of porcelain made with hoa-chè is much higher than that which is manufactured with kaolin.

Material for glazing porcelain.

The principal ingredients in the fabrication of porcelain are petuntse and kaolin; but to these must be added the glaze or varnish, or, as it is called in the account given of Chinese porcelain, the oil, on which depend its splendour and whiteness. This varnish is of a whitish colour, and is obtained from the same kind of stone which yields the petuntse; but for this purpose the whitest stone is always preferred. The glaze is obtained by a process similar to that which is followed in the preparation of petuntse. The stone is first washed and reduced to powder; it is then thrown into a vessel filled with water, and after being purified, a frothy matter rises to the surface. To 100 pounds of this matter, one pound of a substance called che-kao, is added. This latter is a saline substance, somewhat like alum, which is put into the fire, and allowed to remain till it become red hot, when it is reduced to powder. By the addition of this substance the glaze acquires a greater degree of consistence; but at the same time a proper degree of fluidity must be preserved. The glaze prepared in this manner is not employed alone. Another glaze is mixed with it, which is obtained from lime and ashes; to 100 pounds weight of which is also added one pound of che-kao, or the aluminous substance mentioned above. When the two substances are mixed, it is necessary to attend that they be nearly of the same consistence, and the workman ascertains this point by dipping into each of them some cakes of petuntse; and by a close examination of their surfaces after they are drawn out, he is able to judge of the consistence of the fluids. The proportions of the two which are usually employed, are ten parts of the glaze obtained from the stone, to one of that which is prepared from the lime and from ashes.

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In the manufacture of the Chinese porcelain, the first process, after the separate preparation of the materials, is a second purification of the petuntse and kaolin; and when these are found to be in a state of sufficient purity, the workmen proceed to mix the two ingredients together. The proportions employed for the finer kinds of porcelain are equal parts of kaolin and petuntse; for an inferior kind, four parts of kaolin to six of petuntse are employed; and in some kinds of porcelain, only one part of the former is added to three of the latter. This is the smallest proportion of kaolin which is employed in the Chinese manufactories. When the proportions are fixed, and the mixture finished, the mass is thrown into a large pit, which is well paved and cemented. It is then trodden upon, and kneaded till it become hard. This is the most fatiguing part of the labour, for it must be continued without intermission. From the mass prepared in this manner the workmen detach different pieces, which they spread out upon large slates, where they knead and roll them in all directions, taking care that no vacuum be left, and that there be no intermixture of any foreign body. The whole work would be entirely spoiled by the addition of a hair, or a particle of sand. When the paste has been properly prepared, the porcelain, when exposed to heat in the furnace, retains its form without becoming soft, or entering into fusion, and becomes semitransparent, without exhibiting cracks or superficial fissures; but when there is any defect in the mixture or preparation, the porcelain cracks, and becomes warped, or melts in the furnace.

Methods of forming porcelain ware.

The paste being thus prepared, the next operation is to form the vessels for which it is designed. All kinds of plain ware are formed with the wheel. When a cup, for instance, has undergone this operation, the outside of the bottom is quite round. The workman first gives it the requisite height and diameter, and it comes from his hands almost the moment he has received it. Great dexterity and expedition are absolutely necessary, on account of the low price of labour in these manufactories. A workman, it is said, scarcely receives a farthing per board, each board containing no less than twenty-six pieces. The cup then passes to a second workman, by whom the base is formed; after which it is delivered to a third, who applies it to the mould, and gives it the proper form. When it is taken off the mould, it must be carefully turned, and not pressed more to one side than the other; for without this necessary precaution it would become warped or disfigured. The business of the fourth workman is to polish it with the chisel, especially round the edges, and diminish the thickness, in order to give it the proper degree of transparency. Having at length passed through the different hands from whom it receives its form and various ornaments, it then comes to the last workman, who forms the bottom with a chisel. It is wonderful, we are told, to see with how much dexterity and expedition the workmen convey the vessels from one to another; and it is added, that a single piece of porcelain, before it is completely finished, must pass through the hands of no fewer than seventy different workmen. It is indeed, we may observe, to this minute division of labour that its low price is owing; and on the same circumstance depend the remarkable dexterity and expedition which have already been noticed.

Of large works.

In the execution of large works of porcelain, different parts are first formed individually; and when all the pieces are finished, and nearly dry, they are put together and cemented with a paste formed of the same substance, and softened with water. Some time afterwards the seams are polished with a knife on both sides of the vessel, so that when it is covered with a varnish, or glazed, they are so completely concealed, that the least trace of them is not perceptible. It is in this way that spouts, handles, rings, and other parts of a similar nature, are united. And in this way, particularly are fabricated those pieces which are formed upon moulds, or by the hand, such as embossed works, grotesque images, idols, figures of trees or animals, and busts. All these are formed of four or five pieces joined together, which are afterwards brought to perfection by means of instruments proper for carving, polishing, and finishing the different traces which the mould has left imperfect. Flowers and ornaments which are not in relief, are either engraved, or the impression is made by means of a stamp; but ornaments in relief are prepared separately, and added to the pieces of porcelain to which they are destined.

ainting.

The piece of porcelain being prepared according to the operations now described, is next conveyed to the painter; and in this art it is to be observed that the Chinese workmen follow no certain rule, and seem to be unacquainted with any of the principles of perspective. Their knowledge is the effect of practice, guided often by a whimsical imagination. The labour of painting porcelain in the Chinese manufactories is also divided amongst a great number of hands. The business of one man, for instance, is solely limited to the tracing out the first coloured circle with which the brim of the vessel is adorned; another designs the flowers, and a third paints them. One delineates waters and mountains, whilst it is the province of another to draw and paint birds and other animals. Of the painting on Chinese porcelain, it has been observed, that the human figure is often most indifferently executed.

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A peculiar kind of glaze or varnish, we are informed, is obtained from white flint. This glaze, it is said, has the singular property of making the pieces of porcelain to which it is applied exhibit the appearance of veins distributed in all directions. Vessels glazed with this material seem as if the surface were cracked, without the fragments being separated or displaced. The colour of this glaze is whitish gray; and when it is applied to porcelain having an azure blue ground, it communicates a beautifully-variegated appearance. Vases of Chinese porcelain are sometimes fabricated in a different manner. They are ornamented with a kind of fret-work, which has something of the appearance of fine lace, in the middle of which is placed a cup proper for holding any liquid; which constitutes one body with the surrounding fret-work.

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We are informed that the Chinese workmen formerly possessed the secret of fabricating a kind of porcelain of a much more singular nature. On the sides of the vessel thus formed were painted the figures of fishes, insects, and other animals, which could not be seen unless the vessel was filled with water. It is said that this secret is in a great measure lost; but the following is given as part of the process of preparing this kind of porcelain. The vessel which is to be painted, for the purpose of producing this peculiar effect, must be extremely thin and delicate. When it is dry, the colour is laid on, not upon the outside, however, as is usually the case, but upon the inside of the vessel; and it is laid on pretty thickly. The figures which are painted upon it are usually fishes, as being more characteristic of the element in which they live. When the colour is perfectly dry, it is then coated over with a kind of glaze, composed of porcelain earth, so that the azure is thus enclosed between two layers of earthy matter; and when the glaze becomes dry, the workman pours some oil into the vessel, and putting it upon a mould, applies it to the lathe. Porcelain fabricated in this manner, having received its consistence and body within, it is the object of the workmen to make it as thin as possible on the outside, without penetrating to the colour. The external surface is then dipped into a mixture for glazing, and when it is dry it is baked in a common furnace. This kind of porcelain is known by the name of *kia-tsing*, signifying pressed azure. It is supposed that the Chinese do not at present possess the art of making porcelain of this description, which requires a great deal of dexterity and delicate management; and it is added, that they have imperfectly succeeded in the attempts which have been occasionally made to discover the secret of this curious process.

Chinese furnaces.

The next process in the manufacture of porcelain is baking; but before we describe the method of arranging and managing the furnaces employed for this purpose, we shall give a short account of their construction. The Chinese furnaces for baking porcelain are furnished with a long porch, for the purpose of conveying air, and in some measure as a substitute for bellows. This porch answers the same purpose as the arch of a glass-house; but the furnaces which, as the author from whom the account is taken observes, were formerly only six feet in height, and the same in length, are now constructed upon a much more extensive plan. They are twelve feet in height, and nearly four in breadth; and the roof and sides are so thick, that the powerful heat which is applied internally does not penetrate to the outside, at least so much as to be inconvenient to bear it on the application of the hand. The dome or roof is in the form of an inverted funnel, having a large aperture at the top by which the smoke escapes. Beside the principal aperture, there are five others of smaller dimensions, which are covered with broken pots in such a manner that the workman can increase or diminish the heat as he finds it necessary. Through these apertures also he is able to see the progress of the baking of the porcelain, and can judge when it is completed. By uncovering the hole which is nearest the principal opening, he opens with a pair of pincers one of the cases containing the pieces of porcelain, and if he perceives a bright fire in the furnace, and all the pieces brought to a red heat, as well as the colours of the porcelain appearing with a full lustre, he concludes that the process is finished. He then diminishes the fire, and entirely shuts up the mouth of the furnace for some time. In the bottom of the furnace there is a deep hearth about two feet in breadth, over which a plank is laid, in order that the workmen may enter to arrange the porcelain. When the fire is kindled on the hearth, the mouth of the furnace is immediately closed up, and an aperture is left only sufficient for the admission of faggots, about a foot in length, but very narrow. The furnace is first heated for a day and a night, after which two men keep continually throwing wood into it, and relieve each other by turns. One hundred and eighty loads are consumed for one baking. As the porcelain is burning hot, the workman employs for the purpose of taking it out, long scarfs or pieces of cloth, which are suspended from his neck.

Method of baking porcelain.

Having thus given a concise account of the construction of the Chinese furnaces, we proceed now to lay before our readers an account of the method of baking porcelain which is followed in that country. After the porcelain has received its proper form, its colours, and all the intended ornaments, it is transported from the manufactory to the furnace, which is sometimes situated at the other end of the village already mentioned. In a kind of portico, which is erected before it, may be seen vast numbers of boxes and cases made of earth, for the purpose of inclosing the porcelain. Each piece, however inconsiderable it may be, has its own case; and the Chinese workman, by means of this procedure, imitates nature, which, in order to bring the fruits of the earth to maturity, clothes them in a covering, to defend them from the excessive heat of the sun during the day, and from the severity of the cold during the night.

A layer of fine sand is put into the bottom of these boxes, which is covered over with the powder of kaolin, to prevent the sand from adhering too closely to the bottom of the vessel. The piece of porcelain is then placed upon this bed of sand, and pressed gently down, in order that the sand may take the form of the bottom of the vessel, which does not touch the sides of its case; but the case has no cover.

A second, prepared in the same manner, and containing its vessel, is fitted into the first, so that it entirely shuts it, without touching the porcelain which is below; and thus the furnace is filled up with piles of cases, which defend the pieces they contain from the direct action of the fire.

With regard to small pieces of porcelain, such as tea-cups, they are inclosed in common cases about four inches in height. Each piece is placed upon a saucer of earth about twice as thick as a crown piece, and equal in breadth to its bottom. These small cases are also sprinkled over with the dust of the kaolin. When the cases are large, the porcelain is not placed in the middle, because it would be too far removed from the sides, and consequently from the action of the fire.

These piles of cases are put into the furnace, and placed upon a bed of coarse sand six inches in thickness; those by which the middle space is occupied are at least seven feet in height. The two boxes which are at the bottom of each pile remain empty, because the fire acts too feebly upon them, and because they are partly covered by the sand. For the same reason, the case which is placed at the top of each pile is also allowed to remain empty. The piles containing the finest porcelain are placed in the middle part of the furnace; the coarsest are put at its farthest extremity; and those pieces which have the most body and strongest colouring are near its mouth. These different piles are placed very closely in the furnace; and they materially support each other by pieces of earth, which bind them at the top, bottom, and middle, but in such a manner, that a free passage is left for the flame to insinuate itself everywhere around them.

Different kinds of porcelain.

The Chinese divide their porcelain into several kinds or classes, distinguishing each according to the different degrees of beauty and fineness. The whole of the first or most perfect kind is reserved for the emperor; none of it, we are assured, ever comes into the hands of the public, unless, on account of blemishes or imperfections, it is unworthy of being presented to the sovereign. Many have doubted whether at any time the largest and finest porcelain of China has ever been brought to Europe. None of that kind, at least, is offered for sale at Canton. The Chinese, who are apt to undervalue the productions of other countries, entertain a favourable opinion of the Dresden porcelain, and hold in still higher estimation the porcelain which is produced in the French manufactories.

Sir George Staunton's account of the manufacture of porcelain in China.

The following is a short account of the Chinese porcelain manufactures by Sir George Staunton. "From the river," says he, "were seen several excavations made in extracting from the sides of the adjoining hills, the petuntse useful in the manufacture of porcelain. This material is a species of fine granite, or compound of quartz, feldspar, and mica, in which the quartz seems to bear the largest proportion. It appears from several experiments, that it is the same as the growan stone of the Cornish miners. The micaceous part, in some of this granite from both countries, often contains some particles of iron, in which case it will not answer the potter's purpose. This material can be calcined and ground much finer by the improved mills of England, than by the very imperfect machinery of the Chinese, and at a cheaper rate than the prepared petuntse of their own country, notwithstanding the cheapness of labour there.

"The kaolin, or principal matter mixed with the petuntse, is the growan clay also of the Cornish miners. The whashe of the Chinese is the English soap-rock; and the shekan is asserted to be gypsum. It was related by a Chinese manufacturer of that article, that the asbestos, or incombustible fossil stone, entered also into the composition of porcelain. A village, or unwalled town, called Kin-te-chin, was not very far distant from this part of the present traveller's route, in which 3000 furnaces for baking porcelain were said to be lighted at a time, and gave to the place at night the appearance of a town on fire. The genius or spirit of that element is indeed, with some propriety, the principal deity worshipped there. The manufacture of porcelain is said to be precarious, from the want of some precise method of ascertaining and regulating the heat within the furnaces, in consequence of which their whole contents are baked sometimes into one solid and useless mass. Mr. Wedgwood's thermometer, founded on the quality observed by him, of clay contracting in proportion to the degree of fire to which it is exposed, might certainly be of use to a Chinese potter."

2. *Inquiries of Reaumur into the Nature of Porcelain.*

Compos- tion of p celain ex mined.

The first scientific investigation which was made into the nature of porcelain, was undertaken by the celebrated Reaumur; and the result of his researches was communicated to the French Academy of Sciences in the years 1727 and 1729. It was not the external form or appearance, nor was it the decorations of painting and gilding, which are by no means essential to porcelain, that constituted the object of his inquiries. His examination was particularly directed to the peculiar texture and fabric of this substance, with the view of ascertaining the nature and proportions of its constituent parts. For this purpose, he broke to pieces some of the Japanese, the Saxon, and the French porcelains, and carfully noted the peculiarities and differences in their texture. The grain or texture of the Japanese porcelain appeared to possess a considerable degree of closeness and compactness, with a smooth and somewhat shining aspect. He found that the Saxon porcelain was still more compact, and that it was smooth, and shining like enamel, but had nothing whatever of the granular texture. In his examination of the French porcelain, he observed that it had much of the shining appearance, and that its grain was not so close and fine as that of the oriental porcelain, having some resemblance to the grain or texture of sugar. Such were the observations which occurred to the French philosopher at the commencement of his inquiries into the nature of porcelains; and hence he justly concluded, that they were characterised by very marked differences.

Effects o heat on porcelain

Proceeding in his investigation, the same philosopher subjected different porcelains to the action of heat; and the result of his experiments with this powerful agent proved, that they might be distinguished by still more decisive characters. It appeared that the porcelain of the East suffered no change from the action of the greatest heat, whereas that of European manufacture underwent fusion at no very high temperature. This remarkable difference between the Chinese and European porcelains, suggested to Reaumur an ingenious thought, which at last led him to the discovery of the true nature of the composition of porcelain. Having observed that all porcelains have some resemblance to glass in some of their general properties, although they are less compact, he considered them as in the state of a semi-vitrified substance. An earthy substance, he observed, may be in a semi-vitrified state in two ways. It may, in the first place, be entirely composed of vitrifiable or fusible matters; and this being the case, when it is exposed to the action of fire, provided the heat be sufficiently strong and long continued, it will be melted or vitrified. But as this change is not effected instantly, particularly where a violent degree of heat is not applied; and as it passes through different degrees, the progress of which may be more easily observed, according as the heat is managed and regulated, it followed, that by stopping in proper time the application of the heat to porcelain prepared in this way, the ware may be obtained in an intermediate state between those of crude earths and completely vitrified substances; whilst, at the same time, it possesses the semitransparency and other distinguishing properties of porcelain. Porcelain of this nature, it is well known, being exposed to a stronger degree of heat, undergoes perfect fusion and complete vitrification. All the European porcelains which were subjected to experiment by Reaumur, were found to be of this fusible nature.

Porcelain composed of fusible and infusible matter.

But on the other hand, porcelain may be composed of fusible or vitrifiable matter, mixed in certain proportions with another matter, which is absolutely infusible in the strongest heat to which it can be exposed in the furnace; and hence, if a mixture of this kind be subjected to a heat sufficient to melt entirely the vitrifiable part of its composition, this will enter into fusion; but being mixed with another matter which is infusible, and which consequently retains its consistency and opacity, the whole will form a compound, partly opaque, and partly transparent, or, in other words, a semitransparent mass; that is, a semivitrified substance, or porcelain, but possessing qualities totally distinct from those of the former. For as the fusible part of the latter has been brought to its utmost degree of fusibility during the process of baking, although the compound may be exposed a second time to a still stronger degree of heat, it will not approach nearer to complete vitrification, that is, it will retain all the qualities of perfect porcelain. Reaumur found that the porcelain of the East was distinguished by the properties now described; and hence he concluded, that its component parts were arranged upon the principle above mentioned. This opinion was afterwards confirmed by incontrovertible facts, deduced from a train of the most satisfactory and well directed experiments.

Kaolin infusible, and petuntse a vitrifiable matter.

The ingredients which enter into the composition of the Chinese porcelain, namely, the petuntse and kaolin, were the next object of Reaumur's inquiries. Having obtained quantities of each, he subjected them separately to a strong heat, and he found that the petuntse entered into fusion, without addition; but it appeared that the kaolin was absolutely infusible. He then mixed the two ingredients, formed into cakes, and exposed them in a furnace to the proper degree of heat; so that by baking they were converted into porcelain exactly similar to that of the Chinese. From these experiments it appeared, that the petuntse of the Chinese was a vitrifiable substance, and that the kaolin was of a different nature, quite refractory, and totally infusible. After this discovery, Reaumur, it would seem, entertained hopes that he might find materials in France, capable of making porcelain, which should possess the same valuable qualities as that of China; but whether his researches in the discovery of proper materials in his own country, particularly that which corresponds to the petuntse of the Chinese, were baffled, or whether he was prevented by other avocations from prosecuting his inquiries, does not appear. In his second memoir upon porcelain, however, we find, that he afterwards attempted to compose an artificial petuntse, by mixing vitrifiable stones with such saline bodies as were capable of rendering them fusible, or even by substituting for this artificial preparation glass ready formed, with the addition of such matters as he supposed might be successfully employed in the place of kaolin. But it would appear that he did not at the time prosecute his inquiries; for the subject was not resumed until the year 1739, when he announced the discovery of a process for converting common glass into a peculiar kind of porcelain, which has been since known by the name of *Reaumur's porcelain.*

Mistakes of Reaumur.

Although it must appear, from the detail now given, that Reaumur was directed in his researches by the true spirit of philosophical inquiry, he seems to have been misled in certain points. One of his errors was relative to the Saxon porcelain, which he confounded with the other fusible porcelains of European manufacture, unless it be supposed that the porcelain of Saxony was formerly composed of entirely fusible or vitrifiable matters, and that it was porcelain of this description which he examined; for it is now certain, that all the porcelain of that country is capable of resisting the most powerful heat, and is therefore equally infusible with that of China or Japan. The appearance of the internal texture of the Saxon porcelain may perhaps have led the philosopher to this erroneous conclusion; for when it is broken, the internal surface does not exhibit a granular texture, but is uniform, smooth, shining, and compact, having a great resemblance to white enamel. This appearance, however, so far from proving that the porcelain of Saxony is a fused or vitrified substance, shews that it is not entirely composed of fusible matters. The internal surface of the most fusible porcelains, it is well known to those who are acquainted with the subject, is also the least dense, and the least compact; for no vitreous matter can be internally smooth and dense, without having been in a state of complete fusion.

The Saxon, like every other porcelain, especially that of China and Japan, contains a fusible substance, which has been in a state of complete fusion during the process of baking. The density and the internal lustre depend chiefly on this fused matter; but it is also certain, that the Saxon porcelain contains a large proportion of a substance which is absolutely infusible, and from which it derives its beautiful white appearance, its firmness and solidity, during the process of baking. It is this infusible substance which is to be considered as the substitute for the kaolin of China, and which possesses the property of contracting its dimensions, whilst it unites with the fusible material. The Saxon porcelain, therefore, is not to be confounded with porcelain manufactured with vitreous and fusible material; for it seems to be equally excellent as that of Japan, and in some of its properties perhaps superior, as will appear from an examination of the qualities which constitute the peculiar excellence of porcelain.

Reaumur seems likewise to have taken an erroneous view of the nature of the Chinese kaolin. According to his account, this matter is a fine talcky powder, from the mixture of which with petuntse, the porcelain of the East is manufactured. It is not impossible, as has been observed, that a porcelain similar to the Chinese might be produced from a talcky substance of this nature mixed with petuntse; but it is well known to those who are at all familiar with the manufacture of any porcelain, that no vessels can be formed, unless the paste of which they are made possess that degree of ductility and tenacity which renders them fit for being worked upon the lathe, or fashioned in the mould. But substances of a talcky nature, to whatever degree of fineness they may be reduced, never acquire the requisite ductility and tenacity which clays of all earthy substances only possess. But as it appears that the Chinese porcelain has been turned upon the lathe, it is obvious that they must have been formed of a very tenacious paste; and hence it is concluded, that kaolin is not purely a talcky matter, but an infusible clay, which, with the petuntse, a fusible material, forms the ingredients which enter into the composition of Chinese porcelain.

3. *Peculiar Properties of Porcelain.*

Essential qualities of porcelain.

It may be worth while now to consider what are the properties which constitute the perfection of porcelain; and here it is necessary carefully to discriminate between the qualities which are to be regarded as only contributing to the external decoration, and the intrinsic and essential properties in which the fabric and perfection of porcelain consist. Those who have been occupied in experiments upon this subject, have not found it difficult to form compositions which are very white, beautifully semi-transparent, and covered with a shining glazing, but which are extremely deficient in the more essential properties. It appears, indeed, that they cannot be subjected to the necessary operations in first forming the ware, for want of a proper degree of tenacity, that they are not sufficiently compact, and are quite fusible, subject to break by the sudden application of heat or cold, and from the softness of the glazing, which cracks and becomes rough, are soon deprived of their lustre. On the other hand, it is by no means difficult to form compositions of pastes, which are very tenacious, and which are capable of being easily worked and well baked, and in the process of baking which acquire the requisite degree of hardness and density; which are infusible, and capable of resisting the effects of sudden changes of heat and cold; and which, in short, possess all the qualities of the most excellent porcelain, excepting its whiteness and transparency. Materials fit for the composition of such porcelains, it will appear, may be found in abundance in most countries; but those fit for the manufacture of the finer and more perfect porcelains, seem to be sparing productions of nature; and therefore the best kind of porcelain, it is presumed, will always be regarded as a valuable and high-priced commodity.

Nature of stoneware.

It may be observed that the potteries called *stoneware*, such as the brown made at Lambeth and some other places, and the white formerly made at Burslem in Staffordshire, which were glazed by salt, or muriate of soda, being thrown into the furnace when in a state of high fusion, possess all the essential qualities of the Japanese porcelain; for, excepting the whiteness, on which alone the semitransparency depends, if we compare the properties of the Japanese porcelain with those of our stoneware, little difference is found to exist between them. Both seem to possess the same granular texture; both have the same sonorous quality, when struck with a hard body; both have the same density; they possess also the same hardness, by which they strike fire with steel; they can resist the effects of the heat of boiling liquors without breaking, and are equally infusible when subjected to the most violent heat. Hence it is inferred, that if the earth which enters into the composition of stoneware, were free from foreign colouring matters, which prevent the whiteness and semitransparency, and if the vessels were carefully formed and covered with a very fine glaze, they would not be less perfect than the porcelain of the East. (See POTTERY.) Earths fit for the production of the more perfect kinds of porcelain are supposed to be more rare in Europe than in Japan and China; and hence probably it has happened, that, from the want of these earths, the first manufacturers of the porcelain in Europe confined themselves to an external imitation, by employing only vitrifiable matters with fusible salts, and small quantity of white earth, of which fusible and vitreous porcelains were composed.

One of the most valuable qualities of porcelain is the property of resisting sudden alternations of heat and cold, in which the European porcelain exceeds that of China or Japan. The quality of porcelain, it is to be observed, is not to be judged of by a slight trial; for as numerous circumstances concur to render a piece of porcelain capable or incapable of resisting the effects of heat or cold, boiling water may be at the same time poured into two vessels, one of which is good porcelain, and the other of an opposite quality, it is not impossible that the former may break, and the latter may remain entire. The true method of discovering what is good porcelain, is to examine several pieces which are in daily use; and it has been found, that in many pieces of porcelain of oriental manufacture, which have been long used, cracks are seen in the direction of their height, which are never perceived in the more perfect porcelains of European manufacture.

Japanese porcelain formerly reckoned the most perfect.

It has long been a very general opinion, that the Japanese porcelain is the most perfect; it has indeed continued to be the object of admiration and emulation, and has been held up as a model for the European manufacturer. But the taste of Europeans having required a porcelain possessing the qualities of transparency and whiteness in a greater degree than that of Japan, the attempts to imitate it have been mostly confined to experiments. It has therefore been erroneously contended that an article equal to the Japan porcelain cannot be produced in Europe. The Saxon porcelain has been considered as inferior to the Japanese, on account of its greater smoothness, lustre, and less granular aspect of its internal texture; qualities in which it ought really to be regarded as superior to the porcelain from Japan.

4. *Porcelain Manufactories in different parts of Europe.*

Manufactories of porcelain have been long established in almost every country of Europe, but from the experiments of Reaumur it would appear that the only kind then manufactured was the soft porcelain, or *porcelaine tendre*. It has been seen that the Saxon manufacturers charged him with mistake in classing theirs with the soft porcelain; but by admitting that he might have operated upon an article formerly made by them, it is proved that all European porcelain was originally of this kind. Besides that of Saxony, which was the first established in Europe, porcelain is made to a considerable extent at Vienna, at Frankendal, in the neighbourhood of Berlin, and in other places in the German states. The German porcelains are similar to those of Saxony, and are composed of similar materials, although from certain differences in the proportions, or in the modes of managing the manufactories, considerable differences arise in the porcelains manufactured at different places. When M. de la Condamine travelled into Italy, he visited a manufacture of porcelain established at Florence by the Marquis de la Ginor, who was at that time governor of Livorno. The French traveller was particularly struck with the large size of some of the pieces of this porcelain. Statues, and even groups of figures half as large as nature, and modelled from some of the finest antiques, were formed of it. The furnaces, he observed, in which the porcelain was subjected to the process of baking, were constructed with a great deal of ingenuity, and were lined with bricks made of the same materials as those which entered into the composition of the porcelain itself; and hence they were able to resist the effects of high degrees of heat. The paste of the porcelain manufactured at Florence appeared to be extremely beautiful, and to possess all the qualities of the best oriental porcelain. The glazing employed in this manufactory seemed to be inferior in whiteness, a circumstance which is supposed to be owing to the desire of using those materials only which are found in the country.

Manufactures of porcelain in France.

It must be allowed that the labours of the French have been crowned with wonderful success in the improvement and perfection of this manufacture. Some time before even Reaumur communicated the result of his inquiries, porcelain was manufactured at St. Cloud, and also in the suburb of St. Antoine at Paris. This porcelain indeed was of the vitreous or fusible kind, but at the same time it possessed no inconsiderable degree of beauty. Since the period to which we allude, extensive manufactories of porcelain have been established at Villeroy, Chantilly, and Orleans, and at those places the manufacture has been brought to a high degree of perfection. But the great seat of the manufacture is now in the Limousin, where the raw materials are found, and whence the porcelain in a white state is sent to Paris and other places on the continent, to be ornamented. The productions of the celebrated royal porcelain manufactory at Sèvres, near Paris, on account of the pure shining white, the fine glazing and coloured grounds, the splendour and magnificence of the gilding, and the elegance and taste displayed in the shape and figures, are universally allowed to surpass every thing of the kind which has yet appeared. It must be remarked, however, that this manufactory at Sèvres, wherein the "*porcelain dure*" is produced in so great a degree of perfection, is not carried on with a view to profit, but has received occasional grants of money from the government, as a national concern.

In speaking of the French porcelain, we may notice the result of some researches which were made on this subject by Guettard, and of which an account appeared in the Memoirs of the Academy of Sciences, for the year 1765. In the neighbourhood of Alençon, M. Guettard discovered a whitish argillaceous earth, in which he found that mica considerably predominated. This earth he employed as a substitute for kaolin. The substance which he used instead of the petuntse, he obtained from a hard stone, which is described as a quartzose gritt stone, very abundant in that country, and with which the streets of Alençon are paved. With these materials Guettard instituted a series of experiments on porcelain, previously to the year 1751, and was associated in his inquiries with the Duke of Orleans. For many years the Count de Lauraguais, a member of the Academy of Sciences, was keenly engaged in prosecuting experiments to discover the true nature of porcelain, and the means by which the manufacture might be improved and perfected. To obtain the object of his researches, which was to produce porcelain that in its essential qualities might be equal to that of eastern countries, he spared no trouble or expense; and it would appear that he was not unsuccessful in his labours; for in the year 1766, when he exhibited some species of porcelain from his manufactory to the members of the Academy of Sciences, the persons who were appointed by that learned body to examine their properties, delivered it as their opinion, that of all the porcelain made in France, that of the Count de Lauraguais approached most nearly in the essential properties of solidity, texture, and infusibility, to that of China and Japan. It is said, however, that it was considerably deficient in whiteness and lustre, when compared with the ancient porcelain of Japan. The great interest, however, created in France in support of this elegant and useful fabric, the continued experiments of the ablest chemists and scientific men, with the discovery of better materials which are abundant in the South of France, gave to that country facilities which enabled her soon to take the lead of the continent and of Britain in the production of this article.

Manufactory at Tournay.

Porcelain manufactories have long been established at Tournay in Flanders. One of these manufactories furnishes all Flanders with blue and white porcelain. At this manufactory they have a particular process in forming cups and other vessels. They are neither turned on the lathe, nor is the clay compressed in a mould; but after being diluted in water, and when the liquid has acquired a proper consistency, the workmen pour it into moulds, two or three hundred of which are arranged together. When they have filled them all, they return to the first in the row. The liquid part is drawn off by a gentle inclination; the surplus adheres to the side of the vessel, and thus forms the piece which it is intended to make. The piece is detached from the mould by means of a slight stroke; and after being sufficiently dried, it is conveyed to the furnace, to undergo the process of baking.

In England

In England but little progress was made in the manufacture of porcelain, until towards the end of the last century. At an earlier period there was a manufactory carried on by some Germans at Chelsea, afterwards removed to Derby, of porcelain of a very superior quality; but whence they derived their materials is now uncertain. The porcelain which was then made at Liverpool, and some other places, was of an inferior kind, and manufactured so thin, in order to procure transparency, as to render it in a great degree unserviceable. This porcelain was made of the clays from Devonshire, to which a frit, described hereafter, was added to improve the colour of the body, and to create that degree of transparency which was required by the public as a principal attribute of porcelain.

About the year 1768, the discovery in Cornwall of mines of clay and stone similar to those used in France and Germany, and which are believed to be the kaolin and petuntse of the Chinese, soon enabled the English manufacturer to improve his porcelain, by discontinuing the use of frit, or glass, as a component part of the basis or body of the ware, and substituting a mixture of the fusible and infusible earths as the basis of his porcelain, as had been done, at a much earlier period, in Germany and France. And thus the English porcelain, in many of its essential qualities, particularly in the beauty and richness of its paintings and gildings, as well as the elegance of its forms, has become little, if at all inferior, to that of any other country.

There are in England a number of manufactories of porcelain, at Derby, at Worcester, at Coalbrookdale, and at Rotherham, in Yorkshire. But the principal site of this manufacture is now in the Staffordshire Potteries, where it is produced in large quantities, at various manufactories.

5. *Different Processes in the Manufacture of Porcelain.*

Bases.

The basis of those porcelains which were respectively known by the name of *vitreous*, *fusible*, and *soft* porcelain, was in part composed of what was called a *frit*; that is to say, a mixture of alkalis and siliceous earths, brought into fusion, which, forming an opaque glass, was ground very fine, and mixed with an infusible earth or clay, in quantity sufficient to produce a degree of fusion, and consequent transparency of the whole body, but not so much as to prevent the ductility necessary for the formation of the articles to be made. The basis of the porcelains now generally made is composed of a mixture of infusible and fusible earths, in those proportions which, on the application of intense heat, produce that transparency and semi-vitrification which is required as the distinguishing properties of porcelain.

Manipulation.

Up to a certain point, the operations and manipulations are the same in all cases. The clay or infusible earth having been separated by washing from the mass of decomposed granite, of which it forms a part, is mixed with a portion of the fusible earth, finely livigated into a liquid of the consistence of cream, which, after being passed through the finer silk lawns, is placed on kilns to evaporate the superfluous water, until the mass becomes a soft tenacious paste, ready for the operations of the workman. It is then taken to the thrower, to be fashioned on his wheel; and having obtained a sufficient degree of hardness to preserve its form, is transferred to the lathe to be more correctly shaped, and the surface made even. It next has handles, feet, and other requisites added, and is then ready to receive its first firing. To effect this, it is, when sufficiently dry, put into a case made of earthen ware, and placed in the furnace, that it may be subjected to the process of baking. These cases are known amongst the English potters by the name of *seggars* or *saggars*, and they are generally formed of a coarser kind of clay; but this clay must possess the property of resisting the action of heat necessary for the baking of porcelain, without being fused. The porcelain contained in the cases is thus protected from the smoke of the burning fuel. The whiteness of the porcelain depends greatly on the purity of the clay of which the *saggars* are made, so that being of a more compact texture, the smoke is more effectually excluded. These cases are arranged in the furnace or kiln in piles, one upon the other, to the top of the furnace.

A small fire is first made, that the furnaces may be gradually heated; and it is increased more and more until the process of baking is completed, that is, until the porcelain shall have acquired a proper degree of hardness and transparency. To ascertain this point, much attention is necessary, by taking out of the furnace from time to time, and examining, small pieces of porcelain placed for that purpose in some cases, which have lateral openings in the walls of the furnace to render them accessible. When it appears, from the examination of those pieces, that the porcelain is sufficiently baked, the fire is no longer to be supplied with fuel; the furnace is allowed to cool gradually, and the porcelain is afterwards taken out.

But at this point of the process of baking, or firing, the modes adopted in France, and on the continent generally, are materially different from the practice in this country; in fact, are totally reversed. In England the first, or biscuit firing, is employed to produce, by an intense heat, the required degree of transparency and vitrification; whilst in France but a small degree of heat is applied, sufficient only to harden *(degourdir)* the ware, so that it may bear the manipulation necessary before the glazing, without breaking, the transparency and strength being obtained at the second operation of firing, which, like the English biscuit-firing, requires an intense heat to accomplish that object.

Unglazed porcelain called biscuit.

Unglazed porcelain has the appearance of white marble, having nothing of that shining surface which it acquires by covering it with the vitreous composition called glaze, and is said to be in the state of *biscuit*. For particular purposes, the porcelain is sometimes allowed to remain in this state, and particularly when it is employed in smaller and finer pieces of sculpture, where the fineness of the workmanship and the sharpness of the figures are wished to be preserved, as it is well known that these will be greatly injured by being covered with a coat of glazing. The celebrated manufactory of Sèvres has long been distinguished for figures or small statues, and even for larger works, as ornamental vases, &c., which are left in the state of biscuit. The English manufactories are probably not inferior in the delicacy and accuracy of execution of ornamental productions of this kind.

Method of glazing porcelain.

The next operation in the manufacture of porcelain is the process of glazing. This process consists in covering the porcelain with a thin coat of vitreous or fusible matter, which adds greatly to its beauty, by its lustre or shining appearance. In preparing and applying the materials fit for glazing porcelain, it has been found that the same mixture will not admit of general application; for it appears, that what forms a fine glazing for one kind of porcelain, will not answer the same purpose when applied to another. In the former it may have all the necessary requisites, but in the latter it may crack in many places, may have no lustre, and may contain bubbles, or be apt to scale off. The first thing, then, is to prepare a glaze which shall be suited to the nature of the porcelain for which it is intended. The glazing must be appropriated to each kind of porcelain, that is, to the ingredients which enter into its composition, or to the degree of hardness or density of the ware. The materials of which the glazing is composed are prepared by previously fusing together all the substances of which they consist, and thus forming a vitreous mass. This mass of vitrified matter must be finely ground in a mill, and the vitreous powder thus obtained be mixed with a sufficient quantity of water, so that the liquor shall have the consistence of cream of milk. The pieces of porcelain are to be covered with a thin coating of this matter, which is done by immersing them hastily in the liquid, and as they greedily imbibe the water, there remains on the surface a uniform covering of the glazing materials. This covering, which, it must be observed, should be very thin, in a short time becomes so dry, that it does not adhere to the fingers when the pieces are handled. When they are sufficiently dry, they are replaced in the furnace in the same manner as in preparing the biscuit, and the heat is continued till the glazing be completely fused; but the degree of heat necessary for that purpose is far inferior to that which is requisite in baking the paste. As before noticed, however, this does not apply to the French porcelains, the glazing of which is effected by a higher degree of heat than what is applied to the paste or body.

The glaze used for the soft porcelain possessed great advantages in the execution of the more delicate paintings and decorations, by its property of assisting to flux and fix with more certainty the metallic oxides of which the colours are composed. The old Sèvres china is of this description. But at that royal manufactory, under the able direction of M. Brogniat, the *porcelaine dure*, now the only kind made there, has been so much improved, as to admit of its being embellished by paintings of the most delicate and brilliant colours and superb grounds, with gilding equal, if not superior, to the old Sèvres.

Of painting.

The pieces of porcelain which are intended to remain white are now finished, but those which are to be ornamented with painting and gilding must go through various other operations. The colours which are employed in painting porcelain on the glaze are similar to those which are applied in the painting of enamel. They are all composed of metallic oxides or calces, combined with a very fusible vitreous matter. The different colours are obtained from different metals. The oxides of iron afford a red colour; gold, precipitated by means of tin, furnishes a purple and violet colour; copper, precipitated from its solution in acids by means of an alkali, gives a fine green; cobalt, or when combined with vitreous matter, *zaffar*, as it is called, yields a fine blue. Earthy matters which are slightly feruginous, produce a yellow colour; and brown and black colours are obtained from iron in different states, and from manganese. The oxide of chrome, which has but lately come into use, has furnished artists with greens and some other colours, of a brilliancy and fixedness in the fire not before known. These colours are applied to the ware by the painters according to the requisite pattern, and it is again conveyed to the furnace, and the colours are vitrified, to give them the proper degree of fixation and lustre. In the common kind of porcelain, once or twice burning is sufficient, but in the finer decorations the colours must be laid on several times, and as often fired before the full effect can be produced. This process is similar to that practised by enamellers on copper, &c.; but the blue colour from cobalt is much used for painting on the biscuit ware before glazing.

Of printing.

The discovery of a method of imitating the painted patterns of the Chinese by impressions taken from engraved copper plates, was of great importance, as it enabled the European manufacturers to compete with the cheap labour of the Chinese. This discovery is due to a manufacturer at Liverpool, where porcelain was formerly made. The process is as follows. The pattern being engraved on a copper plate of the size wanted, it is charged with the colour to be used, which is mixed with boiled linseed oil; the plate is then placed on a hot stove, and a piece of thin tissue paper, previously primed with a solution on one side of soft soap, is laid upon the plate, and both passed through the rollers of the press as in ordinary printing. The impression is then taken off, and transferred on to the ware. After being well rubbed with a roller of flannel, to cause the colour and oil to adhere to the ware, the piece is then put into lukewarm water, where the paper, by the action of the soap, leaves the ware and the colour upon it. The ware is next dried, and subjected to a degree of heat, to evaporate the oils, and the ware is then in a condition for the glazing.

Gilding.

But when the pieces of porcelain are to be further decorated with gilding, they are pencilled with a mixture of oil and gold, dissolved or thrown down by quicksilver with the aid of heat, and are again introduced into the furnace. Here the gold returns to its solid state, but comes out with a dull surface; and to recover its lustre and usual brilliancy, it is burnished with blood-stones, and other polishing substances. Much care and attention are necessary in the latter part of the process; for if the gold be not sufficiently burned, it will be apt to separate in thin flakes; and if it have been exposed to too great a heat, it is not susceptible of a fine polish. In this manufactory, when pieces of porcelain are to be finished in the highest style, they are frequently returned to the enamel furnace, where the colours are fluxed six or seven different times; and having gone through the processes now described, the porcelain is fit for the market.

Use of platina in colouring porcelain.

The use of platina in porcelain painting has been recommended by Klaproth; and experiments have been made on the subject by that celebrated chemist, with the view of ascertaining its effects for this purpose. In concluding his observations, he says, "The process which I employ in the application of platina to painting on porcelain is simple and easy. I dissolve crude platina in aqua regia, and precipitate it by a saturated solution of sal-ammoniac in water. The red crystalline precipitate thence produced is dried, and being reduced to a very fine powder, is slowly brought to a red heat in a glass retort. As the volatile neutral salt combined with the platina in this precipitate becomes sublimated, the metallic part remains behind in the form of a gray soft powder. This powder is then subjected to the same process as gold; that is to say, it is mixed with a small quantity of the same flux as that used for gold, and being ground with oil of spike, is applied with a brush on the porcelain; after which it is burned-in under the muffle of an enameller's furnace, and then polished with a burnishing tool.

"The colour of platina burnt into porcelain in this manner is a silver white, inclining a little to a steel gray. If the platina be mixed in different portions with gold, different shades of colour may be obtained; the gradations of which may be numbered, from the white colour of unmixed platina to the yellow colour of gold. Platina is capable of receiving a considerable addition of gold before the transition from the white colour to yellow is perceptible. Thus, for example, in a mixture of four parts of gold and one of platina, no signs of the gold were to be observed, and the white colour could scarcely be distinguished from that of unmixed platina: it was only when eight parts of gold to one of platina were employed that the gold colour assumed the superiority.

"I tried in the like manner different mixtures of platina and silver; but the colour produced was dull, and did not seem proper for painting on porcelain.

"Besides this method of burning-in platina in substance on porcelain, it may be employed also in its dissolved state; in which case it gives a different result both in its colour and splendour. The solution of it in aqua regia is evaporated, and the thickened residuum is then applied several times in succession to the porcelain. The metallic matter thus penetrates into the substance of the porcelain itself, and forms a metallic mirror of the colour and splendour of polished steel."

General principles of the manufacture of Porcelain and Earthenware.

Convinced that every accurate and scientific investigation into the nature and processes of any important art, will always be deemed of some value to the philosophical observer, or the enlightened manufacturer, we shall introduce the following observations on the principles of the manufacture of porcelain and earthenware.

Observations by Vauquelin.

Component parts of porcelain and pottery ware.

According to this celebrated chemist, four things may occasion differences in the qualities of earthenware; first, the nature or composition of the matter; second, the mode of preparation; third, the dimensions given to the vessels; fourth, the baking to which they are subjected. By composition of the matter, the author understands the nature and proportions of the elements of which it is formed. These elements in the greater part of earthen ware, either valuable or common, are silex, argil, lime, and sometimes a little oxide of iron. Hence it is evident that it is not so much by the diversity of the elements that good earthenware differs from bad, as by the proportion in which they are united. Silex or quartz makes always two-thirds at least of earthenware; argil or pure clay, from a fifth to a third; lime from 5 to 20 parts in the hundred; and iron from 0 to 12 or 15 parts in the hundred. Silex gives hardness, infusibility, and unalterability; argil makes the paste pliable, and renders it fit to be kneaded, moulded, and turned at pleasure. It possesses, at the same time, the property of being partially fused by the heat which unites its parts with those of the silex; but it must not be too abundant, or it would render the earthen ware too fusible, and too brittle to be used over the fire.

Hitherto it has not been proved by experience that lime is necessary in the composition of pottery; and if traces of it are constantly found in that substance, it is because it is always mixed with the other earths, from which the washings and other manipulations have not been able to separate it. When this earth, however, does not exceed five or six parts in a hundred, it appears that it is not hurtful to the quality of the pottery; but if more abundant it renders it too fusible. The oxide of iron, besides the inconvenience of communicating a red or brown colour, according to the degree of baking, to the vessels in which it forms a part, has the property of rendering them fusible, and even in a greater degree than lime.

Mode of preparation.

As some kinds of pottery are destined to melt very penetrating substances, such as salts, metallic oxides, glass, &c. they require a fine kind of paste, which is obtained only by reducing the earths employed to very minute particles. Others destined for melting metals, and substances not very penetrating, and which must be able to support, without breaking, a sudden transition from great heat to great cold, require for their fabrication a mixture of calcined argil with raw argil. By these means you obtain pottery, the coarse paste of which resembles *brèche*, or small-grained pudding-stone, and which can endure sudden changes of temperature.

Baking.

The baking of pottery is likewise an object of great importance. The heat must be capable of expelling humidity, and agglutinating the parts which enter into the composition of the paste, but not strong enough to produce fusion; which, if too far advanced, gives to pottery a homogeneousness that renders it brittle. The same effect takes place in regard to the fine pottery, because the very minute division given to the earths reduces them nearly to the same state as if this matter had been fused. This is the reason why porcelain strongly baked is more or less brittle, and cannot easily endure alternations of temperature. Hence coarse porcelain, in the composition of which a certain quantity of calcined argil is employed, porcelain retorts, crucibles, tubes, and common pottery, the paste of which is coarse, are much less brittle than dishes and saucers formed of the same substance, but ground with more labour.

Dimensions of the different parts of vessels.

The general and respective dimensions of the different parts of vessels of earthenware, have also considerable influence on their capability to stand the fire. In some cases the glazing or covering, especially when too thick, and of a nature different from the body of the pottery, also renders them liable to break. Thus, in making some kinds of pottery, it is always essential, first, to follow the best proportion in the principles; secondly, to give to the particles of the paste, by grinding, a minuteness suited to the purpose for which it is intended, and to all the parts the same dimensions as far as possible; thirdly, to carry the baking to the highest degree that the matter can bear without being fused; and fourthly, to apply the glazing in thin layers, the fusibility of which ought to approach as near as possible to that of the matter, in order that it may be more intimately united.

M. Vauquelin, being persuaded that the quality of good pottery depends chiefly on using proper proportions of the earthy matter, thought it might be of importance to those engaged in this branch of manufacture, to make known the analysis of different natural clays employed for this purpose, and of pottery produced by some of them, in order that, when a new earth is discovered, it may be known by a simple analysis whether it will be proper for the same object, and to what kind of pottery already known it bears the greatest resemblance.

	Hessian Crucibles.	Argil of Dreux.	Porcelain Capsules.	Wedgwood's Pyrometers.
Silex	69	43.5	61	64.2
Argil	21.5	33.2	28	25
Lime	1	3.5	6	6
Oxide of Iron	8	1.	0.5	0.2
Water	...	18.	...	6.2

Raw kaolin 100 parts; silex, 74; argil, 16.5; lime, 2; water, 7. A hundred parts of this earth gave eight of alum, after being treated with the sulphuric acid.

Washed kaolin, 100 parts; silex, 55; argil, 27; lime, 2; iron, 0.5; water, 14. This kaolin, treated with the sulphuric acid, gave about 45 or 50 per cent. of alum.

Petuntze. Silex, 74; argil, 14.5; lime, 5.5; loss, 6. A hundred parts of this substance, treated with the sulphuric acid, gave seven or eight parts of alum. But this quantity does not equal the loss sustained.

Porcelain of retorts. Silex, 64; argil, 28.8; lime, 4.55; iron, 0.50; loss, 2.77. Treated with the sulphuric acid this porcelain gave no alum.

Porous ware.

There is a kind of earthen vessels, called *Alcarrezes*, which are used in Spain for cooling the water intended to be drunk. These vessels consist of 60 parts of calcareous earth, mixed with alumina and a little oxide of iron, and 36¼ of siliceous earth, also mixed with alumina and the same oxide. The quantity of iron may be estimated at almost one hundredth part of the whole. This earth is first kneaded into a tough paste, being for that purpose previously diluted with water; then formed into a cake of about six inches in thickness, and left in that state until it begin to crack. It is then kneaded with the feet, the workman gradually adding to it a quantity of sea-salt, in the proportion of seven pounds to a hundred and fifty; after which it is applied to the lathe, and baked in any kind of furnace used by potters. The alcarrezes, however, are only about half as much baked as the better kinds of common earthenware; and being exceedingly porous, water oozes through them on all sides. Hence the air which comes in contact with it, by causing it to evaporate, carries off the caloric contained in the water in the vessel, which is thus rendered remarkably cool.

Observations of Brongniart on the Colours used for Enamelling.

Enamel of the ancients.

The art of employing metallic oxides for colouring by fusion different vitreous matters, is of very great antiquity. Every body knows that the ancients manufactured coloured glass and enamel, and that this art was practised in particular by the Egyptians, the first people who in this manner imitated precious stones. The practice of this art in modern times has been carried to a high degree of perfection; but the theory has been neglected. It is almost the only one of the chemical arts in which no attempt has yet been made to apply the new principles of that science. It is well known that all vitrifiable colours have for their basis metallic oxides; but all the metallic oxides are not proper for this purpose; besides, as they are not vitrifiable by themselves, they can scarcely ever be employed alone.

Metallic oxides employed as colours for porcelain.

Highly volatile oxides, and those which adhere little to the great quantity of oxygen they contain, either cannot be employed in any manner, as the oxide of mercury and that of arsenic, or are employed only as agents. The colour they present cannot be depended on, since they must lose it in the slightest heat by losing a part of their oxygen. Such are the puce-coloured and red oxides of lead, the yellow oxides of gold, and some others. Oxides in which the proportions of oxygen are susceptible of varying with too much facility, are rarely employed. The oxide of iron, though black, is never employed for producing that colour; and the green oxide of copper is, under many circumstances, very uncertain. We have said that oxides alone are not susceptible of fusion. However, as they are destined to be applied to thin strata upon vitrifiable substances, they may be attached to them by a violent heat. But, excepting the oxides of lead and bismuth, they would give only dull colours. The violent heat, often necessary to fix them, would change or totally destroy the colours. A flux then is added to all metallic oxides.

This flux is glass, lead, and silex; glass of borax, or a mixture of both. Its general effect is to give splendour to the colours after their fusion; to fix them upon the article which is painted, by promoting more or less the softening of its surface; to envelope the metallic oxides, and to preserve their colour, by sheltering them from the contact of the air; in a word, to facilitate the fusion of the colour at a low temperature not capable of destroying it.

The substances to which they are applied.

But we shall speak here only of the application of metallic colours to vitreous bodies, or to vitreous surfaces. These bodies may be divided into three classes, very distinct by the nature of the substances which compose them, the effects produced on them by the colours, and the changes they experience. These crusts are, first, enamel, soft porcelain, and all crusts, enamels, or glass, that contain lead in a notable quantity; secondly, hard porcelain, or porcelain which has a crust of feldspar; thirdly, glass in the composition of which no lead enters, such as common window-glass. We shall here examine in succession the principles of the composition of these colours, and the general phenomena they exhibit on these three kinds of bodies.

It is well known that enamel is glass rendered opaque by the oxide of tin, and exceedingly fusible by the oxide of lead. It is the oxide of lead, in particular, contained in it, that gives it properties very different from those of the other excipients of metallic colours. Thus all glass and glazing that contain lead, will participate in the properties of enamel; and what we shall say of one may be applied to the rest with very trifling differences. Such are the white and transparent glazing of stoneware, and the glazing of porcelain called *soft glazing*.

Flux for soft porcelain colours

Enamel or soft porcelain colours require much less flux than others, because the glass upon which they are applied becomes sufficiently soft to be penetrated by them. This flux may be either glass of lead and pure silex, called *rocaille*, or the same glass mixed with borax. Montamy asserts that glass of lead ought to be banished from among the enamel fluxes; and he employs only borax. He then dilutes his colours in a volatile oil. On the other hand, the painters of the manufactory of Sèvres employ only colours without borax, because they dilute them in gum; and borax does not dilute well in that substance. Brogniart found that both methods were equally good; and it is certain that Montamy was wrong to exclude fluxes of lead, since they are daily employed without any inconvenience, and as they even render the application of colours easier.

We have said that in the baking of these colours, the crust, softened by the fire, suffers itself to be easily penetrated by them. This is the first cause of the change which they experience. By mixing with the crust they become weaker, and the first heat changes a figure which appeared to be finished into a very light sketch.

The two principal causes of the changes which colours on enamel and soft porcelain are susceptible of experiencing do not depend in any manner upon the composition of these colours, but upon the nature of the glass to which they are applied. It follows from what has been said, that paint ing on soft porcelain has need of being several times retouched, and of several heats, in order that it may be carried to the necessary degree of strength. These paintings have always a certain faintness; but they are constantly more brilliant, and they never are attended with the inconvenience of detaching themselves in scales.

Colours applied to hard porcelain, and to glass.

Hard porcelain, according to the division which Brogniart established, is the second sort of excipient of metallic colours. This porcelain, as is well known, has for its base a very white clay called *kaolin*, mixed with a siliceous and calcareous flux, and for its covering feldspar fused without an atom of lead. The same porcelain, which is that of Saxony, is much newer at Sèvres than the soft porcelain. The colours applied to it are of two kinds. The first, destined to represent different objects, are baked in a heat very inferior to that which is necessary for baking porcelain. They are exceedingly numerous and varied. The others, destined to be fused in the same heat as that which bakes porcelain, lay themselves flat, and are much less numerous. The colours of painting are made nearly like those destined for soft porcelain; they only contain more flux. Their flux is composed of glass of lead and borax. When porcelain is exposed to heat in order to bake the colours, the covering of feldspar dilates itself and opens its pores, but does not become soft; and as the colours do not penetrate it, they experience none of those changes which they undergo on soft porcelain. It must however be said that they lose a little of their intensity by acquiring that transparency which is given to them by fusion.

One of the greatest inconveniences of these colours, especially in the manufactory of Sèvres, is the facility with which they scale off when exposed several times in the fire. To remedy this defect without altering the quality of the paste, Brogniart was of opinion that the crust only ought to be softened by introducing into it more siliceous or calcareous flux, according to the nature of the feldspar. This method succeeded, and being employed, the colours might be exposed two or three times to the fire without scaling, if not overcharged with flux, and laid on too thick.

The third sort of excipient of vitrifiable metallic colours is glass without lead. The application of these colours to glass constitutes painting on glass; an art very much practised some centuries ago, and which was supposed to be lost because out of fashion; but it has too direct a dependence on painting in enamel and porcelain to be entirely lost.

The matters and fluxes which enter into the composition of the colours employed on glass are in general the same as those applied to porcelain. Neither of them differ except in their proportions; but there are a great number of enamel or porcelain colours which cannot be applied to glass, where they are deprived of the white ground that serves to give them relief.

Of Colours in particular.

After collecting the general phenomena exhibited by each class of vitrifiable colours, considered in regard to the body on which they are applied, we shall now make known the most interesting particular phenomena exhibited by each principal kind of colours employed upon soft porcelain and glass in a porcelain furnace.

Reds, Purples, and Violets, made from Gold.

Carmine red is obtained by the purple precipitate of cassius. It is mixed with about six parts of its flux; and this mixture is employed directly, without being fused. It is then of a dirty violet, but by baking it acquires a beautiful red carmine colour. It is, however, exceedingly delicate; but a little too much heat and carbonaceous vapours easily spoil it. On this account it is more beautiful when baked with charcoal than with wood.

This colour and the purple, which is very little different, as well as all the shades obtained from it by mixing it with other colours, really change on all porcelain and in every hand. But it is the only one which changes on hard porcelain. Its place may be supplied by a rose-colour from iron which does not change; so that by suppressing the carmine made with gold, and substituting for it the rose oxide of iron here alluded to, a palette may be exhibited, composed of colours none of which changes in a remarkable manner. This rose-coloured oxide of iron has long been known; but it was not employed on enamel, because on that substance it changed too much. As the painters on enamel, however, have become the painters on porcelain, they have preserved their ancient method.

It might be believed that, by first reducing to a vitreous matter the colour called *carmine* already mixed with its flux, it might be made to assume its last tint. But the heat necessary to fuse this vitreous mass destroys the red colour. Besides, it is remarked that, to obtain this colour very beautiful, it must be exposed to the fire as few times as possible. The carmine for soft porcelain is made with fulminating gold slowly decomposed, and muriate of silver; no tin enters into it, which proves that the combination of the oxide of this metal with that of gold is not necessary to the existence of the purple colour. Violet is also made with purple oxide of gold. A greater quantity of lead in the flux is what gives it this colour, which is almost the same crude or baked. These three colours totally disappear when exposed to a great porcelain heat.

Carmine and purple give us in glass only tints of a dirty violet. The violet, on the other hand, produces on glass a very beautiful effect, but it is liable to turn blue. We have not been able to discover the cause of this singular change.

Red, Rose, and Brown Colours, extracted from Iron.

These colours are made from red oxide of iron prepared with nitric acid. The oxides are further calcined by keeping them exposed to the action of heat; but if heated too much, they pass to brown. Their flux is composed of borax, sand, and minium, in small quantity.

These oxides give rose and red colours capable of supplying the place of the same colours made with oxide of gold. When properly employed upon hard porcelain, they do not change at all. We have caused roses to be painted with these colours, and found no difference between the baked flower and that not baked, except what might be expected to result from the brilliancy given to colours by fusion.

These colours may be employed indiscriminately, either previously fused or not fused. In a great heat they in part disappear, or produce a dull brick ground, which is not agreeable. The composition of them is the same both for soft porcelain and for glass. They do not change on the latter; but on soft porcelain they disappear almost entirely on the first exposure to heat, and to make any thing remain they must be employed very deep. This singular effect must be ascribed to the presence of lead in the crust or glazing. We assured ourselves of this by a very simple experiment. We placed this colour on window glass, and having exposed it to a strong baking, it did not change. We covered several parts of it with minium; and on again exposing it to the fire, the colour was totally removed in the places where the red oxide of lead had been applied. By performing this operation on a larger scale in close vessels, a large quantity of oxygen gas was disengaged.

It appears to us that the observation here referred to clearly proves the action of oxidated lead on glass as a destroyer of colour; it is seen that it does not act, as was believed, by burning the combustible bodies, which might tarnish the glass, but by dissolving, discolouring, or volatilizing with it the oxide of iron, which might alter its transparency.

Yellows.

Yellows are colours which require a great deal of care in the fabrication, on account of the lead which they contain, and which, approaching sometimes to the metallic state, produces on them dark spots. The yellows for hard and soft porcelain are the same; they are composed of the oxide of lead, white oxide of antimony, and sand.

Oxide of tin is sometimes mixed with them; and when it is required to have them more lively, and nearer the colour *du souci*, red oxide of iron is added, the too great redness of which is dissipated in the previous fusion to which they are exposed by the action of the lead contained in this yellow. These colours, when once made, never change; they disappear, however, almost entirely when exposed to a porcelain heat.

These yellows cannot be applied to glass, because they are too opaque and dirty. That employed by the old painters on glass has, on the contrary, a beautiful transparency, and is exceedingly brilliant, and of a colour which approaches near to that of gold. The processes which they gave clearly showed that silver formed part of their composition; but, when exactly followed, nothing satisfactory was obtained. M. Miraud found means to make as beautiful paintings on glass as the ancients, by employing muriate of silver, oxide of zinc, white argil, and yellow oxide of iron. These colours were applied on glass merely pounded, and without a flux. The oxide of iron brought the yellow to that colour which it ought to have after baking, and contributed with the argil and oxide of zinc to decompose the muriate of silver without deoxidating the silver. After the baking, there remained a dust which had not penetrated into the glass, and which was easily removed.

This yellow, when employed thicker, gives darker shades, and produces a russet colour.

Blues.

It is well known that blues are obtained from the oxide of cobalt. All chemists are acquainted with the preparation of them. Those of Sèvres, which are justly esteemed for their beauty, are indebted for it solely to the care employed in manufacturing them, and to the quality of the porcelain, which appears more proper for receiving them in proportion to the degree of heat which it can bear.

Respecting the oxide of cobalt, we may remark a fact which is perhaps not known to chemists; namely, its volatility in a violent heat. It is to this property that we must ascribe the bluish tint always assumed by white in the neighbourhood of the blue.

The blue of hard porcelain, destined for what is called the ground of a great heat *(les fonds au grand feu)* is fused with feldspar; that of soft porcelain has for its flux silex, potash, and lead. It is not volatilized like the preceding; but the heat which it experiences is very inferior to that of hard porcelain. These colours, when previously fused, do not change at all in the application. Blues on glass exhibit the same phenomena as those on soft porcelain.

Greens.

The greens employed in painting are made with green oxide of copper, or sometimes with a mixture of yellow or blue. They must be previously fused with their flux, otherwise they will become black; but after this first fusion they no longer change. They cannot stand a strong heat, as it would make them disappear entirely. Green grounds for a strong heat are composed with the oxides of cobalt and nickel, but a brownish green only is obtained.

Bluish greens, called *celestial blues*, which were formerly colours very much in vogue, can be applied only upon soft porcelain; on hard porcelain they consequently become scaly, because potash enters into their composition. These greens cannot be applied on glass, because they give a dirty colour. To obtain a green on glass, it is necessary to put yellow on one side, and blue, more or less pale, on the other. This colour may be also made by a mixture of blue with yellow oxide of iron.

Bistres and Russets.

These are obtained by mixtures, in different proportions, of manganese, brown oxide of copper, and oxide of iron from ombre earth. They are also previously fused with their flux, so that they do not in any manner change on soft porcelain, since lead has not the same action on oxide of manganese as on that of iron. This colour fades very speedily on glass.

Russet grounds in a great heat, known under the name of *tortoise-shell grounds*, are made in the same manner. Their flux is feldspar; and no titanium enters into their composition, though it is so stated in all printed works. Titanium was not known at the manufactory of Sèvres when Brogniart arrived there. He treated this singular metal in various ways, and never obtained any but grounds of a pale dirty yellow, and very variable in tone.

Blacks.

Blacks are the colours the most difficult to be obtained of a very beautiful hue. No metallic oxide alone gives a beautiful black. Manganese is that which approaches nearest to it. Iron gives an opaque, dull, cloudy black, which changes very easily to red; the colour-makers, therefore, to obtain a black which they could not hope for from the best theorist, have united several metallic oxides which separately do not give black, and have obtained a very beautiful colour, which, however, is liable to become scaly and dull. These oxides are those of manganese, the brown oxides of copper, and a little of the oxide of cobalt. The grey is obtained by suppressing the copper, and increasing the dose of the flux.

The manufactory of Sèvres is the only one which has hitherto produced beautiful blacks in a strong heat. This is owing rather to the quality of its paste than to any peculiar processes, since it does not conceal them. It is by darkening the blue by the oxides of manganese and iron that they are able in that manufactory to obtain very brilliant blacks.

Having here made known the principles of the fabrication of each principal colour, it may be readily conceived that by mixing these colours together all the shades possible may be obtained. It is evident also that care in the preparation, choice in the raw materials, and a just proportion of doses, must produce in the result, differences very sensible to an eye accustomed to painting. A mere knowledge of the composition of the colours does not give the talent of executing them well.

Facts relative to colours recapitulated.

From the facts above mentioned, it is therefore seen, 1st, That amongst colours generally employed on hard porcelain one only is susceptible of changing, viz. carmine, and the tints into which it enters; that its place may be supplied by the reds of iron, and that no colour then changes. 2d, That amongst the colours for soft porcelain and enamel, several change in a considerable degree. These are principally the reds of gold and iron, the yellows, the greens, and the browns. They have not been replaced by others, because this kind of painting has been almost abandoned. 3d, That several of the colours on glass change also by acquiring complete transparency. These, in particular, are the yellows and green. 4th, That it is neither by calcining the colours in a higher degree, nor previously fusing them, as supposed by some, that they are prevented from changing, since these means really alter the changing colours, and produce no effect on the rest. The change which several colours experience upon soft porcelain and upon glass does not depend on the nature of their composition, but rather on that of the body upon which they are applied.

It follows, then, that, by suppressing from the colours of hard porcelain the carmine of gold, which is by no means indispensably necessary, we shall have a series of colours which do not change, or, in other words, remain unalterable. So much for the colours employed in this manufacture. X. X.

PORCH, in *Architecture*, a kind of vestibule supported by columns, and much used at the entrance of temples, halls, and other edifices.

A porch, in ancient architecture, was a vestibule, or a disposition of insulated columns usually crowned with a pediment, forming a covert place before the principal door of a temple or court of justice. When a porch had four columns in front, it was called a tetrastyle; when six, a hexastyle; when eight, an octostyle, and so on.

PORCH, in Greek στοα, a public portico in Athens, adorned with the pictures of Polygnotus and other eminent painters. It was in this portico that Zeno the philosopher taught; and hence his followers were called Stoics.

PORCHESTER, a village of the county of Hants and in the hundred of Portsdown. It is on the north side of Portsmouth harbour, and is remarkable for its extensive and ancient castle, in which, during the war, some thousands of French prisoners were confined. The walls inclose a square of four acres. It formerly belonged to the crown, and was settled by Edward IV. on his queen Margaret. It is now private property, and during the war was rented by the government, and converted into a prison. Since the peace, the population has somewhat declined, having been in 1801, 917; in 1811, 818; in 1821, 757; and in 1831, 739.

PORCO, a province of Bolivia in South America, to the west of the city of Potosi. The region is elevated, and the climate is consequently cold, so that although in the valleys the soil is productive, there is a scarcity of grains and fruit. It is properly a pastoral country, and here are reared vast numbers of sheep, and also vicuñas and guanacos, native sheep. The mountain of Porco in this province is celebrated for its silver mines. It was the first worked by the Spaniards after the conquest; and before that epoch it had been the source whence the Incas of Peru obtained their chief supplies of the precious metal. The original mine is still wrought, but, like most others in this quarter, without much vigour. Porco, the capital of the province, is a small town with but few inhabitants. The population of the province is estimated at above one hundred thousand.

PORCU, a town on the sea-coast of Hindustan, situated in the province of Travancore. It is populous, and carries on a considerable trade. The adjacent country is fertile, and produces abundance of rice. The inhabitants consist of Mahommedan, Hindu, and Christian merchants. The Dutch had formerly a factory here for procuring cargoes of pepper. Long. 76. 24. E. Lat. 9. 23. N.

PORDENONE, a city of Austrian Italy, in the province of Milan, and delegation of Belluno. It stands on the river Roncello, and contains 650 houses, with 4230 inhabitants, who are chiefly employed in making linen goods and paper. Lat. 45. 56. 42. Long. 12. 34. 54. E.

PORETSCHIE, a city of the Russian empire, in the province of Smolensko, the capital of a circle of the same name. It is situated on the river Kasplea, which is navigable thus far, but no farther. It is 478 miles from St. Petersburg, and favourably situated as a depôt for the trade between Smolensko and Riga. It contains three churches, 580 houses, and 5900 inhabitants, with large storehouses. Lat. 55. 10. Long. 31. 25. E.

PORISM, in *Geometry*, is a name given by the ancient geometers to two classes of mathematical propositions. Euclid applies this name to propositions, which are involved in others which he is professedly investigating, and which, although they do not form his principal object, are obtained along with it, as is expressed by their name *porismata*, or acquisitions. Such propositions are now called *corollaries*. But he gives the same name, by way of eminence, to a particular class of propositions which he collected in the course of his researches, and selected from amongst many others, on account of their great subserviency to the business of geometrical investigation in general. These propositions were so named by him, either from the way in which he discovered them, that is to say, whilst he was investigating something else, so that they might be considered as *gains* or *acquisitions*, or from their utility as steps in the investigation. In this sense they are *porismata;* for ποριζω (from which, according to Proclus, the term is derived) signifies both to investigate and to acquire by investigation. These propositions formed a collection in three books, which was familiarly known to the ancient geometers by the name of Euclid's *porisms;* and Pappus of Alexandria says, that it was a most ingenious collection of many things conducive to the analysis or solution of the most difficult problems, and which afforded great delight to those who were able to understand and investigate them.

Unfortunately for mathematical science, this valuable collection is now lost, and it still remains a doubtful question in what manner the ancients conducted their researches upon this curious subject. We have, however, reason to believe that their method was both comprehensive and excellent; for their analysis led them to many profound discoveries, and was restricted by the severest logic. The only account we have of this class of geometrical propositions, is in a fragment of Pappus, in which he attempts a general description of them, as a set of mathematical propositions distinguishable in kind from all others; but of this description nothing remains, except a criticism on a definition of the term given by some geometers, namely, "A Porism is that which is deficient in hypothesis from a local theorem," and which he finds fault with, as defining the porisms only by an accidental circumstance. Pappus also gives an account of Euclid's porisms; but the enunciations are so extremely defective, at the same time that they refer to a figure now lost, that Dr. Halley confesses the fragment in question to be beyond his comprehension.

The high encomiums pronounced by Pappus on these propositions have excited the curiosity of the greatest geometers of modern times, who have attempted to discover their nature and the manner of investigating them. Fermat gave a few propositions, which have been published in his *Opera* (Tolosæ, 1679), and Bullialdus, in a tract entitled *Exercitationes Geometricæ Tres* (Paris, 1657), attempted the same thing, but with less success. Albert Girard, at a still earlier period, announced that he had restored the whole of the three books of Euclid, but it does not appear that this part of his works was ever published.[1]

At length Dr. Simson, Professor of Mathematics in the University of Glasgow, was so fortunate as to succeed in restoring the porisms of Euclid. In the preface to his treatise *De Porismatibus*, he gives the following account of his progress and of the obstacles he encountered: "Postquam vero apud Pappum legeram Porismata Euclidis Collectionem fuisse artificiosissimam multarum rerum, quæ spectant ad analysin difficiliorum et generalium problematum, magno desiderio tenebar, aliquid de iis cognoscendi; quare sæpius et multis variisque viis tum Pappi propositionem generalem, mancam et imperfectum, tum primum lib. 1. Porisma, quod, ut dictum fuit, solum ex omnibus in tribus libris integrum adhuc manet, intelligere et restituere conabar; frustra tamen, nihil enim proficiebam. Cumque cogitationes de hac re multum mihi temporis consumpserint, atque tandem molestæ admodum evaserint, firmiter animum induxi haec nunquam in posterum investigare; præsertim cum optimus Geometra Halleius spem omnem de iis intelligendis abjecisset. Unde quoties menti occurrebant, toties eas arcebam. Postea tamen accidit ut improvidum et propositi immemorem invaserint, meque detinuerint donec tandem lux quædam effulserit quae spem mihi faciebat inveniendi saltem Pappi propositionem generalem, quam quidem multa investigatione tandem restitui."

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[1] In his *Trigonometry*, published at the Hague in 1629, after enumerating the forms of certain rectilinear figures, Girard adds, "Le tout, quand il n'y a que deux lignes qui passent par un point, comme jadis estoyent les Porismes d'Euclid, qui sont perdus, lesquelles J'espère de mettre bientot en lumière, les ayant restituez, il y a quelques années en ça." A similar announcement is also made by him in his edition of the works of Stevinus (Lugduni. Batav. 1634. p. 459.) Having mentioned that Euclid rarely employs a compound ratio, he adds, "Mais il est à estimer qu'il en a plus escrit en ses trois livres de Porismes qui sont perdus, lesquelles, Dieu aidant, J'espère de mettre en lumière, les ayant inventez de nouveau." (See the preface to Simson's *Tractatus de Porismatibus*, in his *Opera Reliqua.*)

Dr. Simson's *Restoration* has every appearance of being just. All the lemmas which Pappus has given for the better understanding of Euclid's propositions are equally applicable to those of Dr. Simson, which are found to differ from local theorems precisely as Pappus affirms those of Euclid to have done. They require a particular mode of analysis, and are of immense service in geometrical investiga tion.

Whilst Dr. Simson was employed in this inquiry, he carried on a correspondence upon the subject with the late Dr. Matthew Stewart, Professor of Mathematics in the University of Edinburgh; who, besides entering into Dr. Simson's views, and communicating to him many curious porisms, pursued the same subject in a new and very different direction. He published the result of his inquiries in 1746, under the title of *General Theorems*, not wishing to give them any other name, lest he might appear to anticipate the labours of his friend and former preceptor. The greater part of the propositions contained in that work are porisms, but without demonstration; and those who wish to investigate one of the most curious subjects in geometry, will there find abundance of materials, and an ample field for discussion.

Dr. Simson defines a porism to be "a proposition, in which it is proposed to demonstrate, that one or more things are given, between which, and every one of innumerable other things not given, but assumed according to a given law, a certain relation, described in the proposition, is to be shewn to take place."

This definition is somewhat obscure, but will be plainer if expressed thus: "A porism is a proposition affirming the possibility of finding such conditions as will render a certain problem indeterminate, or capable of innumerable solutions." This definition agrees with Pappus's idea of these propositions, as far at least as they can be understood from the fragment already mentioned; for the propositions here defined, like those which he describes, are, strictly speaking, neither theorems nor problems, but of an intermediate nature between both. They neither simply enunciate a truth to be demonstrated, nor propose a question to be resolved, but are affirmations of a truth in which the determination of an unknown quantity is involved. In as far, therefore, as they assert that a certain problem may become indeterminate, they are of the nature of theorems; and, in as far as they seek to discover the condition by which that is brought about, they are of the nature of problems.

In order to give our readers a clear idea of the subject of porisms, we shall consider them in the way in which it is probable they occurred to the ancient geometers in the course of their researches. This will at the same time shew the nature of the analysis peculiar to them, and their great use in the solution of problems.

It appears to be certain, that it has been the solution of problems which, in all states of the mathematical sciences, has led to the discovery of geometrical truths. The first mathematical inquiries, in particular, must have occurred in the form of questions, where something was given, and something required to be done; and by the reasoning necessary to answer these questions, or to discover the relation between the things given and those to be found, many truths were suggested, which came afterwards to be the subject of separate demonstrations. The number of these was the greater, because the ancient geometers always undertook the solution of problems, with a scrupulous and minute attention, insomuch that they would scarcely suffer any of the collateral truths to escape their observation.

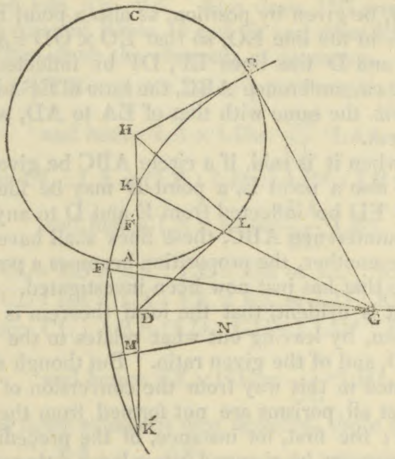
Now, as this cautious manner of proceeding was not better calculated to avoid error than to lay hold of every collateral truth connected with the main object of inquiry, these geometers soon perceived, that there were many problems which in certain cases would admit of no solution whatever, in consequence of a particular relation existing amongst the quantities which were given. Such problems were said to become impossible; and it was soon perceived, that this always happened when one of the conditions of the problem was inconsistent with the rest. Thus, when it was required to divide a line, so that the rectangle contained by its segments might be equal to a given space, it was found that this was possible only when the given space was less than the square of half the line; for when it was otherwise, the two conditions defining, the one the magnitude of the line, and the other the rectangle of its segments, were inconsistent with each other. Such cases would occur in the solution of the most simple problems; but if they were more complicated, it must have been remarked, that the constructions would sometimes fail, for a reason directly contrary to that just now assigned. Cases would occur, where the lines, which by their intersection were to determine the thing sought, instead of intersecting each other as they did commonly, or of not meeting at all, as in the above mentioned case of impossibility, would coincide with one another entirely, and of course leave the problem unresolved. It would appear to geometers upon a little reflection, that since, in the case of determinate problems, the thing required was determined by the intersection of the two lines already mentioned, that is, by the points common to both; so in the case of their coincidence, as all their parts were in common, every one of these points must give a solution, or, in other words, the solutions must be indefinite in number.

Upon inquiry, it would be found that this proceeded from some condition of the problem having been involved in another, so that, in fact, the two formed but one, and thus there was not a sufficient number of independent conditions to limit the problem to a single or to any determinate number of solutions. It would soon be perceived, that these cases formed very curious propositions of an intermediate nature between problems and theorems; and that they admitted of being enunciated in a manner peculiarly elegant and concise. It was to such propositions that the ancients gave the name of *porisms*.

This deduction requires to be illustrated by an example. Suppose, therefore, that it were required to resolve the following problem. A circle ABC, (fig. 1), a straight line DE, and a point F, being given in position, to find a point G in the straight line DE such, that GF, the line drawn from it to the given point, shall be equal to GB, the line drawn from it touching the given circle.

Suppose G to be found, and GB to be drawn touching the given circle ABC in B, let H be its centre, join HB, and let HD be perpendicular to DE. From D draw DL,

Fig. 1.



touching the circle ABC in L, and join HL; also from the centre G, with the distance GB or GF, describe the circle BKF, meeting HD in the points K and K′. It is evident that HD and DL are given in position and magnitude: also because GB touches the circle ABC, HBG is a right angle; and since G is the centre of the circle BKF, HB touches that circle, and consequently HB^2 or $HL^2=KH\times HK'$; but because KK′ is bisected in D, $KH\times HK'+DK^2=DH^2$, therefore $HL^2+DK^2=DH^2$. But $HL^2+LD^2=DH^2$, therefore $DK^2=DL^2$ and $DK=DL$. But DL is given in magnitude, and consequently K is a given point. For the same reason K′ is a given point, therefore the point F being given in position, the circle KFK′ is given in position. The point G, which is its centre, is therefore given in position, which was to be found. Hence this construction:

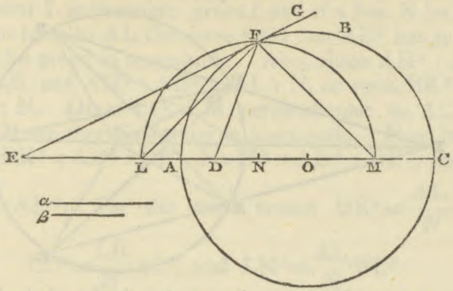
Having drawn HD perpendicular to DE, and DL touching the circle ABC, make DK and DK′ each equal to DL, and find G the centre of the circle described through the points K′FK; that is, let FK′ be joined and bisected at right angles by MN, which meets DE in G, G will be the point required; or it will be such a point, that if GB be drawn touching the circle ABC, and GF to the given point, GB is equal to GF.

The synthetical demonstration is easily derived from the preceding analysis; but it must be remarked, that in some cases this construction fails. For, first, if F fall anywhere in DH, as at F′, the line MN becomes parallel to DE, and the point G is nowhere to be found; or, in other words, it is at an infinite distance from D. This is true in general; but if the given point F coincide with K, then MN evidently coincides with DE; so that, agreeable to a remark already made, every point of the line DE may be taken for G, and will satisfy the conditions of the problem; that is to say, GB will be equal to GK, wherever the point G is taken in the line DE: the same is true if F coincide with K′. Thus we have an instance of a problem, and that too a very simple one, which, in general, admits but of one solution; but which, in one particular case, when a certain relation takes place among the things given, becomes indefinite, and admits of innumerable solutions. The proposition which results from this case of the problem is a porism, and may be thus enunciated:

"A circle ABC being given by position, and also a straight line DE, which does not cut the circle, a point K may be found, such, that if G be any point whatever in DE, the straight line drawn from G to the point K shall be equal to the straight line drawn from G touching the given circle ABC."

The problem which follows, appears to have led to the discovery of many porisms.

Fig. 2.

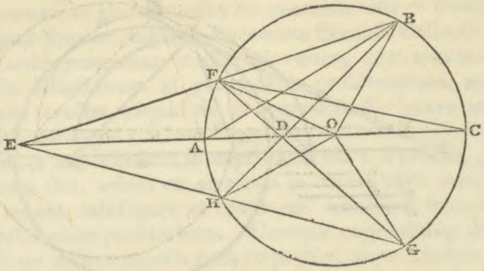


A circle ABC (fig. 2), and two points D, E, in a diameter of it being given, to find a point F in the circumference of the given circle, from which, if straight lines be drawn to the given points E, D, these straight lines shall have to one another the given ratio of α to β, which is supposed to be that of a greater to a less. Suppose the problem resolved, and that F is found, so that FE has to FD the given ratio of α to β; produce EF towards G, bisect the angle EFD by FL, and DFG by FM: therefore EL : LD : : EF : FD, that is in a given ratio, and since ED is given, each of the segments EL, LD, is given, and the point L is also given; again, because DFG is bisected by FM, EM : MD : : EF : FD, that is, in a given ratio, and therefore M is given. Since DFL is half of DFE, and DFM half of DFG, therefore LFM is half of (DFE+DFB), that is, the half of two right angles, therefore LFM is a right angle; and since the points L, M, are given, the point F is in the circumference of a circle described upon LM as a diameter, and therefore given in position. Now the point F is also in the circumference of the given circle ABC, therefore it is in the intersection of the two given circumferences, and therefore is found. Hence this construction: Divide ED in L, so that EL may be to LD in the given ratio of α to β, and produce ED also to M, so that EM may be to MD in the same given ratio of α to β; bisect LM in N, and from the centre N with the distance NL, describe the semicircle LFM; and the point F, in which it intersects the circle ABC, is the point required.

The synthetical demonstration is easily derived from the preceding analysis. It must, however, be remarked, that the construction fails when the circle LFM falls either wholly within or wholly without the circle ABC, so that the circumferences do not intersect; and in these cases the problem cannot be solved. It is also obvious that the construction will fail in another case, viz. when the two circumferences LFM, ABC, entirely coincide. In this case, it is farther evident, that every point in the circumference ABC will answer the conditions of the problem, which is therefore capable of numberless solutions, and may, as in the former instance, be converted into a porism. We are now to inquire, therefore, in what circumstances the point L will coincide with A, and also the point M with C, and of consequence the circumference LFM with ABC. If we suppose that they coincide, EA : AD : : α : β : : EC : CD, and EA : EC : : AD : CD, or by conversion, EA : AC : : AD : CD—AD : : AD : 2DO, O being the centre of the circle ABC; therefore, also, EA : AO : : AD : DO, and by compositition, EO : AO : : AO : DO, therefore $EO\times OD=AO^2$. Hence, if the given points E and D (fig. 3), be so situated that $EO\times OD=AO^2$, and at the same time α : β : : EA : AD : : EC : CD, the problem admits of numberless solutions; and if either of the points D or E be given, the other point, and also the ratio which will render the problem indeterminate, may be found. Hence we have this porism:

"A circle ABC, and also a point D being given, another point E may be found, such that the two lines inflected from these points to any point in the circumference ABC,

Fig. 3.



shall have to each other a given ratio, which ratio is also to be found." Hence also we have an example of the derivation of porisms from one another, for the circle ABC, and the points D and E remaining as before, if, through D we draw any line whatever HDB, meeting the circle in B and H; and if the lines EB, EH, be also drawn, these lines will cut off equal circumferences BF, HG. Let FC be drawn, and it is plain from the foregoing analysis, that the angles DFC, CFB, are equal; therefore if OG, OB, be drawn, the angles BOC, COG, are also equal; and consequently the angles DOB, DOG. In the same manner, by joining AB, the angle DBE being bisected by BA, it is evident that the angle AOF is equal to AOH, and therefore the angle FOB to HOG; hence the arch FB is equal to the arch HG. It is evident that if the circle ABC, and either of the points DE were given, the other point might be found. Therefore we have this porism, which appears to have been the last but one of the third book of Euclid's *Porisms*. "A point being given, either within or without a circle given by position, if there be drawn, anyhow through that point, a line cutting the circle in two points; another point may be found, such, that if two lines be drawn from it to the points in which the line already drawn cuts the circle, these two lines will cut off from the circle equal circumferences."

The proposition from which we have deduced these two porisms, also affords an illustration of the remark, that the conditions of a problem are involved in one another in the porismatic or indefinite case; for here several independent conditions are laid down, by the help of which the problem is to be resolved. Two points D and E are given, from which two lines are to be inflected, and a circumference ABC, in which these lines are to meet, as also a ratio which these lines are to have to each other. Now these conditions are all independent of one another, so that any one may be changed without any change whatever in the rest. This is true in general; but yet in one case, viz. when the points are so related to another, that the rectangle under their distances from the centre is equal to the square of the radius of the circle, it follows, from the preceding analysis, that the ratio of the inflected lines is no longer a matter of choice, but a necessary consequenec of this disposition of the points.

From what has been already said, we may trace the imperfect definition of a porism which Pappus ascribes to the later geometers, viz. that it differs from a local theorem, by wanting the hypothesis assumed in that theorem. Now, to understand this, it must be observed, that if we take one of the propositions called *loci*, and make the construction of the figure a part of the hypothesis, we get what was called by the ancient geometers, a *local theorem*. If, again, in the enunciation of the theorem, that part of the hypothesis which contains the construction be suppressed, the proposition thence arising will be a porism, for it will enunciate a truth, and will require to the full understanding and investigation of that truth, that something should be found, viz. the circumstances in the construction supposed to be omitted.

Thus, when we say, if from two given points, E, D, two straight lines EF, FD, are inflected to a third point F, so as to be to one another in a given ratio, the point F is in the circumference of a given circle, we have a locus. But when conversely, it is said, if a circle ABC, of which the centre is O, be given by position, as also a point E; and if D be taken in the line EO, so that $EO \times OD = AO^2$, and if from E and D the lines EF, DF be inflected to any point of the circumference ABC, the ratio of EF to DF will be given, viz. the same with that of EA to AD, we have a local theorem.

Lastly, when it is said, if a circle ABC be given by position, and also a point E, a point D may be found, such that if EF, FD be inflected from E and D to any point F in the circumference ABC, these lines shall have a given ratio to one another, the proposition becomes a porism, and is the same that has just now been investigated.

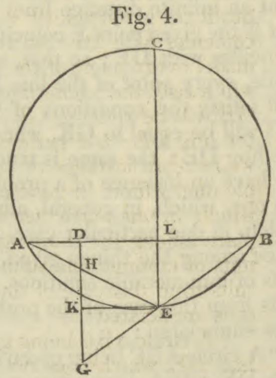
Hence it is evident, that the local theorem is changed into a porism, by leaving out what relates to the determination of D, and of the given ratio. But though all propositions formed in this way from the conversion of loci, are porisms, yet all porisms are not formed from the conversion of loci; the first, for instance, of the preceding, cannot, by conversion, be changed into a locus; therefore Fermat's idea of porisms, founded upon this circumstance, could not fail to be imperfect.

If the idea which we have given of these propositions be just, it follows, that they are to be discovered by considering those cases in which the construction of a problem fails, in consequence of the lines which by their intersection, or the points which by their position, were to determine the problem required, happening to coincide with one another. A porism may therefore be deduced from the problem to which it belongs, just as propositions concerning the *maxima* and *minima* of quantities are deduced from the problems of which they form limitations; and such is the most natural and obvious analysis of which this class of propositions admits.

Another general remark which may be made on the analysis of porisms is, that it often happens that the magnitudes required may all, or a part of them, be found by considering the extreme cases; but for the discovery of the relation between them, and the indefinite magnitudes, we must have recourse to the hypothesis of the porism in its most general or indefinite form; and must endeavour so to conduct the reasoning, that the indefinite magnitudes may at length totally disappear, and leave a proposition asserting the relation between determinate magnitudes only.

For this purpose accordingly Dr. Simson frequently employs two statements of the general hypothesis, which he compares together. This double statement, however, cannot be made without rendering the investigation long and complicated; nor is it even necessary, for it may be avoided by having recourse to simpler *porisms*, or to *loci*, or to propositions of the *data*. The porism which follows, is given as an example where this is done with some difficulty, but with considerable advantage, both with regard to the simplicity and shortness of the demonstration. It will be proper to premise the following lemma.

Fig. 4.



Let AB (fig. 4.) be a straight line, and D, L any two points in it, one of which D is between A and B; also let CL be any straight line. Then shall

$$\frac{LB}{CL}\cdot AD^2+\frac{LA}{CL}\cdot BD^2=\frac{LB}{CL}\cdot AL^2+\frac{LA}{CL}\cdot BL^2+\frac{AB}{CL}DL^2.$$

For place CL perpendicular to AB, and through the points

A, C, B describe a circle, and let CL meet the circle again in E, and join AE, BE. Also draw DG parallel to CE, meeting AE and BE in H and G, and draw EK parallel to AB. Then, from the elements of geometry,

$$\mathrm{CL : LB :: (LA : LE ::)\ LA^2 : LA \times LE},$$

$$\text{and hence } \mathrm{LA \times LE} = \frac{\mathrm{LB}}{\mathrm{CL}} \cdot \mathrm{LA^2}.$$

$$\text{Also } \mathrm{CL : LA :: (LB : LE ::)\ LB^2 : LB \times LE},$$

$$\text{and hence } \mathrm{LB \times LE} = \frac{\mathrm{LA}}{\mathrm{CL}} \cdot \mathrm{LB^2}.$$

$$\text{Now } \mathrm{CL : LB :: LA : LE :: EK} \text{ or } \mathrm{LD : KH},$$

$$\text{and } \mathrm{CL : LA :: LA : LE :: EK} \text{ or } \mathrm{LD : KG},$$

$$\text{therefore, } \mathrm{CL : AB :: (LD : GH ::)\ LD^2 : EK \times GH},$$

$$\text{and hence } \mathrm{EK \times GH} = \frac{\mathrm{AB}}{\mathrm{CL}} \cdot \mathrm{LD^2}.$$

From the three equations now deduced, there results

$$\frac{\mathrm{LB}}{\mathrm{LC}}.\mathrm{LA^2} + \frac{\mathrm{LA}}{\mathrm{LC}}.\mathrm{LB^2} + \frac{\mathrm{AB}}{\mathrm{CL}}.\mathrm{LD^2} = \mathrm{AB \times LE + EK \times GH}.$$

Again, because

$$\mathrm{CL : LA :: (LB : LE :: DB : DG ::)\ DB^2 : DB \times DG},$$

therefore $\mathrm{DB \times DG} = \frac{\mathrm{LA}}{\mathrm{CL}} \cdot \mathrm{DB^2}$. And because

$$\mathrm{CL : LB :: (LA : LE :: DA : DH ::)\ DA^2 : DA \times DH},$$

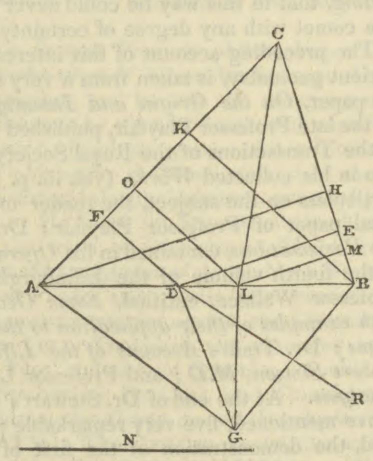
therefore $\mathrm{DA \times DH} = \frac{\mathrm{LB}}{\mathrm{CL}}.\mathrm{DA^2}$. From the result of these two last propositions we have

$$\frac{\mathrm{LB}}{\mathrm{CL}} \cdot \mathrm{DA^2} + \frac{\mathrm{LA}}{\mathrm{CL}} \mathrm{DB^2} = \mathrm{DA \times DH + DB \times DG};$$

But $\mathrm{DA \times DH}$=*twice trian.* ADH, and $\mathrm{DB \times DG}$=*twice trian.* BDG, and therefore $\mathrm{DA \times DH + DB \times DG} = 2$ (*trian.* ADH + *trian.* BDG) = 2 (*trian.* AEB + *trian.* HEG) $= \mathrm{AB \times LE + EK \times HG}$. Now it has been proved, that $\mathrm{DA \times DH + DB \times DG} = \frac{\mathrm{LB}}{\mathrm{CL}} \cdot \mathrm{DA^2} + \frac{\mathrm{LA}}{\mathrm{CL}}.\mathrm{BD^2}$, and that $\mathrm{AB \times LE + EK \times HG} = \frac{\mathrm{LB}}{\mathrm{CL}} \cdot \mathrm{LA^2} + \frac{\mathrm{LA}}{\mathrm{CL}} \cdot \mathrm{LB^2} + \frac{\mathrm{AB}}{\mathrm{CL}} \cdot \mathrm{LD^2}$, therefore $\frac{\mathrm{LB}}{\mathrm{CL}} \cdot \mathrm{AD^2} + \frac{\mathrm{LA}}{\mathrm{CL}} \mathrm{BD^2} = \frac{\mathrm{LB}}{\mathrm{CL}} \cdot \mathrm{AL^2} + \frac{\mathrm{LA}}{\mathrm{CL}} \cdot \mathrm{BL^2} + \frac{\mathrm{AB}}{\mathrm{CL}} \cdot \mathrm{DL^2}$, as was to be demonstrated.

Porism. Let there be three straight lines AB, AC, CB given in position; (fig. 5) and from any point whatever in one of them, as D, let perpendiculars be drawn to the other two, as DF, DE, a point G may be found, such, that if GD be drawn from it to the point D, the square of that line shall have a given ratio to the sum of the squares of the perpendiculars DF and DE, which ratio is to be found.

Fig. 5.



Draw AH, BK perpendicular to BC and AC; and in AB take L, so that $\mathrm{AL : LB :: AH^2 : BK^2 :: AC^2 : CB^2}$. The point L is therefore given; and if a line N be taken, so as to have to AL the same ratio that $\mathrm{AB^2}$ has to $\mathrm{AH^2}$, N will be given in magnitude. Also, since $\mathrm{AH^2 : BK^2 :: AL : LB}$, and $\mathrm{AH^2 : AB^2 :: AL : N}$, *ex equo*, $\mathrm{BK^2 : AB^2 :: LB : N}$. Draw LO, LM perpendicular to AC, CB LO, LM are therefore given in magnitude. Now, because $\mathrm{AB^2 : BK^2 :: AD^2 : DF^2}$, $\mathrm{N : LB :: AD^2 : DF^2}$, and $\mathrm{DF^2} = \frac{\mathrm{LB}}{\mathrm{N}} \cdot \mathrm{AD^2}$. For the same reason $\mathrm{DE^2} = \frac{\mathrm{AL}}{\mathrm{N}} \cdot \mathrm{BD^2}$.

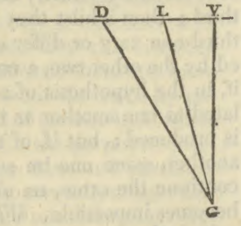
$$\mathrm{LO^2} = \frac{\mathrm{LB}}{\mathrm{N}} \cdot \mathrm{AL^2}, \text{ and } \mathrm{LM^2} = \frac{\mathrm{AL}}{\mathrm{N}} \cdot \mathrm{BL^2}.$$

But, by the preceding lemma, $\frac{\mathrm{LB}}{\mathrm{N}} \cdot \mathrm{AD^2} + \frac{\mathrm{AL}}{\mathrm{N}} \cdot \mathrm{BD^2} = \frac{\mathrm{LB}}{\mathrm{N}} \cdot \mathrm{AL^2} + \frac{\mathrm{AL}}{\mathrm{N}} \cdot \mathrm{BL^2} + \frac{\mathrm{AB}}{\mathrm{N}} \cdot \mathrm{DL^2}$; that is, $\mathrm{DE^2 + DF^2} = \mathrm{LO^2 + LM^2} + \frac{\mathrm{AB}}{\mathrm{N}} \cdot \mathrm{DL^2}$. Join LG, then by hypothesis $\mathrm{LO^2 + LM^2}$ has to $\mathrm{LG^2}$, the same ratio as $\mathrm{DF^2 + DE^2}$ has to $\mathrm{DG^2}$; let it be that of R to N, then $\mathrm{LO^2 + LM^2} = \frac{\mathrm{R}}{\mathrm{N}}.\mathrm{LG^2}$; and therefore $\mathrm{DE^2 + DF^2} = \frac{\mathrm{R}}{\mathrm{N}}.\mathrm{LG^2} + \frac{\mathrm{AB}}{\mathrm{N}}.\mathrm{DL^2}$; but $\mathrm{DE^2 + DF^2} = \frac{\mathrm{R}}{\mathrm{N}}.\mathrm{DG^2}$; therefore, $\frac{\mathrm{R}}{\mathrm{N}}.\mathrm{LG^2} + \frac{\mathrm{BA}}{\mathrm{N}}.\mathrm{DL^2} = \frac{\mathrm{R}}{\mathrm{N}}.\mathrm{DG^2}$, and $\frac{\mathrm{AB}}{\mathrm{N}}.\mathrm{DL^2} = \frac{\mathrm{R}}{\mathrm{N}}(\mathrm{DG^2 - LG^2})$; therefore $\mathrm{DG^2 - LG^2}$ has to $\mathrm{DL^2}$ a constant ratio, viz. that of AB to R. The angle DLG is therefore a right angle, and the ratio of AB to R that of equality, otherwise LD would be given in magnitude, contrary to the supposition. LG is therefore given in position: and since $\mathrm{R : N :: AB : N :: LO^2 + LM^2 : LG^2}$; therefore the square of LG, and consequently LG, is given in magnitude. The point G is therefore given, and also the ratio of $\mathrm{DE^2 = DF^2}$ to $\mathrm{DG^2}$, which is the same with that of AB to N.

The construction easily follows from the analysis, but it may be rendered more simple; for since $\mathrm{AH^2 : AB^2 :: AL : N}$, and $\mathrm{BK^2 : AB^2 :: BL : N}$; therefore $\mathrm{AH^2 + BK^2 : AB^2 :: AB : N}$. Likewise, if AG, BG, be joined, $\mathrm{AB : N :: AH^2 : AG^2}$, and $\mathrm{AB : N :: BK^2 : BG^2}$; wherefore, $\mathrm{AB : N :: AH^2 + BK^2 : AG^2 + BG^2}$, but it was proved that $\mathrm{AB : N :: AH^2 + BK^2 : AB^2}$, therefore $\mathrm{AG^2 + BG^2 = AB^2}$; therefore the angle AGB is a right angle, and $\mathrm{AL : LG :: LG : LB}$. If therefore AB be divided in L, so that $\mathrm{AL : LB :: AH^2 : BK^2}$; and if LG, a mean proportional between AL and LB, be placed perpendicular to AB, G will be the point required.

The step in the analysis, by which a second introduction of the general hypothesis is avoided, is that in which the angle GLD is concluded to be a right angle; which follows from $\mathrm{DG^2 - GL^2}$ having a given ratio to $\mathrm{LD^2}$, at the same time that LD is of no determinate magnitude. For, if possible, let GLD be obtuse, (fig. 6,) and let the perpendicular from G to AB meet in V, therefore V is given: and since $\mathrm{GD^2 - LG^2} = \mathrm{LD^2 \times 2DL \times LV}$; therefore, by the supposition, $\mathrm{LD^2 + 2\,DL \times LV}$ must have a given ratio to $\mathrm{LD^2}$; therefore the ratio of $\mathrm{LD^2}$ to $\mathrm{DL \times VL}$, that is, of LD to VL, is given, so that VL being given in magnitude, LD is also given. But this is contrary to the supposition; for LD is indefinite by hypothesis, and therefore GLD cannot be obtuse,

Fig. 6.



nor any other than a right angle. The conclusion that is here drawn immediately from the indetermination of LD would be deduced, according to Dr. Simson's method, by assuming another point D′ any how, and from the supposition that $GD'^2-GL^2 : LD'^2 :: GD^2-GL^2 : LD^2$, it would easily appear that GLD must be a right angle, and the ratio that of equality.

These porisms facilitate the solution of the general problems from which they are derived. For example, let three straight lines AB, AC, BC, (fig. 5), be given in position, and also a point R, to find a point D in one of the given lines, so that DE and DF being drawn perpendicular to BC, AC, and DR, joined; DE^2+DF^2 may have to DR^2 a given ratio. It is plain, that having found G, the problem would be nothing more than to find D, such that the ratio of GD^2 to DR^2, and therefore that of GD to DR, might be given, from which it would follow, that the point D is in the circumference of a given circle, as is well known to geometers.

The same porism also assists in the solution of another problem. For if it were required to find D such that DE^2+DF^2 might be a given space; having found G, DG^2 would have to DE^2+DF^2 a given ratio, and DG would therefore be given; whence the solution is obvious.

The connection of this porism with the impossible case of the problem is evident; the point L being that from which, if perpendiculars be drawn to AC and CB, the sum of their squares is the least possible. For since $DF^2+DE^2 : DG^2 :: LO^2+LM^2 : LG^2$; and since LG is less than DG, LO^2+LM^2 must be less than DF^2+DE^2.

It is evident from what has now appeared, that in some instances at least there is a close connection between these propositions and the *maxima* or *minima*, and of consequence the impossible cases of problems. The nature of this connection requires to be farther investigated, and is the more interesting because the transition from the indefinite to the impossible case seems to be made with wonderful rapidity. Thus in the first proposition, though there be not properly speaking an impossible case, but only one where the point to be found goes off *in infinitum*, it may be remarked, that if the given point F (fig. 1), be anywhere out of the line HD, the problem of drawing GB equal to GF is always possible, and admits of just one solution; but if F be in DH, the problem admits of no solution at all, the point being then at an infinite distance, and therefore impossible to be assigned. There is, however, this exception, that if the given point be at K in this same line, DH is determined by making DK equal to DL. Then every point in the line DE gives a solution, and may be taken for the point G. Here therefore the case of numberless solutions, and of no solution at all, are as it were *conterminal*, and so close to one another, that if the given point be at K the problem is indefinite; but if it remove ever so little from K, remaining at the same time in the line DH, the problem cannot be resolved. This affinity might have been determined *a priori;* for, as we have seen, it is a general principle, that a problem is converted into a porism when one or when two of the conditions of it necessarily involve in them some one of the rest. Suppose, then, that two of the conditions are exactly in that state which determines the third; then whilst they remain fixed or given, should that third one vary or differ ever so little from the state required by the other two, a contradiction will ensue. Therefore if, in the hypothesis of a problem, the conditions be so related to one another as to render it indeterminate, a porism is produced; but if, of the conditions thus related to one another, some one be supposed to vary, whilst the others continue the same, an absurdity follows, and the problem becomes impossible. *Wherever, therefore, any problem admits both of an indeterminate and an impossible case, it is certain, that these cases are nearly related to one another, and that some of the conditions by which they are produced are common to both.*

It is supposed above, that *two* of the conditions of a problem involve in them a third; and wherever that happens, the conclusion which has been deduced will invariably take place. But a porism may in some cases be so simple as to arise from the mere coincidence of *one* condition with another, though in no case whatever can any inconsistency take place between them. There are, however, comparatively few porisms so simple in their origin, or that arise from problems where the conditions are but little complicated; for it usually happens that a problem which can become indefinite may also become impossible; and if so, the connection already explained never fails to take place.

Another species of impossibility may frequently arise from the porismatic case of a problem which will affect in some measure the application of geometry to astronomy, or any of the sciences depending upon experiment or observation. For when a problem is to be resolved by means of data furnished by experiment or observation, the first thing to be considered is, whether the data so obtained be sufficient for determining the thing sought; and in this a very erroneous judgment may be formed, if we rest satisfied with a general view of the subject. For though the problem may in general be resolved from the data with which we are provided, yet these data may be so related to one another in the case under consideration, that the problem will become indeterminate, and instead of one solution will admit of an indefinite number. This we have already found to be the case in the foregoing propositions. Such cases may not indeed occur in any of the practical applications of geometry; but there is one of the same kind which has actually occurred in astronomy. Sir Isaac Newton, in his *Principia*, has considered a small part of the orbit of a comet as a straight line described with an uniform motion. From this hypothesis, by means of four observations made at proper intervals of time, the determination of the path of the comet is reduced to this geometrical problem. Four straight lines being in position, it is required to draw a fifth line across them, so as to be cut by them into three parts, having given ratios to one another. Now this problem had been constructed by Dr. Wallis and Sir Cristopher Wren, and also in three different ways by Sir Isaac himself in different parts of his works; yet none of these geometers observed that there was a particular situation of the lines in which the problem admitted of innumerable solutions; and this happens to be the very case in which the problem is applicable to the determination of the comet's path, as was first discovered by Boscovich, who was led to it by finding, that in this way he could never determine the path of a comet with any degree of certainty.

The preceding account of this interesting branch of the ancient geometry, is taken from a very elegant and elaborate paper, *On the Origin and Investigation of Porisms*, by the late Professor Playfair, published in the third volume of the Transactions of the Royal Society of Edinburgh, and also in his collected *Works*, (vol. iii. p. 178.) For further particulars on the subject, the reader may consult the original paper of Professor Playfair; Dr. Simson's treatise, *De Porismatibus*, contained in his *Opera Reliqua;* a paper in the fourth volume of the Edinburgh Transactions, by Professor Wallace, entitled, *Some Geometrical Porisms, with examples of their application to the Solution of Problems;* Dr. Traill's *Account of the Life and Writings of Robert Simson, M.D;* and Professor Leslie's *Geometrical Analysis*. At the end of Dr. Stewart's *General Theorems*, above mentioned, five very remarkable porisms are enunciated, the demonstration of the first of which is given in Leybourn's *Mathematical Repository*, (vol. i.) and of the remaining four in the fifth volume of the same work published in 1830. The algebraic analysis may frequently be applied with great advantage in the investigation of porisms, but this manner of treating the subject does not come within the scope of the present article.

PORK, the flesh of swine killed for the purposes of food. The hog is the only domestic animal that we know which is of no use to man when alive, and therefore seems properly designed for food. Besides being loathsome and ugly to every eye, it is killed without reluctance. The Pythagoreans, whether to preserve health, or on account of compassion, generally forbade the use of animal food; and yet it is alleged that Pythagoras reserved the use of hog's flesh for himself. The Jews, the Egyptians, and other inhabitants of warm countries, and all the Mahomedans, reject the use of pork. It is difficult to discover a satisfactory reason for this, or for the precept given to the Jews respecting it, though unquestionably some good one might be assigned. The Greeks greatly commended this food; and Galen everywhere speaks in its praise. The Romans considered it as one of their delicacies; and if some of the inhabitants of the northern climates have taken an aversion to it, that probably arose from their country not being fitted to rear it. Pork is of a very tender structure, increased perhaps from a peculiarity in its economy, namely, taking on fat more readily than any other animal. Pork is a white meat even in its adult state, and then gives out a jelly in great quantity.

PORLOCK, a small market town of Somersetshire, in the hundred of Carhampton, 170 miles from London. It stands at the foot of a lofty range of mountains, on a beautiful bay of its own name, on the Bristol channel. The inhabitants were, in 1801, 600; in 1811, 633; in 1821, 769; and in 1831, 830.

PORO-ISLE, commonly called Porto-Sipora or the island of Good Fortune. It contains four villages, in each of which there are about a thousand inhabitants. It is thirty-three miles in length, by eight in average breadth, and is almost wholly covered with wood. It is situated on the south-western coast of the Poggy Islands, and is inhabited by a race of people similar both in manners and language. Long. 99. 15. E. Lat. 2. 12. S.

PORONNISHIR, one of the Kurile islands in the North Pacific Ocean, about 44 miles in length and 12 in breadth. It is unequal in its surface; the northern part being mountainous, but the north-west less so, though it is still diversified by hills and valleys, one chain of hills rising to a great height, and being never wholly free from snow. It contains abundance of minerals, but is destitute of timber. Wolves and red foxes are found here in plenty; and there is a considerable bay at the north-eastern extremity. The most northern point of the island is Cape Wasitieff, in long. 156. 14. E. Lat. 51. 38. N.

PORPHYRIUS, a famous Platonic philosopher, was born at Tyre in 233, in the reign of Alexander Severus. He was the disciple of Longinus, and became the ornament of his school at Athens, whence he went to Rome, and attended Plotinus, with whom he lived six years. After Plotinus's death he taught philosophy at Rome with great success, and became well skilled in polite literature, geography, astronomy, and music. He lived till the end of the third century, and died in the reign of Diocletian. There are still extant his book on the Categories of Aristotle; a Treatise on Abstinence from Flesh; and several other pieces in Greek. He also composed a treatise against the Christian religion, which is now lost. That work was answered by Methodius bishop of Tyre, and also by Eusebius, Apollinarius, St. Augustin, St. Jerome, St. Cyril, and Theodoret. The Emperor Theodosius the Great caused Porphyrius's book to be burned in 338. Those of his works that are still extant were printed at Cambridge in 1655, 8vo, with a Latin version.

"Porphyrius," says Dr. Enfield, "was, it must be owned, a writer of deep erudition; and had his judgment and integrity been equal to his learning, he would have deserved a distinguished place among the ancients. But neither the splendour of his diction, nor the variety of his reading, can atone for the credulity or the dishonesty which filled the narrative part of his works with so many extravagant tales, or interest the judicious reader in the abstruse subtilties and mystical flights of his philosophical writings."

PORPHYRY, a compound rock. The art of cutting porphyry, practised by the ancients, appears to have been lost. Indeed it is difficult to conceive what tools they used for fashioning those huge columns and other porphyritic works in some of the ancient buildings in Rome. Modern tools will scarcely touch porphyry. Dr. Lister therefore thinks, that the ancients had the secret of tempering steel better than we; and not, as some imagine, that they had the art of softening the porphyry, since it is probable that time and air may have contributed to increase its hardness. Mr. Addison says, he saw a workman at Rome cutting porphyry; but his advances were extremely slow and almost insensible. The Italian sculptors work the pieces of old porphyritic columns still remaining (for the porphyry quarries are long since lost) with a brass saw without teeth. With this saw, emery, and water, they rub and wear the stone with infinite patience. Many persons have endeavoured to retrieve the ancient art, and particularly Leon Baptista Alberti, who, searching for the necessary materials for temper, says, he found goat's blood the best of any; but even this avails not much; for in working with chissels tempered with it, sparks of fire came much more plentifully than pieces of the stone. The sculptors were thus, however, able to make a flat or oval form; but could never attain to any thing like a figure.

In the year 1555, Cosmo de Medicis is said to have distilled a water from certain herbs, with which his sculptor, Francesco Tadda, gave his tools such an admirable hardness and so fine a temper, that he performed some very exquisite works with them, particularly our Saviour's head in demi-relief, and Cosmo's head with that of his duchess. The very hair and beard, how difficult soever, are here well conducted; and there is nothing of the kind superior to it in all the works of the ancients; but the secret appears to have died with him. The French have discovered another mode of cutting porphyry, namely, with an iron saw without teeth, and with *grez*, a kind of free-stone pulverized, and water. The authors of this invention say that they could form the whole contour of a column, if they had matter to work on. Others have proposed to harden tools so as to cut porphyry, by steeping them in the juice of the plant called bear's breech or brankursine. (See Birch's *Hist.* R. S. vol. i. p. 238. vol. ii. p. 73, &c.) Mr. Boyle says, that he caused porphyry to be cut by means of emery, steel saws, and water; but he observes, that in his time the English workmen were ignorant of the manner of working porphyry, and that none of them would undertake to cut or polish it. (See his Works abr. vol. i. p. 11.)

Da Costa supposes, and perhaps with reason, that the method used by the ancients in cutting and engraving porphyry was extremely simple, and that it was performed without the aid of any scientific means. He imagines, that, by unwearied diligence, and with numbers of common tools, they rudely hewed or broke the stone into the intended figure, and by continued application reduced them into more regular designs; and that they completed the work by polishing it with great labour, by the aid of certain hard sands found in Egypt. And he thinks, that in the porphyry quarries there were layers of grit or loose disunited particles, analogous to the porphyry, which they carefully sought for, and used for this work. See GEOLOGY and MINERALOGY.

PORSON (RICHARD), the greatest of the verbal critics and classical scholars of modern times, born on the 25th of

December 1759, was the son of Mr. Huggin Porson, parish clerk of East Ruston, near North Walsham, in Norfolk.

His father taught him, in his childhood, to practise all the common rules of arithmetic by memory only; and, before he was nine years old, he had learned to extract the cube root in this manner. At the same time, for teaching him to read and write, he employed the method which has since been generally introduced in the schools of mutual instruction, making him draw the letters with chalk or on sand; and the neatness and accuracy of his hand-writing, for which he was distinguished through life, may be considered as bearing ample testimony to his father's ingenuity and success.

At the age of nine he was sent to a village school, kept by a Mr. Summers; but his father still made him repeat by heart in the evening the whole of the lessons of the day; and there seems to be sufficient evidence for considering this practice of exercising the memory continually, in very early life, as the best, if not the only method of cultivating, if not of producing great talent. For though a strong memory by no means constitutes talent, yet its possession is almost a necessary condition for the successful exertion of talent in general; and, indeed, it is very possible that the other faculties of the mind may be strengthened by the early cultivation of this one. It is remarkable that Wallis, who was as deservedly celebrated in his day as Porson, for his unerring sagacity, had also a singular facility of retaining numbers and calculations in his memory, but without having taken any particular pains to acquire the habit. Mr. Hewitt, the vicar of the parish of East Ruston, hearing of young Porson's uncommon capacity, undertook to instruct both him and his brother Thomas in classical literature; and when he was about fifteen, Mr. Norris, a wealthy and respectable gentleman of the neighbourhood, having ascertained the truth of the reports that he heard of him, resolved to be at the expense of sending him to Eton. Without this assistance it would have been impossible for Porson to have acquired great excellence in any intellectual pursuit; for his father's situation in life was not such as to exempt his son even from the subordinate occupations of the country. He went out gleaning, in the autumn, with a Horace in his pocket; and he had learned by experience to appreciate the mechanical labours of Penelope, before he was much acquainted with the wisdom and wanderings of Ulysses.

At Eton, his talents procured him the friendship and admiration of the seniors amongst his schoolfellows, and, upon the unfortunate death of his first patron, Mr. Norris, he found a number of liberal contributors, who stepped forward to supply the deficiency; but by far the most active of them was Sir George Baker, then President of the Royal College of Physicians, a man as much distinguished by his own classical taste and acquirements, as by his laudable disposition to cherish learning in others. He received the boy into his house for a vacation, and undertook, at the request of a relation of Mr. Norris, the disagreeable task of receiving, in small sums, as much as was sufficient to purchase an income of L.80 a-year, for a few years, in the short annuities, which served, with great economy, to enable him to remain at Eton. This favour appears to have been too great to be properly acknowledged, or perhaps even duly appreciated, by its object, who only after many years paid Sir George the tardy compliment of a dedication, not, however, of an edition, but of a handsome copy of a single play of Euripides. In his own opinion, Porson learned little at Eton besides the quantity of syllables, being able to repeat by heart before he went there the principal part of the authors that he had to read; that is, almost the whole of Horace and Virgil, the *Iliad*, and many parts of Cicero, Livy, and the *Odyssey*. A story is accordingly told of his book having been changed by one of his schoolfellows in joke, when he was going up to a lesson in Horace, and of his having read and translated what was required of him, without at all betraying the change to his master. At the same time, the emulation of a public school must have been a great advantage to him, as affording him a motive for exertion in his exercises, whether they were to be called his own, or to be written for other boys. It was a copy of Toup's Longinus, presented to him as a reward for a good exercise, that first gave him a decided inclination for the pursuit of critical researches; but he always considered Bentley and Dawes as his great masters in criticism.

In 1777 he was sent to Trinity College, Cambridge, and at first he began to apply more particularly to the mathematics, which had been the favourite study of his boyhood, and in which, as he himself remarked, his proficiency first brought him into a certain degree of public notice. He was, however, soon diverted from this pursuit, although he attained a place amongst the *senior optimes* of his year. But he was in fact more calculated for classical than for mathematical excellence. His memory would have been in a great measure thrown away, if he had been employed in abstract calculations; and his inventive powers do not appear to have been at all of the same class with his retentive faculties; although certainly in the mechanical pursuit of the fashionable methods of modern analysis, which are intended, like steam engines, to overcome all difficulties by the inanimate force of mere patience and perseverance, he was capable of filling as distinguished a place as any living algebraist. The classical prize medal, and the university scholarship, he obtained without difficulty, as matters of course. The exercise, which he exhibited upon the examination for the scholarship, is the well known translation of an epitaph into Greek iambics; which, although not free from some inaccuracies in the use of the tenses, is still a very remarkable production, when it is considered as having been completed in less than an hour, with the help of Morrell's *Thesaurus* only, and never afterwards corrected.

He obtained a fellowship of Trinity College in 1781, and took his degree of Master of Arts in 1785; but not thinking it right to subscribe the Articles of the Church of England, he could not enter into orders, and he was therefore unavoidably deprived of his fellowship in 1791, having no dependence left for his subsistence through life, but his own abilities and acquirements. His friends, however, did not abandon him on this urgent occasion, and in order to keep him out of actual want, a private subscription was set on foot, to which Mr. Cracherode was one of the principal contributors, and by which enough was raised to purchase him an annuity of about L.100 a-year for life. A small addition was made to his income, about two years afterwards, by his election to the Greek Professorship at Cambridge, with a salary of only L.40 a-year. The situation, however, gave him the option of at least doubling his whole receipts, by the delivery of an annual course of lectures in the university; and it was supposed that he would have made this exertion, if he had not been discouraged by the difficulty of obtaining rooms in his college, where it would have been his wish to reside.

Porson married, in 1795, Mrs. Lunan, a sister of the late Mr. Perry, well known as the editor of the *Morning Chronicle*, but he had the misfortune to lose his wife two years afterwards. Mr. Perry continued to be his greatest friend through life, and was so far his best benefactor, as he knew how to oblige him essentially, without the appearance of doing him a favour. Porson had sometimes chambers in the Temple, and sometimes he lodged at the *Morning Chronicle* office; frequently also he was a visitor at Mr. Perry's house at Merton, where he had the misfortune to leave several of his books, at the time of a fire, which destroyed them all, and amongst them some letters of Rhunkenius, with whom he had begun a correspondence in 1783, and who had committed to him some valuable fragments of Æschylus, besides his manuscript copy of the lexicon of Photius, which had cost him ten months' labour. He used indeed to say that this fire had destroyed the fruits of twenty years of his life; but he had the resolution to complete a second copy of the Photius, which is now in the library of Trinity College. His fondness for the mechanical employment of his pen has been regretted by some of his biographers, as having tempted him to waste much of his most valuable time on a trifling amusement; but in fact, his mode of writing Greek was fully as much calculated for expedition as for beauty; and those who have not been in the habit of correcting mutilated passages of manuscripts, can form no estimate of the immense advantage that is obtained, by the complete sifting of every letter, which the mind involuntarily performs, whilst the hand is occupied in tracing it; so that, if the correction of Photius was really worth the labour of two years of Porson's life, it would have been scarcely possible to employ the greater part of those years more advantageously, than by copying him twice over. Mr. Weston, in speaking of "his matchless penmanship," has observed, not very intelligibly, that "here, indeed, he thought himself surpassed by" another person "not in the stroke, but the sweep, of his letters." What Porson really said on this subject was, that, with respect to "command of hand," that person had the advantage, but he preferred the *model* on which his own hand was formed. His writing was, in fact, more like that of a scholar, whilst the method explained in Mr. Hodgkin's *Calligraphia* exhibits more the appearance of the work of a writing master; holding, however, a middle place between the neatness of Porson, and the wonderful accuracy of the country schoolmaster who made the fac simile of the Oxford Pindar in the British Museum.

Upon the establishment of the London Institution, his friends obtained for him the very desirable appointment of principal librarian, with a salary of L.200 a-year, and apartments in the house of the Institution, which was then in the Old Jewry; but although the arrangement was highly honourable to all parties, the librarianship was little more than a sinecure. Porson was, however, in the habit of attending in his place when the reading-room was open, and of communicating, very readily, all the literary information that was required, by those who consulted him respecting the object of their researches. Had the inhabitants of Finsbury Square and its neighbourhood been more disposed to classical studies, and had the librarian of the Institution survived, to witness its completion and prosperity, his sphere of utility would, without doubt, have been greatly extended.

But it must ever be lamented that Porson's habits of life had unfortunately been such as to lay a foundation for a multitude of diseases. He suffered much from asthma throughout the year 1808; his memory began to fail him a little; and in the autumn he had some symptoms of intermittent fever. On Monday the 19th of September he had an apoplectic attack in the street, and he was carried to a neighbouring poor house in a state of insensibility. The next day an advertisement appeared in one of the papers, relating the accident, and describing some manuscripts which were found in his pocket, consisting of Greek fragments and algebraical characters. His friends at the London Institution immediately went in quest of him; he was afterwards well enough to appear in the library, and to receive a visit there from Dr. Adam Clarke; but his speech was impaired, and his faculties evidently imperfect. He survived only through the week, and died in his forty-ninth year, on Sunday the 25th of September 1808, at midnight.

He was buried at Cambridge, in Trinity College Chapel, near the grave of Bentley, and the monument of Newton. He founded by will an annual prize, to be given to the best Greek translation from an English dramatic author; and several specimens of the successful pieces have been published from time to time in the *Classical Journal*. His books were sold by auction, and many of them found purchasers at high prices, especially such as were enriched with any of his manuscript notes in their margins; but more than two hundred of these, which appeared to be the most valuable, were withheld from the sale, and were afterwards purchased, together with the whole of his manuscript papers, by the Society of Trinity College, for the sum of a thousand guineas. He left a sister, married to Mr. Siday Hawes, of Coltishall, Norfolk. His brother Thomas kept a boarding-school at Fakenham, and died, without issue, in 1792: his second brother, Henry, was a farmer in Essex, and died young, leaving three children. His father had lived to 74, his mother to 57.

The principal works of Porson are his *Letters to Travis*, his four plays of Euripides with their prefaces, and the manuscript copy of Photius; the rest, though somewhat voluminous, are chiefly miscellaneous annotations upon detached passages of a multitude of ancient authors. We find nothing in the nature of theory, or of the discovery of general laws, except some canons, which he has laid down, chiefly as having been used by the Greek tragedians in the construction of their verses. These are chiefly contained in the preface to the *Hecuba*, together with its supplement. 1. The first is, that when a tragic iambic ends with a trisyllable, or a cretic, this word must be preceded either by a short syllable, or by a monosyllable. For example, an ancient tragedian would not have written the line Ἔχοι δὲ μήποτ᾽ ἐξ ἀπευκτοῦ δώματος, though it might have been unexceptionable in a comedy. It seems to have been about the year 1790 that Porson first made this observation. He certainly did not attend to it in his own serious translation of the *Epitaph on Alexis;* but it was mentioned, in 1791, by one of Porson's intimate friends, in a moment of conviviality, whilst he was somewhat characteristically attempting to fill his glass out of an empty bottle; and the author of this article observed in answer, that it would certainly sound better, on such an occasion as then occurred, to say, Πᾶν ἐκπέπωκας· οὐδ᾽ ἜνεσΤΙ κότταβος, than οὐ λελειπΤΑΙ κότταβος. 2. The second canon is, that an anapaest is only admissible in a tragic iambic, as constituting the first foot, except in some cases of proper names. This indeed had been cursorily hinted by Dawes. 3. The same critic had also remarked, that the Attic poets never lengthen a short vowel before a mute or aspirate, followed by a liquid, or a middle consonant followed by ρ; and Porson more amply confirmed the observation as very generally, though not universally correct. On the other hand, Dawes had cursorily observed that Homer, and the other ancient epic poets, generally lengthened the vowel in such cases, and Porson's great rival, Hermann, has more fully established this distinction, as affording a good criterion of antiquity. 4. There are also some original remarks of Porson on the caesura, in iambics, and trochaics, and anapaests. He showed that the scenic poets do not elide the final iota, and that the tragedians do not employ the preposition περὶ before a vowel; and some other general laws, of greater importance than these, may probably be found in some of his publications, which it will now be necessary to enumerate in the order of time.

1. His first attempts, as an author, consisted of some anonymous articles in Dr. Maty's *Review*, beginning with a part of Shutz's *Æschylus*, June 1783, *Tracts* ii. Brunck's *Aristophanes*, July 1783, *Tracts* iii.; *Mus. Crit.* ii. 113; written in a day. In Latin, by Schäfer, *Class. Journ.* v. 136. Weston's *Hermesianax*, April 1784, *Tracts*, iv. Huntingford's *Apology for his Menostrophics*, August 1784, *Tracts* v. *Account of the Learned Pig*, April 1785, *Tracts* vi. *Note*, with letters of Le Clerc and Bentley, April 1786, *Tracts* vii.

2. He added some *Notes* to an edition of Xenophon's *Anabasis*, published by Nicholson, at Cambridge, 4to and 8vo, 1786. They are addressed *Lectori si quis erit.*

3. *Three Panegyrical Epistles to Sir J. Hawkins, Gent. Mag.* August, September, and October, 1787. *Tracts* ix.

4. Notes on *Toupii Emendationes in Suidam.* Oxford, 8vo. 1790. Written in 1787.

5. *Letters on the Three Witnesses, Gent. Mag.* Oct. and Dec. 1788. Feb. April, May, June, Aug. 1789. Feb. 1790. The last was reprinted in *Tracts* xix.; most of the others in the collection of *Letters to Mr. Archdeacon Travis*, in answer to his defence of the *Three Heavenly Witnesses*, London, 1790, 8vo. These letters are generally considered, by critics of all parties, as finally decisive of a question, which had often been agitated before, but never so learnedly argued, nor so satisfactorily discussed in all its bearings.

6. In the *Monthly Review*, Robertson's *Essay on the Parian Chronicle*, Jan. 1789, *Tracts* xiii.; satisfactorily answering the principal part of the objections alleged against the authenticity of that monument. Edwards' edition of the work attributed to Plutarch, *on Education*, July 1793, *Tracts* xxi. Payne Knight's *Greek Alphabet*, Jan. 1794, *Tracts* xxiii. Pybus's *Sovereign*, Dec. 1800; an article affording a good specimen of his talent for humour.

7. He is supposed to have written some *Remarks* on an *Essay upon the Transfiguration*, but never expressly acknowledged them. *Tracts* xv.

8. He added a few short *Notes* to the London edition of Heyne's Virgil, 8vo, 1793, for which he made an agreement with the bookseller to correct the press; but he complained that his corrections were disregarded; and in fact several hundred errors, of no great importance, were suffered to disfigure it.

9. He corrected the Greek text of Æschylus for the Glasgow editions, the folio of 1795, and the two volumes octavo, printed in 1794, but only published at London in 1806. The folio is said to have appeared surreptitiously. There are more than two hundred original corrections, and a further number of passages pointed out as corrupt.

10. In the *Morning Chronicle* he published, at different times, a variety of spirited articles of a temporary nature. One of the most amusing was the *Nursery Song* in Greek iambics, 13th of April 1796, called *A Fragment of Sophocles*, and signed "S. England," in ridicule of Ireland's pretended discoveries.

11. *Imitations of Horace. Spirit of the Public Journals*, 1797. *Class. Jour.* iv. 97.

12. The first four plays of Euripides appeared separately at different periods. The *Hecuba*, London, 1797, 8vo. Cambridge, 1802, with a Supplement and additional notes; which were also published separately, London, 1808. *Orestes*, London, 1798, 1811. *Phoenissæ*, London, 1799, 1811. *Medea*, Cambridge, 1801; London, 1812. The four together, London, 1822.

13. *Collation* of the Harleian manuscript of the *Odyssey* for the Grenville *Homer*, Oxford, 1800, 4to; with some short notes. Reprinted, *Class. Jour.* ix.

14. Of the *Review of Wakefield's Lucretius*, in the *British Critic* for May 1801, the principal part appears to be Porson's.

15. *A Letter signed by J. N. Dawes, Monthly Mag.* Dec. 1802, on some Greek constructions; admitting also an inaccuracy of his own with respect to a hiatus, pointed out by Mr. C. Falconer.

16. *A Letter to Professor Dalzel*, dated September, 1803; *Mus. Crit.* i. p. 326; in answer to some remarks published in the Professor's *Collectanea Majora;* with an Epigram respecting Hermann, in Greek and in English.

17. *Herodotus*, Edinburgh, 1806. Porson corrected the press for the first volume.

18. *Supplement to some Indices, Tracts* xxxvi.

19. It is well known that Porson bestowed considerable pains on the restoration of the text of the *Rosetta Stone.* His *Supplements* were added to the plates engraved by the Society of Antiquaries; and they also appear amongst his *Tracts*, xxxvii. In Dr. Clarke's *Greek Marbles*, Cambridge, 1809, 8vo, we find a translation of this inscription, communicated to the editor by Porson, and printed from "a *corrected copy* in his own beautiful handwriting." But we may here venture to apply Porson's favourite remark on the facility of transposition, and to read "a *copy corrected* in his own writing," that is, on the margin of Mr. Gough's translation, as published in *Duane's Coins.* For the whole is very negligently performed; and it is not a little remarkable that this translation, which was at least approved by Porson, is decidedly less accurate than the Latin translation of Heyne, as appears from the investigation of the enchorial inscription published in the sixth number of the *Museum Criticum.*

20. A variety of Porson's fugitive and miscellaneous pieces have reappeared at different times in the *Classical Journal. Authors cited by the Scholiast on Plato*, ii. 619, *Tracts*, xxxviii. *The Epitaph*, iii. 233; more correctly than in the *Tracts*, but still with a gross error in the punctuation of the last line, which stands, in a manuscript copy of his own, Τέθνηχ', ὃ δὴ τάχιστα πάσχοντ' οἱ 'γαθοί. This reading, though not very elegant, is at least more defensible, than to make πάσχειν alone signify to die, and a phrase to end with ὁ δή. A *Charade* in Latin, vii. 248. Some *Notes on Æschylus*, vii. 456; viii. 15, 181; x. 114. *A property of the lines* employed in the 47th proposition of the first book of *Euclid*, p. 401. *Notes on Apollonius Rhodius*, xviii. 370.

21. *Adversaria.* Cambridge, 1812, 8vo, consisting of *Notes* on the Greek Poets, selected from his manuscripts, and arranged by Professor Monk and Mr. C. J. Bloomfield. The first article is an interesting *Lecture on Euripides*, delivered upon his appointment to the Greek Professorship. It is followed by a few miscellaneous observations, and by a large collection of *Notes* on Athenaeus, on Euripides, on the *Fragments of the Tragic and Comic Poets*, on Stobaeus, and on a variety of poets of miscellaneous descriptions. The volume was reprinted at Amsterdam, without any alteration, but the sale of the foreign edition has never been permitted in Great Britain.

22. *Tracts and Miscellaneous Criticisms*, collected and arranged by the Rev. T. Kidd, M. A. London, 1815, 8vo. Besides the articles already noticed as reprinted in this volume, there are a few *Notes on Dawes's Miscellanea Critica*, not before published, No. 51. There are also some supplementary pages of *Simplicius and Cebes*, reprinted by Porson, for the use of his friends, as restored by Schweighäuser. The want of this leaf of the manuscript of *Simplicius* had given rise to the mistaken assertion that Xenophon was proclaimed a public benefactor at the Olympic Games, on occasion of the return of the ten thousand. There are likewise some miscellaneous *Notes* on Athenaeus, Menander, and Philemon, Aristides, Pausanias, and the lexicographers, and some *Indices* of authors quoted by the Scholiasts.

23. *Notae in Aristophanem*, quibus Plutum comoediam adjecit P. P. Dobree. Cambridge, 1820, 8vo.

24. Gaisford *Lectiones Platonicae.* Accedunt R. Porsoni *Notae ad Pausaniam.* Oxford, 1820, 8vo.

25. *Photii Lexicon.* Cambridge, 1822, 8vo.

To attempt to form a just estimate of the merit of such a man as Porson, without servilely following the dictates of common fame, or blindly adopting the opinions of others, is a task of no small difficulty, even to one who had the advantage of his personal acquaintance for the last twenty years of his life. But it may safely be conceded to common fame and to partial friendship, that he was one of the greatest men, and the very greatest critic, of his own or of any other age. "Nothing came amiss," says Mr. Weston, "to his memory. He would set a child right in his twopenny fable book, repeat the whole of the moral tale of the *Dean of*

Badajoz, a page of Athenaeus on cups, or of Eustathius on Homer, even though he did every thing to impair his mental faculties." It cannot, however, be denied, that the talents, and even the industry, that he possessed, might have made him a much greater man, had they been employed in some other department of human intellect. He might *probably* have been as great a statesman or as great a general as he was a scholar, and in these capacities his acquirements would have affected the interests of a much greater multitude of his fellow-creatures, than can ever be benefited by the fruits of his erudition; and he might *possibly* have gained more popularity as an orator or a poet, than his refined investigations of grammar and prosody could ever procure him, although it is not by any means certain that his fancy and invention could have been rendered by any cultivation at all comparable to his memory and acuteness. But as far as regards the possession of a combination of the faculties which he did cultivate, he appears to have been decidedly the most successful of any man on record in the same department. On the other hand, it must be admitted that the subjects of his pursuits were in their nature incapable of raising a man to the first rank amongst the permanent benefactors of the human race; and, if we calmly consider the ultimate objects of prosody and metre, it will appear almost unfair to allow the discoverer of the prosodiacal rules, adopted by the ancient poets in their melodrames and choruses, to rank so very high amongst the luminaries of an age, and yet to look down, with so much contempt as we are accustomed to do, on the character of a modern *Dieu de la danse*, notwithstanding that he thought himself the third great man of his day, with Voltaire and the King of Prussia, for having given soul and sentiment to the measures and movements of the choric representations of the present times.

Amongst the talents of Porson, however, which were so far superior to the importance of the objects on which they were employed, we ought not, perhaps, to consider his remarkable strength of memory as the most to be envied, since many persons who have been possessed of singular and almost miraculous, not to say morbid, memories, have been but little distinguished by any other faculty. It appears to be possible that a memory may in itself be even too retentive for real practical utility, as if of too microscopic a nature; and it seems to be by a wise and benevolent, though by no means an obvious arrangement of a Creative Providence, that a certain degree of oblivion becomes a most useful instrument in the advancement of human knowledge, enabling us readily to look back on the prominent features only of various objects and occurrences, and to class them and reason upon them, by the help of this involuntary kind of abstraction and generalization, with incomparably greater facility than we could do, if we retained the whole detail of what had been once but slightly impressed on our minds. It is thus, for example, in physic, that the experienced practitioner learns at length to despise the relation of individual symptoms, and particular cases, on which alone the empiric insists, and to feel the value of the Hippocratic system of "attending more to the prognostic than the diagnostic features of disease;' which, to a younger student, appears to be perfect imbecility. And it is perhaps for some similar reason that many persons, besides Barnes, "of happy memory," have had to wait long in darkness for "the day of judgment." But it must be repeated, that Porson's judgment and acuteness were really almost paramount to his memory; and with the addition of these faculties, his memory naturally rendered him capable of much that would have been impossible without it.

The respect that is justly due to classical learning has frequently been exaggerated in this country, partly, perhaps, on account of the awe which is naturally entertained, by an ingenuous mind, for its instructors in the earliest studies, by which it is advanced towards maturity. And classical learning having most wisely been placed by our ancestors the foremost, in the order of a liberal education, which is most commonly adopted in Great Britain, a personal as well as a general respect has been involuntarily paid to the characters of the individuals concerned, and to the dignity of all those who are engaged in similar occupations; besides that, the means being, by a most frequent inattention of the human mind, confounded with the end for which they are sought, the words and syllables, and the phrases and measures of the Greek and Latin authors have often been the almost frivolous occupation of a valuable life, instead of that of a few of the years of boyhood, which it was intended to devote to them, and which could not have been so well engaged in any other way. It is, however, wholly unjust to stigmatize the study of the classics, and of languages in general, as being confined to words instead of things; for it is utterly impossible that words can be learned, without the acquisition of a considerable degree of knowledge of the things to which they relate, and of the historical facts which they have been employed to express, and without an involuntary modelling of the mind to the elegance and elevation of sentiment, which pervade the works of those authors who are habitually put into the hands of boys in the course of their elementary studies; an acquirement which is of still greater value to the orator and the statesman, than the command of language, and facility of expression, and beauty of imagery, and power of reasoning, which he derives from a perfect familiarity with the great masters of antiquity. But granting all the respect that can possibly be claimed for ancient literature, we cannot but lament that such a man as Porson should have lived and laboured for nearly half a century, and yet have left little or nothing to the world that was truly and originally his own.

After the full admission of the very high rank which is due to the comparative merits of Porson's talents and acquirements, it may be thought almost idle, if not invidious, to dwell on any trifling exceptions to their magnitude. But it is, in fact, of high importance to the progress of human knowledge, to be aware of the degree in which the first of mankind are liable to error. The admission of the few errors of Newton himself, is at least of as much importance to his followers in science, as the history of the progress of his real discoveries. And it is with reason that the detection of an error in such a man is considered as almost paramount to the establishment of a new fact. The English critics have been reproached, and not without some foundation, as paying too servile a deference to Porson's opinions; and it seems to have been very generally believed amongst them, that it was scarcely possible for him to commit an error or an oversight.

Although Porson was in many respects irregular, and often idle, or even intemperate, yet what he did perform as a critic, may be allowed to leave a large balance, at the end of his life, in favour of his general industry, when compared with that of most of his countrymen. It has indeed been asserted, and perhaps with truth, (*Classical Journal*, xxi.) that "with things Porson appears to have possessed but a very inconsiderate acquaintance; and not a trace is to be found amidst his writings, of that combination of universal encyclopædiacal knowledge with language learning which is so abundantly found in the *Dissertation on Phalaris*, and the countless pages of Scaliger, Salmasius, and Casaubon." Certainly, however, neither Salmasius nor Casaubon, with all their learning, much less Scaliger, with all his industry and parade, nor even Bentley himself, with all his talent and acuteness, was at all comparable to Porson in his own department, that is, as a sound, and accurate, and refined Greek critic.

But it must be confessed, that at Cambridge, even although Porson had resolved to make the classics his principal study, and although there had not yet been many instances of senior wranglers, who were also senior medallists, it was scarcely reputable for a man, with his undeniable abilities, to be only the twenty-first of his year in mathematics. Amongst the literary objects also, which afterwards engaged his attention, he might easily have found time for the study of some of the modern languages; and he might have derived essential benefit from it on many occasions of critical research. He had, indeed, read a good deal of French, but very little Italian. He had studied the Anglo-Saxon, but he knew nothing of the kindred dialects of the north of Europe, in which it is preserved almost entire; and he was wholly unacquainted with Oriental literature. He might have profited materially by some of these studies, in deriving from them a clearer conception of the distinctions of the tenses than he seems to have possessed, and he might have enlightened us in no small degree, with respect to the history of languages and of nations, by such etymological investigations as his comprehensive mind, thus employed, would have rendered him peculiarly capable of pursuing with success.

It has been candidly and very truly admitted by a rival critic in Germany, that Porson committed fewer errors than almost any other person; but it is right to be aware that he has now and then committed some errors, even where he would have been expected to be the most correct. There is, for example, a very strange oversight in one of the criticisms contained in his early review of Weston's *Hermesianax*, which implies a palpable blunder with respect to the gender of a participle, Ζωρὸν μετροῦσα ϑυῶν πορφυρέης Λυσβιον ἐὲ ὑέλου, "the cup of purple glass, which *measured* the fragrant wine;" and even in a subsequent correction of the same passage, published in his *Adversaria*, he has changed the gender of an adjective in a way that is at least very unusual, if not wholly without example, μετροῦν θυόεντα. A mere omission, in a criticism on another author, would scarcely be called an error in an ordinary person; but in such a critic as Porson, it is very remarkable that he should have neglected to notice, in his catalogue of the *Errors of Le Clerc*, omitted by Bentley, (*Adv.* p. 291,) the grossest of all Le Clerc's blunders, which is the quotation of the word *Hypophauli* or *semibarbarous*, from Pollux, with the translation *Sartagines*, or *frying pans;* whilst the real text of Pollux simply and plainly states that the *Teganismi* or *fricassations*, in the *Hippocomus Menander*, is *a semibarbarous word*. These instances, which have occurred in a very cursory perusal of some of Porson's works, would certainly not deserve to be noticed in a general sketch of his character, any otherwise than as exceptions to his perfect infallibility.

It can scarcely be considered as an imperfection in the constitution of Porson's mind, that he wanted that amiable vanity, which is gratified by the approbation even of the most inconsiderable, and which delights to choose for its objects the most innocent and the most helpless of those who are casually present in society. It has been observed that he would neither give nor take praise; and when he was told that somebody had called him a giant in literature, he remarked that a man had no right to tell the height of that which he could not measure. In fact, having learned "to know how little can be known," it is not surprising that he found himself "without a second, and without a judge;" and that he was unwilling to affect a community of sentiment, and an interchange of approbation with those whose acquirements and opinions he felt that he had a right to despise. It might have been wiser, in some instances, to conceal this feeling; but, on the other hand, he had perhaps occasion for something of the habit of retreating into his conscious dignity, from his deficiency in those general powers of ephemeral conversation, which are so valuable in mixed societies; for, with all his learning and all his memory, he was by no means prominent as a talker. He had neither the inclination nor the qualifications to be a fascinating story teller, or to become habitually a parasite at the tables of the affluent; but he was the delight of a limited circle of chosen friends, possessing talent enough to appreciate his merits, and to profit by the information that he afforded them.

There has not yet been a life of Porson that has collected all the particulars that would deserve to be recorded by a biographer, who undertook the task on an extensive scale; but of detached documents there is no deficiency. Mr. Kidd has pointed out almost every work in which his name has been mentioned. The most material articles relating to him will be enumerated here.

Morning Chronicle, 6th October 1808. *A Short Account of the late Mr. Richard Porson, with some particulars relative to his extraordinary talents;* by an admirer of great genius (the Rev. S. Weston,) Μηκέτι πάπταινε κόρσιον, Look for nothing beyond him. London, 1808, 8vo. Republished, with some additions, under the title of *Porsoniana, or Scraps from Porson's Rich Feast*, London, 1814, 8vo. Bloomfield's *Sapphic Ode, Class. Journ.* i. 1. *Some anonymous Iambics*, p. 81. *Sale of his Library*, p. 385. *Athenæum*, iv. 426, 521; v. 55. *Class. Journ.* ix. 386. Savage's *Librarian*, i. 274. *Gentleman's Magazine*, lxxviii. *Monthly Magazine. Dr. Adam Clarke's Narrative. Class. Journ.* ii. 720. *Correspondence of Wakefield and Fox*, London, 1813, 8vo. *Greek Epitaph, Class. Journ.* xxiii. 179; making Porsōnum equal to Newtōnus. Aikin's *General Biography*, x. London, 1815, 4to. Kidd's *Imperfect Outline. Tracts*, 1815. Chalmers's *Biographical Dictionary*, xxv. London, 1816. L. L.

PORT, a harbour, river, or haven, formed either by nature or art to receive and shelter shipping from the storms and waves of the open sea.

Artificial ports are those which are either formed by throwing a strong mound or rampart across the harbour's mouth to some island or rock, or erecting two long barriers, which stretch from the land on each side like arms or the horns of a crescent, and nearly enclose the haven. The former of these are called *mole-heads*, and the latter *piers*.

PORT, is also a name given on some occasions to the larboard or left side of the ship, as in the following instances. Thus, it is said, "the ship heels to port," that is, stoops or inclines to the larboard-side. "Top the yard to port," the order to make the larboard extremity of a yard higher than the other. "Port the helm," the order to put the helm over the larboard-side of the vessel. In all these senses this phrase appears intended to prevent any mistakes happening from the similarity of sounds in the words *starboard* and *larboard*, particularly when they relate to the helm, where a misapprehension might be attended with very dangerous consequences.

PORTS, the embrasures or openings in the side of a ship of war, wherein the artillery is ranged in battery upon the decks above and below.

PORTADOWN, a thriving post-town, in the county of Armagh, Ireland, 66 miles from Dublin. It is situated on the Upper Bann, navigable here for vessels of 60 tons burden, and is by it connected with the Newry Canal. It has of late years been much improved, and its appearance is now highly respectable. The principal trade is in the agricultural produce of the surrounding country, which is forwarded to Newry by the canal, whilst the returning barges bring slates, coal, iron, &c. for the inland market. A good number of hands are employed in the linen and cotton trade. The population in 1831, amounted to 1,591.

PORTAFERRY, a sea-port town, on the eastern shore of the entrance into Strangford Lough, county of Down, Ireland, 80 miles from Dublin. It consists of a small square, a few streets, a range of houses on the quay, and several places for public worship. The principal trade is carried on with the Liverpool and Glasgow markets, for the agricultural produce of the neighbourhood. The population in 1821 was 1512, and in 1831, 2203.

PORTAL, in *Architecture*, a little gate where there are two gates of a different size; also a little square corner of a room cut off from the rest by the wainscot, and forming a short passage into the room. The same name is also sometimes given to a kind of arch of joiners' work before a door.

PORTALEGRE, a city of Portugal, in the province of Alentejo, the capital of a corregimiento of the same name. It is situated on a hill about seven miles from the frontiers, and strongly fortified, being defended by a citadel and many extensive outworks. It is the see of a Bishop, who has a fine cathedral, and under his care an ecclesiastical seminary. There are in this town four parish churches, and five religious houses, with some charitable institutions. It contains 1127 dwelling-houses, with 5780 inhabitants, who make a large quantity of woollen cloth, especially such as is adapted for the troops; and there are carried on some other branches of manufacture.

PORT ANNA MARIA, a bay or harbour on the south coast of Sir H. Mertin's island, in the South Pacific Ocean, seven miles west of Point Mertin. Long. of the entrance 139, 39. W. Lat. 8. 30. S.

PORTARLINGTON, a borough town, situated in King's County and Queen's County, Leinster, Ireland. It is 44 miles from Dublin, and is situated on the river Barrow, which divides it into two parts, and it consists principally of one long street, about two miles in length. The houses are generally large, and regularly built; but the town possesses neither commerce nor manufactures, nor is it situated on any high road of communication. The prosperity of the town depends on a greater proportion of gentry residing in it, than is generally to be found in towns of its size in Ireland; and also on the reputation of its schools. There are two Protestant churches, a Methodist, and Roman Catholic chapel. The borough possessed, before the year 1784, a large property; but the corporation in that year, and in the year 1802, conveyed over to Lord Portarlington, the patron of the borough, the whole of the property, which brings yearly to the noble proprietor L.800 sterling, and for which he pays to the corporation the sum of L.60 late Irish currency. The borough is governed by a sovereign, two bailiffs, and a recorder, and it returns one member to parliament. The population in 1821, amounted to 2877, and in 1831, to 3091.

PORTATE, or a Cross Portate, in *Heraldry*, a cross which does not stand upright, as crosses generally do, but lies across the escutcheon in bend, as if it were carried on a man's shoulder.

PORT-AU-PRINCE, the capital and seat of government of the republic of Hayti, formerly called St. Domingo or Española, one of the West India Islands. It stands at the bottom of the large bay of the same name, in a situation so low and marshy as to render the climate very unhealthy. It is mostly built of wood; the streets are broad but unpaved; nor are any of its edifices remarkable for their architectural elegance. It contains the president's palace, several literary and scientific institutions, a lazaretto, and some other public buildings. There is an academy for medicine, astronomy, law, literature, and other branches of knowledge; a drawing seminary, Lancasterian and primary schools, and a national library. There is also a military school, where the pupils receive instruction gratuitously; and several newspapers and periodical journals are published here. The city is supplied with water by a conduit three English miles in length. It has a spacious and secure port and roadstead, where five hundred vessels may anchor at once. It is surrounded by hills which command the town and harbour; and both the hills and the vallies are abundantly fertile. To the east is situated the noble and celebrated plain of Cul de Sac, extending from thirty to forty miles in length, by nine in breadth. It is chiefly laid out in sugar plantations, most of which can be watered in times of drought by means of canals admirably adapted for the purpose. Commerce is the principal occupation of the inhabitants of Port-au-Prince. The amount of imports may be estimated at twenty millions of francs; but the exports, consisting chiefly of coffee, cotton, Campeachy wood, sugar, and other articles, are much greater. This city was founded in the year 1745; but twenty-five years afterwards it was almost completely destroyed by an earthquake. It was rapidly rebuilt, but was nearly reduced to ruins by fire in 1791. In 1830, it again experienced several shocks of an earthquake, some of which did considerable damage. The inhabitants of the district of Port-au-Prince are estimated at about 90,000, and those of the city at about 30,000. Lat. 18. 34. N. Long. 72. 27. W.

PORTCULLIS, in *Fortification*, is an assemblage of several large pieces of wood, joined across one another like a harrow, and each pointed with iron at the bottom. They are sometimes hung over the gate-way of old fortified towns, ready to be let down in the case of surprise, when the gates cannot be shut.

PORT-DALRYMPLE, a harbour or estuary on the north coast of Van Dieman's Land, in which the Tamar discharges itself, after receiving the North and the South Esk. At the union of the latter it is navigable for vessels of 150 tons.

PORTER, a kind of malt-liquor which differs from ale and pale beer, in its being made with high-dried malt. See Brewing.

PORT-GLASGOW, a sea-port town of Scotland, is situated on the south bank of the Frith of Clyde, in the shire of Renfrew, about nineteen miles below Glasgow, and three above Greenock. This place originally formed part of the adjoining parish of Kilmalcolm, and consisted of the small village of Newark, so called from the barony of that name, which lay in its immediate vicinity. On a point of land projecting into the river, a little above the town, is situated the ancient and now deserted castle of this barony. The ground on which the town stands was, in 1668, purchased from Sir Patrick Maxwell of Newark, by the magistrates of Glasgow, with a view to provide a convenient harbour for the vessels belonging to the merchants of that city. A harbour was therefore constructed, and streets were laid off, according to a regular plan. In 1695 the place was, by the competent authority, detached from the parish of Kilmalcolm, and, with a few adjacent farms, erected into a distinct parish, approaching in form nearly to a square, and not exceeding an English mile either in length or in breadth. It was called New Port-Glasgow, or more commonly Port-Glasgow, a name simply expressing the design of its erection as the port or harbour of Glasgow. In 1775 it was created a borough of barony; and by the reform act of 1832 it became a parliamentary borough of the third class, uniting with Kilmarnock, Rutherglen, Dumbarton, and Renfrew, in returning a member.

Port-Glasgow is one of the most handsome and regularly built sea-port towns of Scotland. The streets are straight, and for the most part cross each other at right angles; whilst the houses, pretty nearly equal in size, and generally whitewashed, give to the whole a light and uniform appearance. The only buildings worthy of particular notice are the town-house and the parish church. Of these the former is of plain but substantial workmanship, ornamented in front with a portico, resting on four massy fluted columns, surmounted with a handsome spire, which rises from the centre. The parish church was built in 1823. It is square in form, and plain in outward appearance, but is deservedly admired for the simple elegance of its internal construction. A commodious chapel of ease belonging to the establishment was built in 1774. The only other place of worship in the parish belongs to the Associate Synod.

The land of this parish church lies along the bank of the river, having been long occupied as gardens, presenting a rich and highly cultivated appearance. The town itself is romantically situated at the bottom of a hill, which, covered with wood and verdure, exhibits a beautiful object to travellers passing along the river.

Attached to this port are two capacious harbours, substantially built, and completely sheltered from the storm. The first dry or graving-dock in Scotland was constructed here in 1762, and has since been improved at great expense. Some years ago, the harbour accommodation having been found too small, the inhabitants resolved to avail themselves of their local advantages, by converting the bay of Newark, which is naturally adapted to the purpose, into a spacious dock, where vessels of the largest class might be kept securely afloat in every state of the tide. Accordingly, in June 1830, the trustees of the harbour obtained an act of parliament, investing them with the necessary powers; and the work, which was contracted for by Mr. Gibb, an eminent architect, was commenced in the spring of 1834, and carried on with every dispatch until 1836, when a small portion of the outer wall gave way. In consequence of this untoward incident, the operations were considerably impeded, and it was even deemed expedient to erect a ruble breakwater, to enable the trustees to restore the outer wall so soon as the works had been allowed sufficient time to consolidate. As a substitute for the outer wall, and in order to secure the full benefit of the wet-dock, the trustees have, in the mean time, resolved to construct a wooden wharf on the outside. The works having since been considered as sufficiently consolidated, and the inner walls having afforded abundant evidence of their stability, the necessary sheds, together with the wharfs alluded to, have lately been contracted for, and are at present in rapid progress; so that this important undertaking, which has cost its enterprising promoters about L.40,000, may now be considered as completed. Many ships have already discharged their cargoes in it. Besides the numerous sail of merchantmen at present, (December 1838), within its walls, there is the British Queen, steam-ship, (receiving her machinery), the largest vessel ever built in the United Kingdom. This is the only wet-dock of the kind on the west coast of Scotland. It extends over a space of twelve imperial acres, is 25 feet deep, has an entrance-gate of 55 feet in width, is provided with spacious quays and commodious sheds, cranes, and other conveniences, and possesses extraordinary facilities for ingress and egress, owing to the great depth of water in the roads and entrance, and the protection afforded by the lofty hills by which the dock is sheltered. With all these advantages, in addition to an extensive tide harbour, Port-Glasgow now affords shipping accommodation of a very superior description. The charges on shipping at this port are much lower than at any other in Scotland. This is in a great measure owing to the extensive bonded warehouses held by the corporation, situated alongside the dock-walls, where every description of goods may be deposited at trifling rates.

The foreign trade of this port is chiefly with the West Indies and North America. It is the principal place on the Clyde for the importation of North American timber, for the reception of which it has large wood-ponds. Not less than 27,975 tons were imported in 1834. A comparative view of the tonnage employed in the foreign trade of the town during the last eight years indicates considerable improvement; the average inward tonnage for the four years prior to the 5th of January 1834 having been 23,901, and for the four years ending the 5th of January 1838, 28,761 tons. The harbour revenue exhibits a corresponding annual increase. In 1831, the harbour-dues amounted to L.1454; in 1834, to 1639; in 1836, to L.1800; and at present they average about L.2000 per annum. The customs collected have for the year ending in January 1838 amounted to L.94,161, a sum much less than what was received a few years ago. But the deficiency is not to be attributed to any decline of trade; for under the existing laws the amount of customs collected at any warehousing port forms no criterion for ascertaining the real extent of its commerce. The deficiency is attributable to two causes, which bear no direct reference to the decline or the improvement of trade; namely, first, the collection at Glasgow since the year 1834, of the duties upon tobacco, which were formerly paid here; and secondly, the facilities afforded by recent laws for recovering bonded goods from the port of importation without payment of the duty. Thus, merchandize of every description, although imported here, is daily removed under bond to other places, where the duties are paid, which causes a diminution of the customs paid at this port, and may at first sight lead to the inference that the commerce of the place is declining, whilst, in point of fact, it is on the increase.

The coasting trade of Port-Glasgow was at one time very considerable; but owing to the great facility with which vessels of inferior burden now find their way up the river, nearly the whole of this branch has been transferred to Glasgow.

The work of ship-building is carried on here to a considerable extent. Of late years the carpenters have been chiefly employed in the construction of steam-boats, of which they have produced a great number, some of them of the largest class, and all of them of remarkable symmetry and superior workmanship. The manufacture of ropes and sail-cloth has been prosecuted for about a century. A considerable trade is carried on in sugar-refining.

In 1700 the population was not more than 400 souls; but in 1718, the inhabitants amounted to twice that number. From this period the population continued steadily, though not rapidly, to increase until the year 1790, when it consisted of 4036 persons. At each of the four decennial censuses which have since been taken, it was as follows:—In 1801, 3865; in 1811, 5116; in 1821, 5262; and in 1831, 5192. From a survey which was taken expressly for the New Statistical Account, in the summer of 1835, it was ascertained that the population had increased to 6018. The comparatively slow increase of population in this place, and its occasional falling off, as above indicated, are referable to the fluctuations of foreign trade, and to the depressing influence of the neighbouring ports of Greenock and Glasgow.

PORTGREVE, or Portgrave, was anciently the principal magistrate in ports and other maritime towns. The word is formed from the Saxon *port*, a port or other town, and *geref*, a governor. It is sometimes also written *portreve*. Camden observes, that the chief magistrate of London was anciently called *portgreve;* but instead of him, Richard I. appointed two bailiffs; and soon afterwards John granted them a mayor as their yearly magistrate.

PORTICI, a palace of the king of Naples, six miles from the capital, and charmingly situated on the sea-shore, near Mount Vesuvius. It is enriched with a vast number of fine statues, and other remains of antiquity, taken out of the ruins of Herculanum. See Pompeii.

PORTICO, in *Architecture*, a kind of gallery formed on the ground; or a piazza encompassed with arches supported by columns, where people walk under covert. The roof is usually vaulted, but sometimes flat. The ancients called it *lacunar*. Though the word *portico*, be derived from *porta*, a gate or door, yet it is applied to any disposition of columns which form a gallery, without any immediate relation to doors or gates.

PORT-JACKSON, a bay and English settlement on the east coast of New Holland. The two heads through which the entrance lies are distant from each other one mile and three quarters; and the heads on each side are high, steep, perpendicular cliffs, between which ships may run in safety. It may be entered in all winds. Within, the port divides into two branches, the one stretching eighteen miles west, the other seven miles north-west. Both contain numerous creeks, on one of which is situated the town of Sidney, the chief town of Botany Bay. Long. of Castle Point, 151. 11. 49. E. Lat. 33. 51. 45. S.

PORTLAND, a town of Maine, one of the United States of North America. See Maine.

Portland, an island on the coast of Dorsetshire, or rather a peninsula, since it is joined to the mainland by a lofty bank of pebbles, which runs parallel to the sea, about three miles in length. Within the beach is a small arm of the sea, called the Fleet, the passage over which, by a ferry, is the common communication with Weymouth, from which it is distant about three miles. The island is a solid mass of stone, peculiarly adapted for buildings of the first class; and the extracting it from the quarries, and placing it on vessels, form the chief employment of the inhabitants. The surface of the rock is covered with a soil, the herbage of which feeds a small race of sheep, celebrated for the delicate flavour of their flesh. Some cows are also kept, and a small part of the land yields corn, but not sufficient for the inhabitants. The parish comprehends seven hamlets. It has a church near the centre; and towards the south end is the well constructed light-house, so important to navigation. Portland road is a secure anchorage, and is defended by a small fort. Lat. of the light-house 50, 31. 22. Long. 2. 26. 59. W. The population was in 1801, 1619; in 1811, 2079; in 1821, 2254; and in 1831, 2670.

Portland Islands, is a cluster of small islands in the Eastern Seas, to the westward of New Hanover. They were so named by Captain Cintenet in 1767. The north-east point of the most eastern isle, is in Long. 147. 18. E. Lat. 2. 36. S.

Portland Island, in the South Pacific Ocean, is situated near the east coast of New Zealand. Long. 178. 12. E. Lat. 39. 25. S.

Portland vase, a celebrated funeral vase, long in possession of the Barberini family, but which was purchased for a thousand guineas by the Duke of Portland, from whom it derived its present name. Its height is about ten inches, and its diameter where broadest six. There are upon it a variety of figures of most exquisite workmanship, in bas relief, of white opaque glass raised on a ground of deep blue glass, which appears black except when held against the light. It seems to have been the work of many years, and there are antiquarians who date its production several centuries before the Christian era; since sculpture was declining in excellence even in the time of Alexander the Great.

PORT LOUIS, a fortified sea-port of France, in the department of Morbihan, and arrondisement of L'Orient. It is situated at the mouth of the river Blavet, on the bay of its own name, and is inclosed by the sea on three sides. It has a citadel of great strength, three churches, a naval hospital and exchange, 365 houses, and 3480 inhabitants. Lat. 47. 45. Long. 3. 32. W.

PORT-MACQUARIE, an inlet on the east coast of New Holland, into which falls the river Hastings. It received its present appellation from Mr. Oxley, who surveyed it in 1818. Long. 152. 53. 54. E. Lat. 31. 25. 115. S.

PORT-ROYAL, a town of the island of Jamaica. See Jamaica.

PORT-SANDWICK, a harbour of the island of Mallicollo, in the South Pacific Ocean. Long. 167. 67. E. Lat. 16. 25. S.

PORTOBELLO, a parliamentary burgh, situated on the Frith of Forth, nearly three miles from Edinburgh. The town is neatly built, and as the beach is extensive, and commodious for sea-bathing, it is consequently much frequented in the summer season as a watering-place. It is not a place of trade, but has several manufactories for making bricks, tiles, and potteries, a crystal and glass work, and one or two others of less importance. The town is governed by a provost, two baillies, and six councillors; and, with Leith and Musselburgh, it returns a member to parliament. The stationary population in 1821, amounted to 1912, and in 1831, to 3170.

PORTOBELLO, a town situated on the isthmus of Panama. See Panama.

PORTO FERRAJO, the capital of the Island of Elba, in the province of Pisa, and the duchy of Tuscany, celebrated as the residence of Napoleon during his banishment to that island. It is situated on a tongue of land running into the sea, and forming a small bay. It is fortified, and contains two churches, an hospital, 600 houses, with 3120 inhabitants, who depend chiefly upon some salt works and the tunny fishery. Lat. 42. 49. 6. Long. 9. 20. 15. E.

PORTO-NOVO, a sea-port town of the south of India, in the Carnatic. It is esteemed the safest port on the Coromandel coast. The ground is good, and vessels may anchor in six fathoms water. In August 1781, the British gained a victory here over Hyder Aly. Long. 79. 52. E. Lat. 11. 30. N.

PORTO RICO, or Puerto Rico, one of that group of West India islands called the great Antilles, and the smallest of the four in population and extent, but yielding to none in fertility and general importance. It is situated to the east or windward of Hayti, Cuba, and Jamaica, being separated on the west from the first named island by a channel twenty-five leagues in breadth, and having the Atlantic Ocean on the north, with the Carribean Sea on the south. It is about ninety miles in length from east to west, by thirty-three miles in average breadth; and contains, according to an exact admeasurement, a plane superficies of 2970 square miles.[1] A chain of lofty mountains intersects it from east to west; the highest part, called Luguilla, at the north-east extremity of the island, being 1334 Castillian yards in height. Valleys, levels of table land, and gentle declivities, all highly fruitful, are every where found embosomed in these mountains; and they are themselves susceptible of cultivation to the very tops. To the north and south of this interior ridge, situated between it and the sea coast, are those richly fertile valleys which produce the chief wealth of the island. They are formed by smaller ridges of hills, which run north and south from the principal chain, and are much more level than those situated amongst the loftier mountains, which present an unequal, undulating surface, and a continued succession of gentle acclivities, covered with trees displaying all the varied colours and vivid foliage of the tropics. The valleys of the north and east coasts are the richest in cattle, and the most picturesque, the pasturage there being always verdant and luxuriant, from the abundant supply of rain which they receive; whilst those of the south coast, richer than the north in sugar, are often parched by excessive drought. This, however, can easily be remedied, for water is found by digging only half a yard below the surface of the ground. Few countries of the same extent as Porto Rico are watered by so many streams. Seventeen rivers, taking their rise in the mountains, cross the valleys of the north coast and fall into the sea. Some of them are broad and deep, and navigable for two or three leagues from their emboucheurs, which, however, are much obstructed by bars. These rivers are well stocked with excellent fish; and the banks of the whole of them are nearly all under cultivation. The south, west, and east coasts are well supplied with water, notwithstanding the unfrequency of rain. There are several large streams, besides numberless rivulets, and branches of navigable water. Porto Rico therefore possesses great natural facilities for inland navigation, particularly upon the north coast. Of course we find the year divided in this island, as in the others belonging to the West Indies, into the wet and dry seasons, the former the winter, the latter the summer. But this distinction does not give a proper idea of the seasons in Porto Rico; for on the north coast it sometimes rains during the whole year, whilst on the south coast a perfect deprivation of rain for twelve or fourteen months is no uncommon phenomenon, even when in the mountains there are daily showers. The climate of the north and south coasts of this island, therefore, are essentially different, although under the same tropical influence. The only difference of temperature to be observed throughout the whole island, is between the valleys and the mountains, which happens in every country similarly situated. In the mountains the inhabitants enjoy the coolness of spring, whilst the valleys, were it not for the daily breeze which blows generally from the north-east and east, would be uninhabitable. In August the atmosphere is oppressively hot, the thermometer being frequently above 90° of Fahrenheit; and during the coldest season it is never below 70°. In September the rains descend like a deluge, and the rivers swell and overflow their banks, completely inundating the low lands, whilst the smallest brooks become deep and rapid torrents. In October the weather becomes cooler, and in the following month the north and north-east winds generally set in, diffusing an agreeable coolness through the atmosphere. When the fury of the north wind abates, the most delightful weather is experienced. Hurricanes, the scourge of the West Indies, sometimes visit this island, generally between the months of July and October. In the year 1825, one occurred on the 27th of July, which nearly laid it desolate. Notwithstanding the general heat of the climate, and the humidity of some parts of Porto Rico, it is reckoned healthy. The number of mountains and running streams, the absence of stagnant water, and the general cultivation of the land, no doubt powerfully contribute to purify the atmosphere and render it salubrious to man. This island exhibits a singular scarcity of indigenous animals. There are no venomous snakes or reptiles, no beast of prey, or indigenous quadrupeds of any kind to be found in the forests, scarcely any of the feathered tribes, and no noxious insects. But rats of an enormous size and in great numbers infest the country, and sometimes commit dreadful ravages upon the sugar canes.

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[1] These are the dimensions assigned to the island by Colonel Flinter in his *Account of the Present State of the Island of Puerto Rico*, 1834. Malte Brun, on what authority does not appear, makes it one hundred and twenty miles in length by forty in breadth; and other geographical writers extend its longitudinal dimensions still further. Probably the discrepancy arises from extreme points being taken in the one case, whilst a medium measurement is that given by Colonel Flinter, who had the most ample means of knowing every thing connected with the island. To his work on Porto Rico we have been chiefly indebted for the present account of it.

The principal wealth of Porto Rico consists in agriculture. No manufactories are carried on, and no mines of gold and silver have been explored, if such exist. The soil is of the richest description, and a prolific and luxuriant vegetation covers every part of the island. The agriculturist is not limited by the nature of the soil to the exclusive cultivation of any particular produce. Every species of fruit and vegetables, congenial to tropical climates, may be planted with the certainty of reaping an abundant harvest. The best and most luxuriant pasture for rearing cattle; the rich, deep, vegetable mould necessary for the sugar cane; the humid soil in which the cocoa vegetates; and the cool mountain glades, so congenial to the coffee plant, may all be found within a small circle. Cotton, tobacco, and indigo, the latter being a spontaneous product of the fields, only require a little attention to render them objects of importance.

The whole agricultural riches of the island, houses, lands, and slaves, not included, were valued in 1832 at 37,993,599 dollars, and the produce at 6,883,371 dollars; of which there were exported through the custom houses to the value of 3,411,845½ dollars. The contributions levied on this property amounted only to 266,526 dollars, which is less than 3¼ per cent. on the value of property, and less than 5⅞ per cent. on the value of produce. We have no doubt that the value of property and produce is much greater than what has just been stated; for as the people of the country themselves make the valuation, they always endeavour to make it appear as small as possible, in consequence of the direct tax levied on property.

Colonel Flinter thinks that there cannot be fewer than two hundred thousand horned cattle on the island, the other animals being proportionally more numerous than they appear to be from the statement given; and he thinks that the total value of the cattle may be estimated at 7,858,774 dollars. A great traffic has long been carried on in them, with the English, French, and other settlements. They bring a higher price than those of South America, in consequence of being fattened from the finest pasture land in the world, and from their extreme tameness. Vast quantities of raw and tanned hides are likewise exported. The production of sugar is the next great branch of industry. That the soil and climate are admirably adapted for the cultivation of the cane will be seen from the following fact. The proportion of sugar produced from the land employed in its cultivation, is in Jamaica and Dominica, ten quintals per acre; in Grenada, fifteen quintals per acre; in St. Christopher's and Tobago, twenty quintals per acre, and in St. Vincent's, twenty-five quintals per acre; whilst in Porto Rico it is estimated at thirty quintals per acre.

Notwithstanding the great natural resources of this island, there are imported, besides manufactured goods, considerable quantities of provisions and other articles, of which, by attention, Porto Rico might be made itself to yield sufficient supplies. However, an examination of the exports and imports shows, that of late years, the produce of the land exported, considerably exceeds the value of goods and provisions imported.

Amount of Exports and Imports for several years.

Years.	Imports. Dollars.	Exports.	Difference in favour of Exports.	Amount of Duties.
1810	1,005,694	662,570	...	...
1828	2,039,928	2,590,726	550,798	522,034
1830	2,208,941	3,411,845	1,202,903	...

In 1830, there entered about 60,000 tons of shipping, of which one-half belonged to America, one-fourth to Spain, and the remaining fourth chiefly to England, France, and Denmark. The importations from America, which in value amount to one-third of the whole, consist of salt fish, flour, butter, lard, grain, lumber, boards, staves, and articles of furniture. The mother country exports her olives and brandies, her wines and dried fruits, oils of olive and almond, carpets for kneeling on, and other manufactures, alputc, anchovies, and so forth. England imports cotton goods, Irish linen, hardware, earthen-ware, and the like; and France imports linens, cambrics, ladies' dresses and ornaments, toys and jewellery. Foreign goods pay seventeen per cent. of importation duties, *ad valorem*; and an export duty of six per cent. is levied on all goods sent from the island, with the exception of timber and live stock, which are charged much higher. Spanish vessels from the peninsula pay six per cent. of importation duty, and the export tax is also much less than it is for foreign vessels. It is scarcely necessary to say, that the exports from Porto Rico consist of live stock, sugar, coffee, tobacco, and the other rich productions of the island. Colonel Flinter states his conviction that the value of the exportations and importations exceeds the amount which appears in the custom-house returns; for goods are undervalued in general, and a considerable contraband trade is carried on. The nett revenue of the island in 1832 amounted to 798,404 Spanish dollars (each equal to 4s. 3¾d sterling), and the expense of maintaining the civil and military establishments, amounted to 630,300 dollars; thus leaving a balance in the treasury, of 168,104 dollars. The taxes, although levied in an obnoxious manner, being for the most part direct, are comparatively light. In 1832, the direct taxes produced 207,141; the custom-house duties, 493,930; and the indirect taxes, 97,333 dollars. The government, laws, and institutions of this island, are nearly similar to those formerly established by the kings of Spain in every part of the western hemisphere. There is a regular military force stationed on the island, and likewise a strong disposable body of well-disciplined militia.

Porto Rico contains fifty-eight towns and villages, thus giving nearly one to every six square leagues. The largest place is San Juan, the capital. It is finely situated on the slope of a hill, on the north coast of the island. The streets, which run parallel and cross each other at right angles, are perfectly straight, and run down to the side of the bay. It is enclosed on every part by strong fortifications, which render the town almost impregnable. It is considered as one of the best and healthiest towns in the West Indies. It is adorned by a number of useful public edifices and institutions. Amongst these may be mentioned, the cathedral, a large mass of building, which has never been finished; four churches, two chapels, three convents, an episcopal palace, and a seminary for the education of the clergy; the royal military hospital, a large stone edifice, and an establishment of the same kind for females; the government house, called the fortress of Santa Catalina, which has stood for upwards of two hundred years; the royal goal, a large stone edifice; a house of correction; a large and handsome town-house; a beautiful theatre, built at the public expense; a custom-house; an arsenal, and some others. A society, called the Economical Society, is established for promoting the fine arts. There is also a mathematical class; whilst two schools for boys, and one for girls, are paid for by the municipality. There is an excellent and secure harbour, and a commodious wharf. This town is the residence of the governor, and the Catholic bishop, and here all the principal courts are held. San Juan was founded in the year 1514. Within a century afterwards it was twice taken and plundered by the English, who, however, could gain no permanent footing on the island, neither at these times nor at a later period under General Abercromby. The population is estimated at 30,000.

Some of the provincial towns may be considered as large with reference to the extent of the island; such as Mayagues and Aguadilla on the west coast, Pouce on the south, Pepino and Cayey in the interior, and Humacao on the eastern coast. The other towns and villages, with few exceptions, are merely skeletons, containing a large square, with the church, the houses of the curate and magistrate, the militia quarters, and a few residences of wealthy people. There are fifteen ports in which custom-houses and receptories have been established. By far the greater number of the inhabitants are scattered over the island in agricultural establishments. The total number will be seen from the following table:

Statement of the Population of the Island of Porto Rico, from the year 1778 *to* 1830, *inclusive, according to the official returns made to the Spanish Government.*

Years.	Whites.	Free people of colour.		Total free of colour.	Slaves.	Total coloured population.	Total population of the island.	Ratio of increase.
		Mulatoes.	Blacks.					
1778 to 1802	78,281	55,164	16,414	71,578	13,333	84,911	163,192	132 per cent.
... 1812	85,662	63,983	15,823	79,806	17,536	97,342	183,014	12 ditto.
... 1820	102,432	86,269	20,191	106,460	21,730	128,190	230,622	26 ditto.
... 1827	150,311	95,430	25,057	120,487	31,874	152,361	302,672	40 ditto.
... 1830	162,311	100,430	26,857	127,287	34,240	161,527	323,838	6½ ditto.

This shews an extraordinary rate of increase; and allowing that the population has augmented in the same ratio since the last census was taken, we may safely estimate the number of inhabitants of this island in 1839 at about four hundred thousand souls. The island of Bieques, situated three leagues from the north-east coast of Porto Rico, is under the command of the captain-general of the latter. It is ten leagues in length, by two in breadth, and reckoned one of the most fertile spots in the West Indies. It has several commodious ports and harbours, and from its position to the windward might be made of considerable importance to Porto Rico, if properly settled, which it is not.

Porto Rico was discovered by Christopher Columbus in 1493, and was supposed at the time to contain 660,000 inhabitants. Having learned that the Spaniards had made themselves masters of Española, these savages looked upon the invaders as invincible and immortal. But to put the matter to the test, they tried an experiment on one of the domestics of Columbus, and finding that he was mortal, they rose upon the Spaniards, and made a great slaughter of them, whilst employed in plundering the treasures of the natives. The Spaniards seldom required so good a pretext for retaliation, and they accordingly rose upon the inhabitants, and effected their total extermination. Since then it has been gradually settled by Spaniards; and from the census given above, it will be seen that it promises at no distant date to be as thickly peopled as it was when first visited by the prince of navigators. R.R.R.

PORTO SANTO. See Madeira.

PORTO-SEGURO, a large tract of country in Brazil, situated to the north of Rio and Espiritu-Santo. It was formerly reckoned a province of itself, but at the new provincial division of the country in 1829, it was formed into a comarca of Bahia. Along with Espiritu-Santo, it forms one continuous tract, presenting such a sameness of natural features, that they have generally been described together. It is separated from Rio de Janeiro on the south, by the river Capabuan or Itabupuana. On the west it borders on Minas Seraes; the river Belmonte separates it from Bahia on the north, whilst its eastern limits are washed by the Atlantic ocean. It has a sea-coast of four hundred miles in length; and the maritime district is the only part of the country as yet peopled by Europeans, or their mixed descendants. "The lofty and naked ridge of middle Brazil," Porto Seguro.

Porto Seguro.

says Prince Maximilian, "in the provinces of Minas Geraes, Goyaz, and Pernambuco, is divided from the eastern coast, by a broad tract of high forests, which extend from Rio de Janeiro to the Bay of All-Saints (Bahia) about eleven degrees of latitude, and which are not yet taken possession of by the Portuguese settlers; only a few roads have hitherto been opened, with infinite labour, along the rivers that traverse them. In these forests, where the primitive inhabitants, who are pressed upon at every other point, have till now enjoyed a serene and peaceful abode, we may still find those people in their original state." In fact the aborigines of Espiritu-Santo and Porto Seguro have been found more difficult to civilize than any other native tribes in this quarter of the world, and the country itself is still in a great measure uncultivated. The civilized people are wholly confined to the coast, and even there they are not perfectly secure from hostile attacks. Yet the salubrity of the climate, and the fertility of the soil, have rendered this district an object of interest with government, so that settlers have been induced to occupy it. The virgin forests with which it is nearly covered, abound with the finest timber, including the cedar, the sassafras tree, and various other resinous and aromatic species; and no province possesses such an abundance of the tree which supplies the Peruvian balsam. "In the provinces of Espiritu-Santo and Porto-Seguro," says a recent traveller, "are found several kinds of wood suited to cabinet-work and architecture. The Ibirapitanga (Brazil wood) now so necessary in manufactures, and which is beginning to fail in Pernambuco, is met with here," and, we may add, on the authority of others, in abundance.

Between the southern limits of the country and the Rio Doce, which separates Espiritu-Santo from Porto Seguro, are situated several towns and villages, and a few military posts, to secure the settlers from the inroads of the savages. About twenty miles north of the Itabupuana, on the southern bank of the river Itapemirim is a village of the same name, more recently built than the others, and containing some good houses. The inhabitants, who are but few in number, carry on a small trade in sugar, cotton, rice, millet, and timber. The Sera de Itapemirim, from which the river descends, is celebrated for the works for washing gold, called Minas de Castello, five days journey up the Itapemirim. From this place to the frontier of Minas Geraes, a road has been opened through the dangerous wilderness of woods; but it is hazardous to travel along it on account of the savage hordes of Puries and Botucudoes, by which the country is infested. From the village of Itapemirim to the village of Nova de Benevente, the country presents alternate woods and meadows, with a stream at intervals, but no river of any size. Benevente stands at the foot of a hill on the northern bank of the Iritiba or Reritigba, called also the Benevente. This place was built by the Jesuits, who here collected a great number of Indians for the purpose of civilizing them; but the hard labour exacted by the crown drove most of them to other quarters. This was the largest establishment on the coast, and the church and convent erected by the missionaries are still seen in the neighbourhood of the town. Between Benevente and the Rio de Espiritu Santo, which gives name to the province, the country is one continuous and magnificent forest, abounding with multitudes of the feathered tribes. The river Espiritu Santo, which is of considerable magnitude at its mouth, rises in the mountains on the frontiers of Minas Geraes, and descending with many windings, through the extensive ancient forests of the Tapuyas, issues forth at the foot of one of those higher chains of mountains which stretch towards the sea. According to Cazel, the proper name of this river is the Santa Marta. It is stated to be navigable to the first fall, about forty miles up, and the tide ascends twelve miles to the Serra, a river which joins it on the left. Villa Velha, a small and unimportant town, stands on the south bank of the river, not far from its mouth; and about half a league from it, on the opposite side of the bay, is the present capital of Espiritu-Santo, called Villa da Victoria. It is built, according to Cazal, on an amphitheatrical site, on the western side of an island fifteen miles in circumference. It is a pretty neat place, with considerable buildings, constructed in the old Portuguese style. The population of this city is estimated at 12,500.

From this town to the Rio Doce, the limits of Espiritu-Santo on the north, there are several rivers and small towns; but generally speaking, not only the interior but the seacoast is densely wooded. This province comprehends three-fourths of the captaincy, which, in the year 1534, was assigned to Vasco Fernando Coutinho, as a remuneration for his services in Asia. The Portuguese were repeatedly driven from the colony by the natives, but ultimately they obtained a decisive victory over the savages, and effected a permanent settlement. The Jesuits were the first who succeeded in making peace with the aborigines, and in 1551 they founded the college of Vittoria; but, as we have observed, they made little progress in this quarter.

The adjoining comarca of Porto Seguro extends from the Rio Doce to the river Belmonte. It lies between 19° 33′ and 15° 25′ of south latitude, which gives it a length of sixty-five leagues. It was upon this part of the coast that Cabral first set foot, and took possession of Brazil for the crown of Portugal. Some Portuguese having settled here, they intermarried with the natives, so that Pedro Campo Tourinho, its first donatory, found himself, in a few years, the lord of a tolerably well-peopled colony. Santa Cruza town, built on the bay where Cabral cast anchor, soon became considerable and flourished; but the settlement was afterwards transferred to the banks of the Ioâo de Tyba, four miles to the northward, no doubt from this site holding out greater advantages of soil. Besides this place, Tourinho founded the town of St. Amaro, three miles to the south of Porto Seguro, which was subsequently demolished by some of the Indian tribes. After passing through various hands, this captaincy ultimately reverted to the crown in 1758. It was then in a very wretched state, and contained only two towns. The Jesuits, with all their zeal, were able to effect but little, and at the time of their expulsion, they left only two aldeias entirely Indian. As early as 1553, they founded a college in the capital, with a view to prosecute their labours amongst the Indians of the province, but, as in the case of Espiritu-Santo, with very little success.

The Rio Doce, or sweet river, the most considerable stream between Rio and Bahia, has its origin in the mountains of Minas Geraes, and assumes the name which it bears after the confluence of the Rio Piranga with the Ribeiro do Carmo. It runs through a considerable tract of country, forming several falls in its course. The banks of this river are covered with thick forests, which are the haunt of a great number of different animals. But far more formidable than all those beasts of prey, and the terror of these forests, is the savage Botucudo, the original inhabitant of the country. Some stations have, from time to time, been formed on the beautiful banks of the Doce; but they have never thriven, from being liable to attacks by the savages, so that the country is still very thinly peopled, and no communication is kept up except along the river. From the banks of the Rio Doce to the St. Matthæus, a dreary uninhabited wilderness extends along the coast. Indeed, for more than a hundred miles the maritime district is a very flat tract of country; the dull monotony which it presents being only here and there relieved by a sheet of water, or small mountain elevation. The district of St. Matthæus contains about 3000 inhabitants, who cultivate a great deal of mandioc, and export annually 60,000 alquieres of flour, and also planks from the neighbouring forests. The orange, the lemon, and the water-melon, flourish here luxuriantly.

The river St. Matthæus, originally called the Cricare, like the other large streams in this quarter, rises in the mountains of Minas Geraes, and descends through ancient forests peopled by savage tribes, forming various falls, and receiving several rivers in its course. Cazal mentions the large stream of Cotache as joining it on the left margin. Nearly thirty miles from the St. Matthæus is the Mucuri, at the mouth of which stands the Villa de St. Joze do Portalegre. This place has of late years risen into some importance, from the opening of a road along the banks of the river, to Villa do Principe in Minas Geraes. Almost all the fine species of wood found on the eastern coast of Brazil, abound in the forests of this district. Five leagues to the north of the Mucuri, is the river Peruhipe, four miles from the mouth of which is the town of Villa Vicosa, consisting of about one hundred houses, with a church and camara, pleasantly situated amongst groves of cocoa palms. The inhabitants carry on a trade in mandioc flour, which is exported in small coasting vessels. Ten miles farther north is Caravellao, situated on a river of the same name, about five or six miles from the sea. The river is two miles in breadth, and proportionally deep; and up to the town its banks are beautifully interspersed with plantations. Caravellao is bustling and populous, and carries on a brisk trade in the productions of the country, especially mandioc flour, large quantities of which are annually exported. The port is much frequented by vessels from Pernambuco, Bahia, Rio, and the other towns on the east coast.

Porto Seguro, the capital of the comarca, is situated at the mouth of the river Buranhem, in lat. 16° 40′ south, and long. 40° 12′ west. The port, which has given name both to the town and the district, is formed by a ledge of rocks which runs out for about a mile from an extended point of the main, in a direction parallel to the land, presenting a natural mole. This town is less considerable than Caravellao, but may contain a population of about 3000 souls. The upper part of it lies on an elevated ridge, but the major portion of the inhabitants are established on the declivity nearer the river, a place more advantageous for carrying on trade. A third part of the town lies close to the mouth of the river. There is little agricultural industry displayed in this country, the greater part of the farina consumed being brought from Santa Cruz. This, with salt fish, constitutes the chief subsistence of the inhabitants. About eighteen miles north of Porto Seguro, is the town of Santa Cruz, already mentioned. It is smaller and less important than the capital, although once in a flourishing condition. Some attention, however, is paid here to agriculture; and farina is exported to various parts of the coast. The most northerly town of Porto Seguro is the Villa de Belmonte, situated on the Rio Grande de Belmonte, which falls into the sea in latitude 15° 40′ south. This town was originally an aldeia of christianised Indians, but few of them now remain, and the place has sunk into decay. The whole population of Espiritu Santo, has been reckoned at 74,000; that of Porto Seguro is probably not more. But a great part of the country is still in complete possession of several Indian tribes, amongst which the Botucudes, the remains of the once formidable Aymores, are the most conspicuous.

PORT-PATRICK, a sea-port town and parish, on the west coast of Wigtonshire, at the distance of 133 miles from Edinburgh. It is situated on the shore of the Irish Sea, at the nearest point to Ireland, the distance being only twenty-one miles to Donaghadee. From this cause, as well as from being the best place for crossing between the two countries, steam packets and sailing vessels regularly sail between the two ports with the mails from Edinburgh, London, and Dublin. The town is not large, but it is beautifully situated, with a fine southern exposure, and encompassed on the other side by a ridge of small hills, which shelters it from the cold air of the sea. The climate is therefore salubrious, and on that account is much resorted to during the summer months for sea-bathing. The harbour was formerly small and inconvenient, but very extensive improvements having been carried on by the late Sir James Hunter Blair and by government, to render the harbour fit for shipments at all times of the tide, it has, especially its quay, been made one of the best in the kingdom. The chief trade arises from the importation of cattle and horses from Ireland. The population in 1821, amounted to 1818, and in 1831, to 2239.

PORTRAIT, in *Painting*, the representation of a person, and especially of a face, done from the life.

PORTREE, is a small village, containing a church and a very few houses, with an excellent bay and a good harbour, in the isle of Skye.

PORTSMOUTH, a town of the county of Southampton or Hampshire, within the hundred of Portsdown, and seventy-four miles from London. It stands on an island divided from the mainland by a small creek or arm of the sea. This island, called Portsea, is about fifteen miles in circumference, and contains nearly 5100 acres of land of great fertility; and, besides the borough of Portsmouth, the town formerly known as Portsmouth common, but now by the name of the island, and also what may be denominated a town called Southsea, besides many other neat houses. The last of these towns has grown up to importance within a few years, because it has become a place of great resort for sea-bathing; and hence the usual accommodations of such places have been constructed and extended.

The population appears for the four decennial enumerations to have been, in the three divisions, as follows:

	1801.	1811.	1821.	1831.
Portsmouth Borough and Parish	7,839	7,103	7,246	8,083
Portsea	24,327	31,365	34,785	38,199
Portsea Guildable	1,060	2,099	3,594	4,107
	33,026	40,567	45,675	50,389

Portsea Guildable is a part of the parish of Portsea, not within the jurisdiction of the borough of Portsmouth. The limits of that borough contain within them the whole of the *town* of Portsea; and the right of voting for members of parliament was conferred on the inhabitants, occupiers, by the reform bill. The corporation now consists of fourteen aldermen and forty-two councillors, who elect the mayor. It is divided into seven wards, and has justices of the peace appointed by the Crown.

The statements of population are exclusive of the corps of royal marines and regular troops, as well as the seamen on board the ships in the harbour, which are estimated to amount to about 4000 persons.

The soil of the island is marshy, and was formerly found to be unhealthy; and besides, the inhabitants suffered much from the scarcity and dearness of good water. But of late years those evils have been remedied by complete draining of the moist parts, and by the construction of good sewers, which carry into the sea the impurities of the towns. Two efficient Water Companies have completed works for the supply of that necessary of life; and no town in England is now better supplied with it, or at a cheaper rate, than the inhabitants of Portsmouth and its vicinity. The returns of deaths show that forty years ago they were one in thirty annually of the population; whilst in the three years 1827, 1828, 1829, they did not exceed one in sixty.

The favourable situation of Portsmouth for a naval arsenal, led to the constructions that have since distinguished it, at the period when the sovereigns of England first began to form a naval force. Some of the fortifications were erected on the sea-side as early as the reign of King Henry the

Eighth; but the walls surrounding the town were first built of stone in the reign of Elizabeth. In every subsequent reign additions and improvements have been made to it.

As the town of Portsmouth is surrounded with walls, the streets are for the most part narrow, nor can it as a whole be represented as a well-built place. The High Street is of moderate breadth, and has a few good buildings; but a part of it is disfigured and contracted, by having the market house running through the middle of it. Some of the buildings are of ancient date; one especially in the High Street is worthy of observation, as having been the dwelling in which the Duke of Buckingham was assassinated, in the reign of King Charles I. It may be remarked, that the best buildings in Portsmouth are the inns and hotels, which are numerous, and proportioned to the great number and various descriptions of occasional residents arriving and departing, as passengers to and from all parts of the world. The largest pile of building is the marine barracks, capable of accommodating some thousands of soldiers; but it is absolutely without taste or ornament. The walls that surround the town are shaded with trees, and afford a good promenade to the inhabitants. Another promenade is furnished on the grand parade, where every morning the troops destined to take the guard for the day and night are assembled. From the parade, by a slope, the king's bastion is reached, where the garrison standard is hoisted every morning at break of day. At the east end of the Grand Parade is the garrison chapel, the remnant of an ancient hospital, called *Domus Dei*, built in 1238. The building has recently been taken down, and the chapel, or rather the chancel part of it, is now the only remains of the ancient erection.

At the west end of the platform, on an ancient building, which, before the dissolution of the monasteries, had been the government house, a lofty *semaphore* has been erected, from which signals are made to the ships in the harbour and at Spithead. It is also connected with a chain of telegraphs, terminating at the Admiralty Office in London, and by which communications are conveyed, so that a message has been sent and an answer received in two minutes. In a niche in the wall of this ancient building is a bust of King Charles I., with an inscription underneath, stating that "after his travels through France and Spain, and having passed very many dangers both by sea and land, he arrived here the 5th October 1623." This was on his return from the secret journey he made in search of a bride of the Spanish royal family.

The parish church is a venerable object, said to have been built originally in 1220, and dedicated to the then recently canonized St. Thomas à Becket. The chancel is the only part left of the original building, and affords a contrast, by its numerous pillars, clustered pilasters, and ribbed pointed arches in the Saracenic style, with the architecture of the nave, built in the plain Tuscan style, the pillars of which support circular arches, and carry the roof. Few places of worship in the kingdom are superior to this church in internal beauty, which is chiefly due to the elegance of the chancel, but is increased by a few painted windows over the altar, which has been recently presented to it. At the west end is the tower, added in 1693, which is 120 feet in height. Over this, in an octagon latticed erection called the lanthorn, is a fine peal of eight bells. Surmounting the whole, as a weather vane, is a gilt model of a ship, six feet long, which has a shifting flag on the mizen mast that moves with the slightest motion of the air, and indicates from what quarter the wind blows, when the breeze is not sufficiently strong to move the hull of the ship.

The walls of this church are adorned with a great variety of handsome ancient and modern monuments; one of the most remarkable of which is that to the memory of the Duke of Buckingham, whose assassination has already been adverted to. In the parish register is to be seen the registration of the marriage of king Charles II. with the Infanta of Portugal, 22d May 1662. This document, in letters of gold on vellum, is highly illuminated in the style of the old missals, and states the marriage to have been performed by Sheldon, bishop of London. Some doubts have since been suggested whether any other ceremony was used, except a private marriage by a Catholic priest.

Besides this capacious church, there is open to the inhabitants the large garrison chapel for the established worship, and four places of meeting for several sects of dissenters. In the other towns the places of worship are numerous. At Portsea, there are, for the episcopal worship, the parish church of Kingston, the dock-yard chapel, St. George's church, St. John's church, besides a Catholic chapel, a Jew's Synagogue, a Wesleyan, two Independent, and two Baptist meeting houses. In Southsea is St. Paul's church, with a Methodist and a Baptist chapel. At Landport, or a part better known as the Halfway Houses, is All Saints' church, besides no less than nine chapels of various sects. Almost all these places of worship have schools attached to them, some on Sundays and others for week days; and in addition to them is a large school, where reading, writing, and arithmetic are taught on Bell's system. A philosophical institution has been established, containing a museum of natural history and curiosities, and a choice library, rapidly increasing. At the rooms lectures are delivered on physical and moral philosophy, and on the belles lettres. There is also over the market house a mechanic's institute, where meetings are held, and weekly lectures delivered. A well endowed grammar school in Penny Street affords classical instruction to fifty boys, sons of the inhabitants of the town. The town-hall, gaol, theatre, custom-house, and the other public buildings in Portsmouth, present very little attraction.

Few markets are better supplied than that of Portsmouth. A large part of the fertile island of Portsea is laid out in kitchen and fruit gardens, from which spring crops of vegetables are grown much earlier than in other parts of the kingdom. No market produces finer meat; large quantities of poultry, hares, partridges, and eggs, are brought from France, and the extensive water communication gives facility to provide hay, corn, flour, and other articles, at very cheap rates. To this cheapness of provisions, combined with the purity of the air, and the number of comfortable houses recently built, may be attributed the great extension of Southsea which the population tables present.

The buildings in Portsea, except those belonging to the government, are by no means distinguished. The streets are regularly built, well paved and lighted, and kept generally in a clean state, but as the greater part of the inhabitants consist of artificers and labourers of different grades employed in the dock-yard, or otherwise in the public service, the houses are mostly small, conformably to the finances of the occupants. Southsea consists of houses of a more respectable class, forming terraces or rows mostly looking on the sea, and enjoying the prospect of the inner harbour, the fortresses that guard the entrance to it, and the buildings and scenery on the opposite shore. It has one distinguished pile called the *king's rooms*, consisting of an elegant suite of rooms, eighty feet in front. Within is the promenade room, forty-five feet long, thirty-five feet wide, and seventeen feet high, adapted for music or dancing; and besides, it contains baths, both warm and cold, and gives a cheerful appearance to the spot. Besides the three towns here noticed, there are groups of houses on the island, and single dwellings of various descriptions. The largest of the groups, called the Halfway Houses, from lying midway between Portsea and the parish church, has many respectable houses, as well as the new church of All Saints.

The most important view in which Portsmouth can be looked upon is as the great depôt of the British naval power, and in this view the state of the surrounding water

Portsmouth.

and of the harbour above the town, become worthy of observation and description. One of the great advantages of this place is that very fine anchorage known by the name of Spithead. It is about half way between the mainland and the Isle of Wight, but nearer to the latter. It is protected by the high land of the island from southerly winds, and from northerly and easterly winds by the mainland. It has an advantageous entrance. For, though at the east there are some dangers on what is called the Princessa shoal, and on the ranges of rocks called Bambridge's Ledge, and Betty's Ledge, they, as well as the Nab rock, the Long rock, the Warner, and Romansland, are so well provided with either floating lights or distinguishing buoys, that there is little risk, except in those very thick fogs when the buoys cannot be seen, nor the leading marks observed on the sea-shore. At this entrance it is a great advantage, that at St. Helen's, at the east end of the island, there is a good anchorage, so that if the wind takes a vessel short, she can safely ride till the breeze is in her favour. The western entrance to Spithead is by Hurst Castle, and the rocks called the Needles. This passage is always safe in fair winds, on account of the definite track which is shewn by the buoys, lights, and landmarks; but it is so hazardous, that few ships attempt in a contrary wind to beat through. The passage out by the Needles is used by more vessels than come into Spithead that way.

The anchoring ground at Spithead is very good for holding, and very clear, except near the wrecks of the Royal George, the Boyne, and the Edgar, around which the tide has formed considerable banks. There is a regular depth of water in every part, varying from six to twelve fathoms, and the space is sufficient for the whole navy of England to ride at single or double anchor, without danger of falling on board each other when swinging with the changes of the tide.

Within the smooth water, between the island and the mainland, there are other very good anchorages, besides that of Spithead. The Mother-bank is one of them, which, though there are but two fathoms of water at low tides, has near to the bank from seven to nine fathoms, where in time of war merchant ships have been collected to wait for the convoy of ships of war. Stakes Bay is another anchorage, where there is from four to nine fathoms water, and where merchant ships often anchor.

The great advantages arising from so secure a rendezvous as Spithead, so near to the great national marine arsenal, are too obvious to need any elaborate remarks. The entrance to the harbour of Portsmouth is very narrow, but with sufficient depth of water for the largest ships. The channels by which vessels approach the mouth of the harbour, are commanded by batteries of such power that an enemy's fleet, however strong, would be annihilated before it could reach even the entrance. Within the narrow gut at the entrance, on one side of which is Portsmouth, and on the other side Gosport, the water spreads out into a wide basin, in which those ships of war that are under repair, or preparing for sea, are riding, and some of them lying at the wharfs of the dock which borders the harbour on the eastern side. From thence the harbour extends into the land, and contains, in one part called Rotten Row, the ships that are in ordinary, being with no other crew but a few warrant officers, to prevent them from plunder, or from injury by weather. The water here branches off in various directions, and by the help of the tide is navigable to Farnham, and to Porchester Castle, a pile of antiquity that will reward the curiosity of a visitor.

The dock-yard of Portsmouth is one of those noble objects in which every Briton feels an interest. But this has already been described under the article Dock Yards.

The gun wharf, under the ordnance department, is an immense arsenal, consisting of various ranges of buildings for the reception of military and naval stores and artillery. Some of the storehouses are vast piles, especially two, which, with their dependencies, are fitted to contain all kinds of necessaries for the sudden equipment both of a fleet and an army. On the wharf is the grand depôt for guns, carronades, and mortars, with shot and shells of almost every weight and size, all of which are arranged in immense pyramids. Here also in time of peace the guns from the ships in ordinary at the port are lodged, each ship's guns being kept in a separate tier, whilst the carriages are deposited away in the same regular manner in the proper storehouses, so that the whole may be easily collected again and re-embarked. The small armoury is a spacious building, and the great object of admiration. Within it are upwards of 20,000 stand of arms, all placed in the same ornamental style as those of a similar description in the tower of London. The roof of this building is covered with copper, which being oxydized by exposure to the atmosphere, when viewed on approaching it from the quay gate, conveys to the mind the idea of a green glassy slope, or a still wave of the sea.

Portsoy.

The victualling establishment has recently been removed from Portsmouth to the opposite side of the harbour, and properly belongs to the town of Gosport. The expense of this depository is said to have amounted to half a million of money. The storehouses, of vast dimensions, are used as depositories for bread, beef, pork, and other articles of food, of rum, wine, and clothing, that are kept ready for the supply of the navy. A special object of curiosity at this establishment is the machinery substituted for manual labour in making biscuit, whereby every process, in its minutest detail, is effected, preparatory to its being ready for the oven, including kneading, rolling, forming, and stamping. Another object worthy of attention is a fine new steam corn mill, recently built an an expence of L.76,000.

Portsmouth is not merely a port for warlike purposes, but enjoys a considerable foreign and coasting trade. The custom-house is a large and convenient building, and in its stores merchandize may be kept under bond free of duty till it is sold for internal consumption, or is exported. The shipping belonging to the port, in which Gosport is included, consists of about 300 sail of vessels, registered at nearly 10,000 tons; some are engaged in the Newfoundland fishery, and since the trade with India has been laid open, a few vessels have landed cargoes here from beyond the Cape of Good Hope. There is a considerable importation of wine, and some of West India articles, but the chief business consists in timber, corn, Irish provisions, Spanish and Portuguese fruits, and the vine of both these countries. The amount of duty annually received on imported articles at the custom-house, is from L.50,000 to L.60,000.

PORTSOY, a burgh of barony and a sea-port town, in the parish of Fordyce, and county of Banff. It is situated on a point of land, jutting into a small bay, of the same name, on the Moray Frith, and consists of a few streets, irregularly built. The harbour is small, but safe, and is capable of admitting vessels of 150 tons. The chief trade is in linen and thread, manufactured principally for the Aberdeen, London, and Nottingham trade. Grain is also shipped from the port, and there is a considerable trade arising from the herring fishing. Portsoy is famed for the serpentine, erroneously called Portsoy marble, which is quarried to a considerable extent near the town. It is beautifully variegated, and as it is susceptible of a high polish, it is much used for ornaments. There is also found the splendid variety of flesh-coloured granite, possessing Labrador feldspar, which is nowhere else to be found, except in Arabia, where it was first discovered. The population in 1821 amounted to 1,700, and in 1831, the population of the parish and burgh was 3,364.

PORTUGAL.

History.

Ancient boundaries.

Portugal, the most westerly kingdom of Europe, is bounded on the west and south by the Atlantic Ocean, and on the east and north by Spain. By modern writers we find this country constantly styled in Latin *Lusitania;* and it is certain, that anciently a part of Spain went by that name; but it does not by any means appear that the country called by the ancients *Lusitania* had the same boundaries with the modern kingdom of Portugal. Before the time of Augustus Cæsar, Lusitania seems to have been bounded on the north by the ocean, and on the south by the river Tagus; thus comprehending all Galicia, and excluding two out of the six provinces of Portugal. But in the more strict and limited sense of the word, it was bounded on the north by the *Durius*, or the Douro, and on the south by the river *Anas*, or the Guadiana; so that it was not quite equal to modern Portugal in length, but considerably exceeded it in breadth.

Etymology of the name.

The commonly received opinion with regard to the etymology of the word *Portugal* is, that a great number of Gauls landed at Porto, or Oporto, whence it received the name of *Portus Gallorum*, or *the Port of the Gauls;* and that in process of time the name gradually extended over the whole country, being softened, or rather shortened, into *Portugal.* But the time when this event happened, the reason why these Gauls went thither, and what became of them afterwards, are all particulars which lie buried in oblivion. It is pretended, however, that, upon an eminence which overlooks the mouth of the Douro, there stood an ancient town called *Cale*, strong and well peopled, but ill suited for trade; and that this occasioned the construction of a lower town or hamlet, which was called *Portus Cale*, or the haven of Cale, and, in process of time, *Portucalia.* At length, when this place became so considerable as to be erected into an episcopal see, the bishops subscribed themselves, as the records of ancient councils testify, *Portucalenses*, the name of the city being transferred to the diocese. It is true that these bishops afterwards changed their title, and subscribed themselves *Portuenses*, or "bishops of Portu." But the facts just mentioned are actually recorded in authentic histories; and as the diocese of Portucalia in a great measure contained that little country in which the sovereignty originally commenced, the name extended itself with the acquisitions of the sovereigns, and came to be applied to the whole kingdom, though the diocese itself has changed its name.

Portugal originally only a small kingdom.

Portugal, though even yet but a small kingdom, was originally much smaller. The Spanish and Portuguese historians agree, that Don Alonso, king of Leon and Castille, and son of Don Ferdinand the Great, bestowed his daughter, Donna Theresa, in marriage upon an illustrious stranger, Don Henry, and with her gave him the frontier province, which he had conquered from the Moors, small indeed in extent, but excellently situated, and so pleasant and fertile that it has sometimes been styled *Medulla Hispanica*, or the Marrow of Spain. To this territory was added the title of Count; but authors are very much divided respecting the time when this stranger came into Spain, and who he was. The more probable opinion appears to be, that he was a grandson of Robert, the first duke of Burgundy. The manner in which he obtained the principality may be briefly related.

Henry of Burgundy the first count of Portugal.

The king, Don Alonso, apprehensive that his success in taking the city of Toledo would bring upon him the whole force of the Moors, sent to demand assistance from Philip I. of France, and the Duke of Burgundy, whose daughter he had married. His request was granted by both princes; and a numerous body of troops was speedily collected for his service, having at their head Raymond count of Burgundy, Henry, younger brother of Hugh duke of Burgundy, Raymond count of Toulouse, and many others. In the year 1087 they arrived at the court of Don Alonso, where they were received and treated with all possible marks of esteem; and having in the course of two or three years given great proofs of their courage and conduct, the king resolved to bestow his only daughter, named Urraca, then at most in her ninth year, upon Raymond count of Burgundy, and assigned them the province of Galicia for the support of their dignity. About four years afterwards, Don Alonso, being desirous to express his gratitude to Henry of Burgundy, gave him in marriage a natural daughter of his, born whilst he remained in exile at Toledo, whose name was Donna Theresa; and upon this marriage he conveyed in full property the country which has already been mentioned. The new sovereign, with his consort, fixed their residence in the town of Guimaraens, pleasantly situated on the banks of the river Ave. The remains of an ancient palace belonging to their successors are still to be seen; and on account of its having been anciently the capital, the king granted the inhabitants an immunity from taxes.

Difference with Castille.

The Portuguese, finding themselves now independent, immediately began, like most other nations, to attempt the subjugation of their neighbours. Henry is said to have performed great exploits against the Moors; but the accounts given of them are extremely indistinct and unsatisfactory. He died in 1112, and was succeeded by his son Don Alonso, then in the third year of his age. In the minority of the latter the kingdom was governed by the queen-mother Donna Theresa, assisted by two able ministers. During the first nine years of their administration nothing remarkable happened; but, after that period, some differences took place between the queen regent and Urraca queen of Castille. Theresa insisted that some part of Galicia belonged to her in virtue of her father's will, and therefore seized upon Tuy, an episcopal town, and a place of some consequence. Urraca, having assembled a numerous army, proceeded in person into Galicia, where Theresa was obliged to abandon Tuy, and take shelter in one of her own fortresses. The consequence would probably have been fatal to the new kingdom, had not the archbishop of Compostella, without whose assistance Urraca could perform nothing, demanded leave to retire with his vassals. This offended the queen so much that she threw him into prison; an act of violence which excited such a commotion amongst her own subjects, that the Portuguese were soon delivered from their apprehensions. Theresa immediately afterwards fell into a similar error, by throwing into prison the archbishop of Braga, who had not espoused her cause so warmly as she expected. The bishop, however, was quickly delivered by a bull from the pope, who also threatened the kingdom with an interdict. Soon after this, Urraca died, and all differences were amicably settled at an interview between Theresa and Don Alonso Raymond, who succeeded to the kingdom of Castille. But, in 1126, the king of Castille being obliged to march with the whole strength of his dominions against his father-in-law, the king of Aragon and Navarre, Theresa took the opportunity of again seizing upon Tuy; but the king having soon returned with a superior army, she was again obliged to abandon her conquest.

Alonso's wars with the Moors and king of Castille.

But the greatest misfortune which befell this princess was a quarrel with her own son, Don Alonzo Enriquez. It does not appear indeed that Theresa had given him any just cause of offence; but it is certain that a civil war ensued, in which the queen's forces were totally defeated, and herself made prisoner, a situation in which she continued during the remainder of her life. Enriquez having thus attained to the free and full possession of his dominions, made several attempts upon various places in Galicia, but without success; and he was at last constrained to conclude a peace with Alonso, king of Castille and Leon, who had assumed the title of *Emperor of the Spains*, more especially as his dominions happened to be at that time invaded by the Moors. The number of infidels was so great that the Count of Portugal had but little hopes of subduing them; but a plague having broken out in the Moorish army, they were obliged to retreat, after which he reduced several places belonging to that nation. In the mean time, the Emperor Don Alonso, having made an irruption into the Portuguese territories, destroyed everything with fire and sword. The king of Portugal surprised and cut off a considerable part of his army; but this did not prevent the emperor from marching directly towards him. At the intercession of the pope's legate, however, all differences were accommodated, a peace concluded, and all places and prisoners taken on both sides were delivered up.

Victory of Ourique.

Meanwhile, the progress of the Christian arms in Spain being reported to Abu-Ali Texefien, the miramamolin or chief monarch of the Moors in Barbary, he directed Ishmael, his lieutenant in Spain, to assemble all the forces in the southern provinces, and to drive the Christians beyond the Douro. Ishmael immediately began to prepare for putting these orders in execution; and having added a considerable body of troops which had arrived from Barbary to those whom he had raised in Spain, the whole army was very numerous. He was met by Don Alonso of Portugal on the plains of Ourique, upon the banks of the river Tagus, where Ishmael took all possible means to prevent the Christians passing that river, because his own cavalry, in which consisted the strength of his army, would thus have more room to act. The Portuguese forces were inconsiderable in number in comparison with the Moors; but Ishmael, being too confident of victory, divided his army into twelve bodies, and disposed them in such a manner as might best prevent the flight, not sustain the attack, of the Christians. The consequence was, that his army was overthrown with incredible slaughter, and a vast number of prisoners taken, amongst whom were one thousand Christians of the sect styled Mozarabians, whom, at the request of Theotonus, prior of the Holy Cross, Don Alonso set at liberty with their wives and children, and procured them settlements in his own dominions.

Don Alonso assumes the title of king.

After this signal victory, gained in the year 1139, Don Alonso was proclaimed king by his soldiers, and ever afterwards retained that title, renouncing all kind of subjection to the crown of Spain. Being very desirous, however, of reducing the power of the emperor, he formed a league with Raymond, count of Barcelona, and regent of the kingdom of Aragon, against that prince. In virtue of this treaty, he entered Galicia with a considerable force on one side, whilst Don Raymond simultaneously invaded it on the other. But neither of these enterprises succeeded. The Portuguese monarch met with a severe check in his expedition into Galicia, where he received a dangerous wound, whilst some of the nobility who attended him were taken prisoners. At the same time, having received intelligence that the Moors had invaded his dominions, he was obliged to retire; but his retreat was not made in sufficient time to prevent the strong fortress of Leiria from falling into their hands. This fortress they demolished, and put the garrison to the sword; but the king caused it to be reconstructed of greater strength than before, and placed in it a more numerous garrison. Yet he undertook nothing farther during this campaign. The war continued with various success till the year 1145, when the king projected an enterprise against Santarem, a strong city, at no great distance from Lisbon. In this he luckily succeeded, and thus gained a considerable tract of country, with a strong barrier to his dominions.

After this success Don Alonso caused himself to be crowned king of Portugal before an assembly of the states, where he also solemnly renounced all dependence upon the crown of Spain; declaring, that if any of his successors should condescend to pay tribute or to do homage to that crown, he ought to be deemed unworthy of enjoying the kingdom of Portugal. The next year the king undertook to recover Lisbon from the Moors; but there are so many fables related of this expedition that it is impossible to come at the truth. All that can be gathered from these accounts is, that he undertook the siege with a small army, and was able to make little progress in it, partly from the strength of the place, and partly also from the numerous garrison by which it was defended. At length, fortunately for Don Alonso, a fleet of adventurers, French, English, Germans, and Flemings, who were on their way to the Holy Land, having anchored at the mouth of the Tagus, he demanded their assistance, as not altogether foreign to their design of making war upon the infidels. His request was readily granted; and, with their assistance, Lisbon was speedily reduced; a conquest which so much enhanced the reputation of this monarch, and brought such numbers to recruit his army, that before the end of the year 1147 he had reduced twelve other considerable cities.

Reduces Lisbon and other cities.

His regal dignity confirmed by the pope. War with Don Ferdinand of Spain.

For many years after this, Don Alonso was successful in all his undertakings. He settled the internal government of his kingdom; procured a bill from Pope Alexander III. confirming his regal dignity; undertook many successful expeditions against the Moors; and became master of four out of the six provinces which compose the present kingdom of Portugal. In all his undertakings he was assisted by the counsels of his queen, Matilda, a woman of great capacity, and capable of governing the kingdom in her husband's absence. By her he had a numerous offspring, including three daughters, the eldest of whom, Donna Matilda, was married to the king of Aragon; the second, Urraca, to Don Ferdinand king of Leon; and the third, Theresa, to Philip earl of Flanders. In 1166, however, the king thought proper, from what cause we know not, to invade the dominions of his son-in-law Don Ferdinand, and to seize upon Limmia and Turon, two cities of Galicia, in which he placed strong garrisons. Elated with his success, he next year marched with a numerous army towards Badajoz, which he invested. On receiving the news of this attack, Don Ferdinand, who had assembled a large army at Ciudad Rodrigo, marched to its relief. But before he came in sight of the fortress it had surrendered to the king of Portugal; upon which Don Ferdinand resolved to besiege his antagonist in his newly-conquered city. Don Alonso perceiving his design, endeavoured to draw out his forces into the field. Though at that time upwards of seventy years of age, he placed himself on horseback, and pushing forward at the head of his horse to get out at the gate, struck his leg against one of the bolts with such violence that the bone was shattered to pieces. This accident occasioned such confusion that the Portuguese troops were easily beaten, and Don Alonso was taken prisoner. He was exceedingly mortified by this reverse, especially as he had no great reason to expect kind treatment from his son-in-law. However, the king of Leon behaved towards him with the greatest respect and affection. He desired him to lay aside all thoughts of business, and attend to his cure; but finding him restless and impatient, he assured him that he expected nothing more than to have things put into the same condition as before the war, and that in future they should live in peace and friendship. To this proposal the king of Portugal most readily assented; but he returned to his dominions before his cure was perfected, and thus became lame all the rest of his life. This, however, did not abate his military ardour; for his courage transported him into the field whenever he was called thither by the interests of his subjects. Towards the end of his reign, an opportunity seemed to present itself of obtaining once for all an entire release from the disagreeable pretensions of the king of Leon, who, it seems, had insisted on the king of Portugal doing homage for his kingdom. This was a quarrel between the king of Leon and his nephew Don Alonso king of Castille. The latter solicited assistance from the king of Portugal, which was readily granted. But Don Ferdinand having received intelligence that the infant Don Sancho, the king's eldest son, was advancing towards Ciudad Rodrigo, assembled his troops with such diligence on that frontier, that being enabled to attack him unexpectedly, he entirely defeated him.

Don Sancho's success against the Moors.

Understanding, however, that Don Sancho was recruiting his forces with great diligence, he suggested that they might be much better employed against the infidels, who remained careless and unprepared, expecting the issue of the contest. Don Sancho did not fail to profit by this advice; and after some movements intended to amuse the enemy, he made a sudden irruption into Andalusia, penetrating as far as Triana, one of the suburbs of Seville. The Moors assembled their forces in order to attack him on his retreat; but Don Sancho having first fatigued them by the celerity of his march, at length chose a strong camp, and, having given his troops time to repose, drew them out and offered the enemy battle. The Moors accepted the challenge, but were entirely defeated; and Don Sancho returned to Portugal loaded with spoil. For some years afterwards the war continued without producing any remarkable event; but, in 1184, Joseph king of Morocco having already transported multitudes of men from Barbary, at length followed in person with a prodigious army, and carried all before him as far as the Tagus. He appeared before the city of Santarem; but having exhausted and reduced his army by unsuccessful assaults on that place, he was attacked by the Portuguese assisted by Ferdinand of Leon, and entirely defeated and slain. By this victory the Portuguese were left at liberty to improve the interior of their country, and to fortify their frontiers; but not long afterwards, that is, in the year 1185, the king died, in the seventy-sixth year of his age.

Wise administration of Don Sancho I.

Don Alonso was succeeded by his son Don Sancho I. Of this prince it is remarkable, that before he ascended the throne he was of a restless and warlike disposition; but no sooner did he come to the possession of the kingdom than he became a lover of peace, and began with great assiduity to repair the cities which had suffered most by the war, and to repeople the country around them. By his steady attention to the work of restoration, he in a short time quite changed the appearance of his territories, and procured to himself the glorious title of The Restorer of Cities, and Father of his Country. In the year 1189, a fleet, composed for the most part of English vessels, but having on board a great number of adventurers of other nations, bound for the Holy Land, entered the river Tagus. They were very kindly received and supplied with all kinds of refreshments by Don Sancho, who took this opportunity of soliciting them to assist him in a design he had formed of attacking the city of Silvas in Algarve, to which they readily assented. Having joined them with a squadron of his own galleys, and marched a body of troops by land, the place was reduced, and the English, according to agreement, were rewarded with the plunder. But in a short time, the Moors from Africa having once more invaded Portugal, the town was several times taken and retaken, until at last Don Sancho, sensible of the difficulties of retaining it, caused it to be demolished. His last enterprise was the reduction of Elvas; soon after which he died, leaving the reputation of being the best economist that ever sat on the throne of Portugal. With the character of being rather liberal than avaricious, he had amassed a treasure of more than seven hundred thousand crowns in ready money, besides fourteen hundred merks of silver, and one hundred of gold plate, which he disposed of some time before his death. He was interred by his own command in the cathedral of Coimbra; and when his body was taken up four hundred years afterwards, that it might be laid in a new tomb, it was found uncorrupted.

Differences with Castille.

The history of Portugal presents scarcely any event of importance till the year 1289; when, in the reign of Don Denis, a difference commenced with Castille, which subsisted for a long period. Frequent reconciliations took place; but these were either of short duration, or never sincere. At length, in the reign of John I., Don Juan of Castille, who had also pretensions to the crown of Portugal, invaded that kingdom at the head of the whole force of his dominions, and with the flower of the Castillian nobility entered the province of Alemtejo. According to the Portuguese historians, he besieged Elvas, but without effect; a disappointment which enraged him to such a degree that he determined the following year to invade Portugal a second time, and lay waste the country before him. Accordingly, having collected an army of thirty thousand men, he invaded Portugal, and took and ruined several places, whilst King John lay inactive, with a small army, waiting for some English succours which he expected. At last he ventured an engagement with the forces which he had, and, notwithstanding the great superiority of the enemy, obtained a complete victory; after which he made an irruption into Castille, and had the good fortune to gain another battle, which fixed him firmly upon the throne of Portugal. The Castillians were obliged to consent to a truce of three years, which was soon afterwards improved into a lasting peace.

The city of Ceuta taken from the Moors.

In 1414, King John undertook an expedition against the Moors in Barbary, where he commanded in person; but before he set out, his queen Philippa, the daughter of John duke of Lancaster, died of grief at the thoughts of his absence. The expedition, however, proved successful, and the city of Ceuta was taken from the Moors almost at the first assault; but scarcely had the king left that country, when the princes of Barbary formed a league for the recovery of the place; and though they were defeated by the young princes of Portugal, whom John again sent into Barbary, yet the trouble of keeping it was so great that some of the king's council were of opinion the town should be demolished. But John, having considered the arguments on both sides, determined to preserve the city; and therefore enlarged and strengthened the fortifications, augmenting his forces there to six thousand foot and two thousand five hundred horse, which he hoped would prove sufficient for repelling the attacks of the Moors.

King John died in 1428, and was succeeded by his eldest son Edward. The latter undertook an expedition against Tangier, in Barbary, but the event proved very unfortunate; the Portuguese being so shut up by the Moors, that, to obtain leave to return to Portugal, they were obliged to give up Ceuta. The king's son, Don Ferdinand, was left as a hostage for the delivery of Ceuta; but, with the utmost cruelty and injustice, the king and council of Portugal constantly refused to deliver up the place. Many preparations indeed were made for recovering the prince by force; but before any thing could be accomplished the king died in 1430, which put an end to all these designs.

Passage to the East Indies discovered.

The war with Barbary continued at intervals, but with little success on the part of the Portuguese; and, till 1497, there is no event of any consequence recorded in the history of Portugal. This year, however, was remarkable for the discovery of the passage to the East Indies by the Cape of Good Hope. The enterprising spirit of the Portuguese had, for a considerable time before, prompted them to undertake voyages along the coast of Africa; yet, when they undertook their first voyage of discovery, it is probable that they had nothing farther in view than to explore those parts of the coast of Africa which lay nearest to their own country. But a spirit of enterprise, when roused and put in motion, is always progressive; and that of the Portuguese, though slow and timid in its first operations, gradually acquired vigour, and prompted them to advance along the western shore of the African continent far beyond the utmost boundary of ancient navigation in that direction. Encouraged by success, they became more adventurous, despised dangers which formerly appalled them, and surmounted difficulties which were once deemed insuperable. When the Portuguese found in the torrid zone, which the ancients had pronounced to be uninhabitable, fertile countries, occupied by numerous nations, and perceived that the continent of Africa, instead of extending in breadth towards the west, according to the opinion of Ptolemy, appeared to contract itself, and to bend eastwards, more extensive prospects opened to their view, and inspired them with hopes of reaching India, by continuing to hold the same course which they had so long pursued.

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After several unsuccessful attempts to accomplish what they had in view, a small squadron sailed from the Tagus, under the command of Vasco de Gama, an officer of rank, whose abilities and courage fitted him to conduct this difficult and arduous enterprise. From ignorance, however, of the proper season and route of navigation in that vast ocean through which he had to steer his course, his voyage was long and dangerous. At length he doubled that promontory which had been descried by Diaz, and which, for several years, had been the object of terror and of hope to his countrymen. After a prosperous navigation along the south-east coast of Africa, he arrived at the city of Melinda, and had the satisfaction of discovering there, as well as at other places where he touched, people of a race very different from the rude inhabitants of the western shore of that continent, which alone the Portuguese had hitherto visited. These he found to be so far advanced in civilization and acquaintance with the various arts of life, that they carried on an active commerce, not only with the nations on their own coast, but with remote countries of Asia. Conducted by their pilots, who held a course with which experience had rendered them well acquainted, he sailed across the Indian ocean, and landed at Calicut, on the coast of Malabar, on the 22d of May 1498, ten months and two days after his departure from the port of Lisbon. (See the article Gama.)

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The samorin or monarch of the country, astonished at this unexpected visit of an unknown people, whose aspect, and arms, and manners, bore no resemblance to those of any of the nations accustomed to frequent his harbours, and who arrived in his dominions by a route hitherto deemed impracticable, received them at first with that fond admiration which is often excited by novelty; but in a short time, from whatever motives, he formed various schemes to cut off Gama and his followers. The Portuguese admiral, however, was not to be overreached by such politics as his. From every danger to which he was exposed, either by the open attacks or secret machinations of the Indians, he extricated himself with singular prudence and dexterity, and at last sailed from Calicut with his ships, loaded not only with the commodities peculiar to that coast, but with many rich productions of the eastern parts of India. He returned to Portugal in two years after his sailing from the Tagus, but with a great loss of men; for out of one hundred and forty-eight persons who sailed with him, only fifty-five returned. The king received him with all possible testimonies of respect and kindness; created him Count of Videgueira; and not only declared him admiral of the Indies, but also made that office hereditary in his family.

The Portuguese entered upon the new career opened to them with activity and ardour, and made exertions, both commercial and military, far beyond what could have been expected from a kingdom of such inconsiderable extent. All these were directed by an intelligent monarch, capable of forming plans of the greatest magnitude with systematic wisdom, and of prosecuting them with unremitting perseverance. The prudence and vigour of his measures, however, would have availed but little without proper instruments to carry them into execution. Happily for Portugal, the discerning eye of Emanuel selected a succession of officers to take the supreme command in India, who, by their enterprising valour, military skill, and political sagacity, accompanied with disinterested integrity, public spirit, and love of their country, have established a title to be ranked amongst the persons most eminent for virtue and abilities in any age or nation. Greater things perhaps were achieved by them than were ever accomplished in so short a time. Within twenty-four years after the voyage of Gama the Portuguese had rendered themselves masters of the city of Malacca, in which the great staple of trade carried on amongst the inhabitants of those regions in Asia which Europeans have distinguished by the general name of the East Indies, was then first established. This conquest secured to them great influence over the interior commerce of India, whilst, at the same time, by their settlements at Goa and Diu, they were enabled to engross the trade of the Malabar coast, and to obstruct greatly the long-established intercourse of Egypt with India by the Red Sea. In every part of the East they were received with respect; in many they had acquired the absolute command. They carried on trade there without rivalry or control; they prescribed to the natives the terms of their mutual intercourse; they often fixed what price they pleased on the goods which they purchased; and they were thus enabled to import from Hindustan, and the regions beyond it, whatever was useful, rare, or agreeable, in greater abundance, and of more various kinds, than had been formerly known in Europe.

The settlement of the Portuguese in India.

Opposition made by the Venetians.

Not satisfied with this ascendant which they had acquired in India, the Portuguese early formed a scheme not less bold than interested, of excluding all other nations from participating in the advantages of commerce with the East; and they accomplished one half of what their ambition had planned. In consequence of this the Venetians soon began to feel that decrease of their own Indian trade which they had foreseen and dreaded. In order to prevent the farther progress of this evil, they incited the soldan of the Mamlukes to fit out a fleet in the Red Sea, and to attack those unexpected invaders of a gainful monopoly, of which he and his predecessors had long enjoyed undisturbed possession. The Portuguese, however, encountered his formidable squadron with undaunted courage, entirely defeated it, and remained masters of the Indian Ocean. They continued their progress in the East almost without obstruction, until they established there a commercial empire; to which, whether we consider its extent, its opulence, the slender power by which it was formed, or the splendour with which the government of it was conducted, there had hitherto been nothing comparable in the history of nations. Emanuel, who laid the foundation of this stupendous fabric, had the satisfaction to see it almost completed. Every part of Europe was supplied by the Portuguese with the productions of the East; and if we except an inconsiderable quantity which the Venetians still continued to receive by the ancient channels of conveyance, our quarter of the globe had no longer any commercial intercourse with India, and the regions of Asia beyond it, except by the Cape of Good Hope.

Inquisition introduced into Portugal.

In September 1522, King Emanuel died of an epidemical fever, and was succeeded by his son John III. The most remarkable transaction of this prince's reign was the introduction of the inquisition into his dominions. This happened in the year 1525, or, as some say, in 1535. A famine happening to cease in a short time after the Holy Office was introduced, the priests persuaded the ignorant multitude that it was a blessing from heaven on account of erecting such a tribunal. It was not long, however, before the bulk of the nation perceived what kind of a blessing the inquisition had conferred. But their discernment came too late; for by that time the inquisitors had acquired such power, that it became equally ineffectual and dangerous to attempt disclosing any of their mysteries.

Solyman the Magnificent. Conduct and policy of the Portuguese.

In the mean time Solyman the Magnificent, the most enlightened monarch of the Ottoman race, observing the rising power and opulence of the Portuguese, attributing it to its proper cause, and eager to supplant them, sent orders to the pasha of Egypt to employ his whole strength against the Christians in the East Indies. The pasha, in obedience to these orders, sailed from the Red Sea with a greater naval force than ever the Mahommedans had employed before, having four thousand Janizaries and sixteen thousand other troops on board. Yet, by the courage and conduct of the Portuguese officers and soldiers, all this mighty armament was defeated, and their East India possessions were saved from the danger which threatened them. In Africa, likewise, the king of Fez was baffled before the town of Safi, whilst fresh quarrels breaking out amongst the native princes, gave great relief to the Christians, who had long been obliged to carry on a defensive war, and had more than once been on the very brink of ruin. For a long time indeed their safety had depended solely on the quarrels of the Moors amongst themselves; for such were the envy and jealousy which reigned amongst the Portuguese, that they could never combine heartily in opposing the common enemy; and therefore, had their enemies united against them, they must certainly have been cut off. But whenever the scheriffs quarrelled with each other, one party was sure to have recourse to the Portuguese, who, by sending them a small supply, secured quiet to themselves, and had the pleasure of seeing their enemies destroy one another. Yet in the end even this had bad consequences. For, on the one hand, it kept up a martial spirit amongst the Moors, and on the other it made them acquainted with the Portuguese discipline; so that after every short interval of repose, they not only found them as much enemies as before, but more formidable than ever. The consequence of all this was, that King John began to apprehend that the conquest of Barbary was impossible, and therefore limited his ambition to keeping those few fortresses which he had already acquired; a necessary and prudent measure, which nevertheless displeased the generality of his subjects.

Brazil.

King John exerted himself greatly in the settlement of Brazil in South America, which he brought into a good state, caused several strong towns to be erected there, and took all possible methods to encourage the conversion of the natives to Christianity. He also introduced many regulations for the welfare and happiness of his subjects. The disputes of the nobility about precedency were frequently attended with disagreeable consequences, which made the king resolve to settle them definitively by established rules; and the principles established by him on this occasion have subsisted ever since, and serve in a great measure to prevent such altercations. He had also other designs in his mind, particularly with regard to the reformation of religious persons of both sexes; but, on a close examination of his affairs, he found that his subjects in general had been so much injured by his leaving their concerns to the inspection of his council, that he was thrown by grief into a kind of apoplexy, from which he never recovered. His death happened in June 1557; and he was succeeded by his son Dom Sebastian III. an infant of three years of age.

Education of the young king.

After the death of King John, the administration remained in the hands of the queen, grandmother of Sebastian, who behaved with great prudence and circumspection. The Moors, however, supposing that under a minority they might be able to dispossess the Christians of such places as they held in Barbary, laid close siege to Masagan. But the queen regent speedily sent succours, and promised such rewards to those who distinguished themselves, that the Moors, although they brought eighty thousand men into the field, were obliged to abandon the enterprise. This was at first magnified as a conspicuous instance of the queen's capacity and wisdom; but, in a short time, the natural aversion which the Portuguese have to the government of women, together with the prejudice they had conceived against her country, as being a Castillian, appeared so plainly, and gave her so much uneasiness, that of her own accord she resigned her authority into the hands of Cardinal Dom Henry, the king's brother. Dom Alexis de Moneses was now appointed the governor to the king, and Gonsales de Gomera and two other priests his preceptors. By these instructors the king's education was totally marred. His governor assiduously inculcated upon his mind that the chief virtue of a king was courage, and that danger was never to be avoided, but always surmounted; whilst his other tutors, instead of instructing him in the true religion, only inspired him with an abhorrence of professed infidels. The consequence was, that he became rash, inconsiderate, and obstinate, displaying all those qualities that conspired to draw upon him the catastrophe which ruined both him and the kingdom.

Sebastian undertakes an expedition against Africa.

After the king had grown up to man's estate, his desire was to distinguish himself against the infidels. He himself intended to conduct an expedition to the East Indies; but the prime minister Alcoçova, who did not choose to attend his monarch to such a distance, substituted Africa in its stead. This expedition the king entered into in the most inconsiderate and absurd manner. He first sent for Dom Antonio, prior of Crato, with some hundreds of soldiers; next he carried his principal courtiers with him from a hunting match, and without equipages; he then sent for the Duke of Aveyro, who brought with him such troops as he could collect on so short a warning; and when all these were assembled, the king spent his time in hunting, and slight excursions against the enemy, without doing any thing of consequence, except exposing his person upon all occasions. At length he returned to Portugal in tempestuous weather, and his unexpected arrival was celebrated with the greatest rejoicings.

The trifling success which had attended the king in this expedition served only to inflame him with a greater desire for another; and from the time of his return he seemed to think on nothing else. He was highly delighted also with an accident which furnished him with a pretence for war, of which, however, he stood in no great need. Muley Hamet, king of Fez and Morocco, had been dispossessed of his dominions by his uncle Muley Moloch. At the beginning of this war Dom Sebastian had offered him the Portuguese troops in Africa, a tender which was rejected with contempt; but now being a fugitive, and having in vain solicited assistance from Philip of Spain, Muley Hamet applied to the king of Portugal; and, that he might the more easily succeed, he caused the fortress of Arzila, which his father had recovered, to be restored to the Portuguese. The king was in rapture at this event, and fancied that his glory would exceed that of all his predecessors. He was, however, dissuaded against engaging in this expedition by all his friends. Philip of Spain, having done everything to dissuade him at a personal conference, sent Francisco Aldana, an old and experienced officer, to Morocco; and, at his return, ordered him to attend Dom Sebastian, in order to give him an account of the state of affairs in that country. This he performed with the greatest fidelity, but without any effect. The queen-dowager and the cardinal united in their endeavours to divert him from this unfortunate enterprise; but he treated them both with so little respect that his grandmother broke her heart; and the cardinal, to show his distaste of the measure, retired to Evora without coming either to court or to council, an example which was followed by many of the nobles. Many of these, however, transmitted remonstrances to the king on the impropriety of his conduct; and Philip sent to him the Duke de Medina Celi to lay before him once more the reasons why he thought his scheme impracticable, and to put him in mind that he had no hand in pushing him upon his destruction, or of concealing from him the dangers into which he seemed determined to plunge himself and his subjects. Lastly, he received a letter on the subject from Muley Moloch himself, in which that prince explained to him his own right to the crown of Fez, and showed that he had only dispossessed a tyrant and a murderer, who had therefore no right to his friendship or assistance. The Moorish prince next assured him that he had no reason to fear either the power or the neighbourhood of the Portuguese; and as a proof of this, as well as a mark of his esteem, he was content to make him a present of some ten miles of arable ground round each of the fortresses he possessed in Africa, viz. Tangier, Ceuta, Masagan, and Arzila. At the same time, he addressed himself to Philip king of Spain, with whom he was on good terms, desiring him to interpose with his nephew Sebastian, that things might yet be adjusted without the effusion of human blood. But the king of Portugal was deaf to all salutary advice; and therefore paid no regard to this letter, nor to the remonstrances of his uncle.

ew expe- tion to frica.

On the 24th of June 1577, he set sail from the bar of Lisbon with a fleet of fifty ships and five galleys, twelve pieces of cannon, and many transports and tenders, making in all near a thousand sail. His troops consisted of nine thousand Portuguese infantry; three thousand Germans; seven hundred Italians, commanded by Sir Thomas Stukeley, an English exile, remarkable for his bravery; two thousand Castillians and three hundred volunteers, commanded by Dom Christoval de Tuvara, master of the horse, a man of courage, but without either conduct or experience. He touched first at Lagos Bay in the kingdom of Algarve, where he remained for four days; and thence he proceeded to Cadiz, where he was magnificently feasted for a week by the Duke de Medina Sidonia, who once more endeavoured to dissuade him from proceeding further in person. But this exhortation proved as fruitless as the rest; and the king having sailed with a strong detachment for Tangier, ordered Dom Diego de Souza, the commander-in-chief, to follow with the remainder of the army.

The troops landed on the coast of Africa without any accident, and joined at Arzila. Here the king was met by the Scheriff Muley Hamet, on whose account he had undertaken the war, who delivered him his son Muley, a boy of twelve years of age, as a hostage, and brought a reinforcement of three hundred Moors. The boy was sent to Masagan under a strong guard; but the father remained in the Portuguese camp. Here it was resolved in a council of war to reduce the town of Larache, but it was disputed whether the troops should proceed thither by land or by sea. Don Sebastian, who espoused the former opinion, finding himself opposed by Muley Hamet, answered him so rudely that he left his presence in disgust; after which the king's opinion prevailed, and the army began its march on the 29th of July. As they proceeded, the king received a letter from the Duke of Alba, requesting him to attempt nothing beyond the taking of the town of Larache. Along with the latter was sent an helmet which had been worn by Charles V.

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On the other hand, Muley Moloch, having received intelligence of this formidable invasion, took the field with forty thousand foot and sixty thousand horse, and conducted everything with the greatest prudence, notwithstanding he was so enfeebled by fever that he could not sit upon horseback. Finding reason to suspect that part of his army were desirous of going over to his rival, he proclaimed that such as inclined to join their old master were at liberty to do so. This at once put a stop to the defection, and only a few availed themselves of the liberty which was granted them. Being likewise doubtful of the fidelity of a body of three thousand horse, he sent them to reconnoitre the enemy, by which act of confidence he secured them. Still, however, fearing that his officers might be corrupted by Portuguese gold, he entirely changed the disposition of his army, so that none of his officers commanded the corps to which they had been accustomed, and having new men to deal with, had none in whom they could confide.

Having taken these precautions, he advanced against the Portuguese army with such celerity that he came in sight of them on the 3d of August. On this Dom Sebastian called a council of war, in which many who out of complaisance had declared for this march, were now for returning. They were separated from the enemy by a river, but the Moors being masters of the ford, it was impossible to force them immediately from their post; neither was it practicable for them to wait for a more favourable opportunity, because they had no provisions. The foreign officers, on the contrary, were of opinion that fighting had now become necessary, and a retreat dangerous. This, however, was violently opposed by the scheriff, who saw plainly that they ran a great risk of being defeated, and of losing all, whilst, at the same time, they were not certain of gaining any thing of consequence should they prove victorious; whereas, if they withdrew towards the sea, they might entrench themselves till they were relieved by their fleet; and during this interval, if Muley Moloch should die, he looked upon it as certain that a great part of the army would desert to him, which would render him master not only of the kingdom, but of the fate of the Christians also. When he found that the king was bent upon fighting, he only requested that the engagement might be delayed till four o'clock in the afternoon, that, in case of a defeat, they might have some chance of escaping. But even in this he could not prevail; for the king having disposed everything for a battle the next day, was impatient to begin the onset as soon as it was light.

In the mean time, Muley Moloch was so sensible of the advantages of his situation, that he was inclined to take the whole Portuguese army prisoners; but finding his disease increase to such a degree that he had no hopes of recovery, he came to the resolution to fight, that his antagonist might not avail himself of his death. The disposition of the Christian army was, through the care of some old officers in Don Sebastian's service, regular and correct. The infantry were disposed in three lines; the battalion of volunteers formed the vanguard; the Germans, commanded by Colonel Amberg, and the Italians by Sir Thomas Stukeley, were stationed on the right; the Castillian battalions occupied the left, and the Portuguese were in the centre and rear; the cavalry, consisting of about fifteen hundred men, being partly on the right, under the command of the Duke d'Avegro, to whom the scheriff joined himself with his horse. On the left was the royal standard, with the rest of the cavalry, under the command of the Duke of Barcelos, eldest son of the Duke of Braganza, Dom Antonio, prior of Crato, and several other persons of rank. The king took post at first with the volunteers. Muley Moloch also disposed his troops in three lines. The first consisted of the Andalusian Moors, commanded by three officers who had distinguished themselves in the wars of Granada; the second was composed of renegadoes; and the third consisted of the natives of Africa. They were formed in a crescent, with ten thousand horse on each wing, and the rest in the rear, with orders to extend themselves in such a manner as to encompass the Christian army. Muley Moloch, though extremely weak, was taken out of his litter, and set on horseback, that he might see how his commands had been obeyed; and being perfectly satisfied with the situation of his troops, he directed the signal of battle to be given.

The Christians advanced with the greatest resolution, broke the first line of the Moorish infantry, and disordered the second. On this Muley Moloch drew his sword, and would

The Portuguese army entirely defeated.

have advanced to encourage his troops; but his guards prevented him, on which his emotion of mind became so great that he fell from his horse. One of his guards caught him in his arms, and conveyed him to his litter, where he immediately expired, having only time to lay his finger on his lips by way of enjoining them to conceal his death. But by this time the Moorish cavalry had wheeled quite round, and attacked the Christian army in the rear; upon which the cavalry in the left wing made such a vigorous effort that they broke the Portuguese on the right; and at this time the scheriff, in passing a rivulet, was drowned. In this emergency, the Germans, Italians, and Castillians, performed prodigies; but the Portuguese, according to their own historians, behaved indifferently. Attacked on all sides, however, they were unable to resist; and the whole army, except about fifty men, were killed or taken prisoners. The fate of the king is variously related. According to some, he had two horses killed under him, and then mounted a third. His bravest officers were killed in his defence; after which the Moors surrounding him, seized his person, stripped him of his sword and arms, and secured him. They immediately began to quarrel about the prisoner, upon which one of the generals rode in amongst them, crying, "What, you dogs, when God has given you so glorious a victory, would you cut one another's throats about a prisoner?" At the same time, discharging a blow at Sebastian, he brought the king to the ground, when the rest of the Moors soon despatched him. Others affirm, that one Louis de Brito meeting the king with the standard wrapped round him, Sebastian cried out, "Hold it fast; let us die upon it;" upon which, charging the Moors, he was seized, but rescued by Brito, who was himself taken with the standard and carried to Fez. The latter affirmed, that after he was taken, he saw the king at a distance, and unpursued. Dom Louis de Lima met him afterwards making towards the river; and this is the last account of his being seen alive.

Portugal conquered by Philip of Spain.

Immediately after the battle, Muley Hamet, the brother of Muley Moloch, was proclaimed king by the Moors. The next day, having ordered all the prisoners to be brought before him, the new sovereign gave orders to search for the body of Dom Sebastian. The king's valet-de-chambre brought back a body, which he said was that of his master, but so disfigured with wounds that it could not well be known; and, notwithstanding the most diligent search, this monarch's death could never be properly authenticated. This body, however, was preserved by Muley Hamet, who delivered it up as the body of the unfortunate Dom Sebastian to Philip king of Spain. By the latter it was sent to Ceuta, thence transported to Portugal, and buried amongst his ancestors in the monastery at Belem, with all possible solemnity.

By this disaster, the kingdom of Portugal, from being the most eminent, sunk at once into the lowest rank of the European states. All the young nobility were cut off or carried into slavery, and the kingdom was exhausted of men, money, and reputation; so that Dom Henry, who assumed the government after the death of his brother Dom Sebastian, found himself in a very disagreeable situation. The transactions of his reign were trifling and unimportant; but after the death of the king a great revolution took place. The crown of Portugal was claimed by three different competitors, viz. the Prince of Parma, the Duchess of Braganza, and Philip of Spain. Whatever might have been the merits of their respective claims, the power of Philip quickly decided the contest in his favour. He found his schemes facilitated by the treachery of the regents, who took the most scandalous methods of putting the kingdom into his hands. Under pretence of inspecting the magazines, they withdrew some of the powder, and mixed the rest with sand; they appointed an agent to repair for succours to France, whence they knew that they could not arrive in time; they dissolved the states as soon as they discovered that they were bent upon maintaining the freedom of the nation; and, under a show of confidence, they sent off to distant places such of the nobility as they suspected.

Philip finding everything in his favour, commanded the Duke of Alva to invade Portugal at the head of twenty thousand men. The people, perceiving that they were betrayed, exclaimed against the governors, and placed on the throne Don Antonio, prior of Crato. But his forces being inexperienced, and his own conduct indifferent, he was quickly defeated by the Duke of Alva, and forced to leave the kingdom. On his flight the whole kingdom submitted, together with the garrisons of Barbary, and also the settlements upon the coast of Africa, in Brazil, and in the East Indies. The Madeiras. however, excepting the isle of St Michael, held out for Don Antonio until they were reduced, and the French navy, which came to their assistance, entirely defeated and destroyed.

Terms granted by him to his new subjects.

Philip made his entry into Lisbon as soon as the kingdom had been totally reduced, and endeavoured to conciliate the affections of the people by confirming the terms which he had before offered to the states. These terms were, that he would take a solemn oath to maintain the privileges and liberties of the people; that the states should be assembled within the realm, and nothing proposed in any other states that related to Portugal; that the viceroy or chief governor should be a native, unless the king should give that charge to one of the royal family; that the household should be kept on the same footing; that the post of first president, and all offices, civil, military, and judicial, should be filled by Portuguese, all dignities in the church and in the orders of knighthood confined to the same, the commerce of Ethiopia, Africa, and the Indies, reserved also to them, and to be carried on only by their merchants and vessels; that he would remit all imposts on ecclesiastical revenues; that he would make no grant of any city, town, or jurisdiction royal, to any but Portuguese; that estates resulting from forfeitures should not be united to the domain, but go to the relations of the last possessor, or be given to other Portuguese in recompense of services; that when the king came to Portugal, where he should reside as much as possible, he should not take the houses of private persons for his officers' lodging, but keep to the custom of Portugal; that wherever his majesty resided, he should have an ecclesiastic, a treasurer, a chancellor, two masters of requests, with inferior officers, all of them Portuguese, who should despatch everything relating to the kingdom; that Portugal should ever continue a distinct kingdom, and its revenue be consumed within itself; that all matters of justice should be decided within the realm; that the Portuguese should be admitted to charges in the households of the king and queen of Spain; that all duties on the frontiers should be taken away; and, lastly, that Philip should give three hundred thousand ducats to redeem prisoners, repair cities, and relieve the miseries which the plague and other calamities had brought upon the people. All these conditions, formerly offered and rejected by the Portuguese, the king now confirmed; but although the Duke of Ossuna, by way of security, had promised them a law, that if the king did not adhere to them, the states should be freed from their obedience, and might defend their right by the sword, without incurring the reproach of perjury or the guilt of treason, this he absolutely refused to ratify.

All these concessions, however, failed to answer the purpose; nay, although Philip was to the last degree lavish of honours and employments, the Portuguese were still dissatisfied. This had also an effect which was not foreseen. It weakened the power and absorbed the revenues of the crown; and, by putting it out of the power of any of his successors to be liberal in the same proportion, it raised only a short-lived gratitude in a few, and left a number of malcontents, to which time was continually adding.

reatment
f Dom An-
onio.

Thus Philip, with all his policy and endeavours to please, found his new subjects still more and more disgusted with his government, especially when they found their king treating with the utmost severity all those who had supported Don Antonio. The exiled prince, however, still styled himself, "king of Portugal." At first he retired to France, and there demanded succours for the recovery of his dominions. Here he found so much countenance, that with a fleet of nearly sixty sail, and a considerable body of troops on board, he made an attempt upon Terceira, where his fleet was beaten by the Spaniards, and many prisoners being taken, all the officers and gentlemen were beheaded, and a great number of meaner people hanged. Dom Antonio, however, kept possession of some places, coined money, and performed many other acts of sovereign power; but he was at length constrained to retire, which he did with some difficulty, and returning into France, he passed thence into England, where he was well received; and many fitted out privateers to cruize against the Spaniards under his commission. But after Philip had ruined the naval power of Portugal as well as that of Spain, by equipping the Armada, Queen Elizabeth made no difficulty of owning and assisting Dom Antonio, and even of sending Sir John Norris and Sir Francis Drake with a strong fleet and a considerable army to restore him. Upon this occasion Don Antonio sent his son Don Christoval a hostage to Muley Hamet, king of Fez and Morocco, who was to lend him two hundred thousand ducats. But Philip prevented this by surrendering Arzila; which, with the unseasonable enterprise against Corunna, and the disputes that arose between Norris and Drake, rendered the expedition abortive; so that, except carrying the plague into England, it was attended with no consequences worthy of notice. Dom Antonio remained some time afterwards in England; but finding himself disregarded, he withdrew once more into France, where he fell into great poverty and distress; and having at length died in the sixty-fourth year of his age, his body was buried in the church of the nuns of Ave Maria, with an inscription on his tomb, in which he is styled, "king." He left behind him several children, who, on account of his being a knight of Malta, and having made a vow of chastity at his entrance into the order, were looked upon as illegitimate.

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ebastian.

But Dom Antonio was not the only pretender to the crown of Portugal. The people, partly from love of their prince, and partly from their hatred to the Castillians, were continually feeding themselves with the hopes that Dom Sebastian would appear and deliver them; and in this respect such a spirit of credulity reigned, that they would probably have taken a negro for Dom Sebastian. This humour induced the son of a tiler at Alcobaça, who had led a profligate life, and at length turned hermit, to give himself out as that prince; and having with him two companions, one of whom styled himself Dom Christoval de Tavora, and the other the bishop of Guarda, they began to collect money, and were in a fair way of creating much disturbance. But the cardinal archduke caused them to be apprehended, and after leading them ignominiously through the streets of Lisbon, he who took the name of Sebastian was sent to the galleys for life, and the pretended bishop was hanged. Not long afterwards, Gonsalo Alvarez, the son of a mason, gave himself out as the same king, and having promised marriage to the daughter of Pedro Alonso, a rich yeoman, whom he created count of Torres Novas, he assembled a body of about eight hundred men, and some blood was spilt before he was apprehended. At length, being clearly proved to be an impostor, this person and his intended father-in-law were publicly hanged and quartered at Lisbon. The punishment, however, instead of extinguishing public credulity, served only to increase it.

remark-
le knave.

About twenty years after the fatal defeat of Sebastian, there appeared at Venice a person who created much more trouble. He assumed the name of Don Sebastian, and gave a very distinct account of the manner in which he had passed his time since that defeat. He affirmed, that he had preserved his life and liberty by hiding himself amongst the slain; that, after wandering in disguise for some time in Africa, he returned with two of his friends into the kingdom of Algarve; that he gave notice of this to the king Don Henry; that finding his life sought, and being unwilling to disturb the peace of the kingdom, he returned again amongst the Moors, and passed freely from one place to another in Barbary, in the habit of a penitent; and that after this he became a hermit in Sicily, but at length resolved to go to Rome, and discover himself to the pope. On the road he was robbed by his domestics, and came almost naked to Venice, where he was known and acknowledged by some Portuguese. Complaint, however, being made to the senate, he was obliged to retire to Padua. But as the governor of that city also ordered him to depart, he, not knowing what to do, returned to Venice, where, at the request of the Spanish ambassador, who charged him not only with being an impostor, but also with many black and atrocious crimes, he was seized, and thrown into prison. He underwent, before a committee of noble and impartial persons, twenty-eight examinations, in which he not only acquitted himself clearly of all the crimes which had been laid to his charge, but entered into so minute a detail of the transactions which had passed between himself and the republic, that the commissioners were perfectly astonished; and, moved by the firmness of his behaviour, his singular modesty, the sobriety of his life, his exemplary piety, and his admirable patience under affliction, they showed no disposition to declare him an impostor. The noise of this was diffused throughout Europe, and the enemies of Spain endeavoured everywhere to give it credit.

The state, however, refused to discuss the point, whether he was or was not an impostor, unless they were requested so to do by some prince or state in alliance with them. Upon this the Prince of Orange sent Dom Christoval, the son of the late Dom Antonio, to make that demand; and at his request an examination was instituted with great solemnity. But no decision followed; only the senate set him at liberty, and ordered him to depart from their dominions in three days. By the advice of his friends, therefore, he proceeded to Padua in the disguise of a monk, and from thence to Florence, where he was arrested by the command of the grand duke, who delivered him up to the viceroy of Naples. He remained several years prisoner in the castle Del Ovo, where he endured incredible hardships. At length he was brought forth, led with infamy through the streets of the city, and declared to be an impostor, who assumed the name of Sebastian; at which words he said gravely, "And so I am." In the same proclamation it was affirmed that he was in truth a Calabrian; but as soon as he heard this he said, "It is false." He was next shipped on board a galley as a slave, and carried to San Lucar, whence, after being for some time confined there, he was transferred to a castle in the heart of Castille, and never heard of more. Some persons were executed at Lisbon for their endeavours to raise an insurrection in his behalf; but it was thought strange policy, or rather a strange want of policy, in the Spaniards, to make this affair so public without proofs; and the attempt to put down the objection, by affirming that he was a magician, justly excited ridicule and contempt.

Bad consequences of the Spanish administration.

The administration of affairs in Portugal, during the reign of Philip, was certainly detrimental to the nation; and yet it does not appear that this proceeded so much from any ill intention in that monarch, as from errors in judgment. His prodigious preparations for the invasion of England impoverished all his European dominions; but it absolutely exhausted Portugal. The pretensions of Dom

Antonio, and the hopes of despoiling their Indian fleets, exposed the Portuguese to the resentment of the English, from which the king wanted power to defend them. Their clamours were not the less loud for their being in some measure without cause. The king, in order to pacify them, borrowed money from the nobility upon the customs, which was the only remedy he had left; and this was attended with fatal consequences. The branches, thus mortgaged, became fixed and hereditary; so that the merchant was oppressed, whilst the king in fact received nothing. This expedient failing, a tax of three per centum was imposed, in the nature of ship-money, for the defence of the coasts and the commerce of the country, and for some years it was properly applied; but it then became a part of the ordinary revenue, and went into the king's exchequer without account. This made way for diverting other appropriated branches; as, for instance, that for the repair of fortifications, the money being strictly levied, whilst the works were suffered to decay and tumble down; and also that for the maintenance of the conquests in Africa, by which the garrisons mouldered away, and the places were lost. Upon the whole, in the space of eighteen years, the nation was visibly impoverished; and yet the government of Philip was so incomparably preferable to that of his immediate successors, that his death was justly regretted, and the Portuguese were taught by experience to confess, that of bad masters he was the best.

Philip III. and Philip IV.

His son Philip, the second of Portugal and the third of Spain, sat twenty years upon the throne before he paid a visit to Portugal, where the people put themselves to a most enormous expense to receive him. He held an assembly of the states, in which his son was sworn as his successor. Having done all that he wanted for himself, he acquired a false idea of the riches of the nation, from the immoderate and foolish display made during his stay at Lisbon; and having shown himself little, and done less, he returned into Spain, where he acted the part of a good king upon his death-bed, in deploring bitterly that he had never thought of acting it before. The reigns of Philip III. and Philip IV. were characterised by a series of bad measures, and worse fortune. All their dominions suffered greatly; Portugal most of all. The loss of Ormus in the east, and of Brazil in the west, together with the shipwreck of a fleet sent to escort one of merchantmen from Goa, brought the nation incredibly low, and encouraged the Conde Duke to hope that they might be entirely crushed. These are the heads only of the transactions of forty years. To enter in any degree into particulars, would only be to point out the breaches made by the Spanish ministers in the conditions granted by Philip; which, with respect to the nation, was the original contract and unalterable constitution of Portugal whilst subject to the monarchs of Castille, but which notwithstanding, they often flagrantly violated.

The Portuguese oppressed by the Spaniards.

The very basis and foundation of their privileges was, that the kingdom should remain separate and independent, and consequently that Lisbon should continue as much its capital as ever. But so little was this observed, that neither promotion nor justice was to be obtained without journeys to Madrid, which was not more the capital of Castille than it was that of Portugal. The general assembly of estates was to be held frequently, and they were only held thrice in the space of sixty years; two of them being held within the first three years. The king was to reside in this realm as often and as long as possible. Philip I., however, was there but once; Philip II. resided only four months; and Philip III. never at all. The household establishment was suppressed during all these reigns. The viceroy was to be a native of Portugal, or a prince or princess of the blood; yet when any of the royal family bore the title, the power was in reality in the hands of a Spaniard. Thus, when the Princess of Mantua was vice-queen, the Marquis de la Puebla was sent to assist her in council, and she could do nothing without his advice. The council of Portugal, which was to be composed entirely of natives, was filled with Castillians, as the garrisons also were, though the contrary had been provided. The presidents of provinces, or corregidors, were to be natives; but, by keeping those offices in his own hands, the king eluded this article. No city, town, or district, was to be given to any except Portuguese; yet the Duke of Lerma had Beja, Serpa, and other parts of the demesnes of the crown, which were formerly appendages of the princes of the blood. None but natives were capable of offices in the courts of justice, in the revenue, in the fleet, or of holding any post civil or military; yet these were given promiscuously to foreigners, or sold to the highest bidder, not excepting the government of castles, cities, and provinces. The natives were so far from having an equal chance in such cases, that no situations in the presidios were ever given to them, and scarcely any in garrisons; and whenever it occurred, in the case of a person of extraordinary merit, whose pretensions could not be rejected, he was either removed, or not allowed to exercise his charge, as happened to the Marquis of Marialva and others. The forms of proceeding, the jurisdiction, the ministers, the secretaries, were all changed in the council of Portugal, being reduced from five to three, then two, and at last to a single person.

A revolution in favour of the Duke of Braganza.

By reason of these and many other grievances too tedious to be enumerated, the detestation of the Spanish government became universal; and in 1640 a revolution took place, in which John duke of Braganza was declared king, by the title of John IV. This revolution, as being determined by the almost unanimous voice of the nation, was attended with very little effusion of blood; neither were all the efforts of the king of Spain able to regain his authority. Several attempts, indeed, were made for this purpose. The first battle was fought in the year 1644, between a Portuguese army of six thousand foot and eleven hundred horse, and a Spanish army of nearly the same number. The latter were entirely defeated; and this contributed greatly to establish the affairs of Portugal on a firm basis. The king carried on a defensive war during the remainder of his life; and after his death, which happened in 1655, the war was renewed with great vigour.

Perilous state of Portugal on his death.

This was what the Spaniards did not expect; for they expressed an indecent joy at his death, hoping that it would be followed by a dissolution of the government. It would not, indeed, be easy to conceive a kingdom left in more perilous circumstances than Portugal was at this time. The king, Dom Alonso Enriquez, was a child not more than thirteen years of age, reputed of unsound constitution both of body and mind; the regency was in a woman, and that woman a Castillian; the nation was involved in a war respecting the title to the crown; and the nobility, some of them secretly disaffected to the reigning family, were almost all of them embarked in feuds and contentions with each other; so that the queen scarcely knew whom to trust or how she should be obeyed. She acted, however, with great vigour and prudence. By marrying her only daughter, the Princess Catherine, to Charles II. king of Great Britain, she procured for Portugal the protection of the English fleets, with reinforcements of some thousands of horse and foot; and at last, in 1665, the war was terminated by the glorious victory of Montesclaros. This decisive action broke the power of the Spaniards, and fixed the fate of the kingdom, though not that of the king of Portugal. Alonso was a prince whose education had been neglected in his youth, who was devoted to vulgar amusements and mean company, and whom the queen for these reasons wished to deprive of the crown, that she might place it on the head of his younger brother Dom Pedro. To accomplish this object, she attempted every method of stern authority and secret artifice; but her endeavours of every kind were vain. The

Portuguese would not consent to set aside the rights of primogeniture, and involve the kingdom in all the miseries attending a disputed succession.

om Alon- obliged resign e throne.

But after the death of the queen-mother, the infant entered into cabals against the king, of a much more dangerous nature than any that she had carried on. Alonso had married the Princess of Nemours; but being impotent, and less handsome than his brother, that lady transferred her affection to Dom Pedro, to whom she lent her assistance to hurl the king from the throne. Alonso was compelled to sign a resignation of the kingdom; and his brother, after governing a few months without any legal authority, was in a meeting of the states unanimously proclaimed regent, and vested with all the powers of royalty. Soon after this revolution, for such it may be called, the marriage of the king and queen was declared null by the chapter of Lisbon; and the regent, by a pontifical dispensation, and with the consent of the states, immediately espoused the lady who had been the wife of his brother. He governed, under the appellation of regent, fifteen years, when, upon the death of the king, he mounted the throne by the title of Dom Pedro II.; and after a long reign, during which he conducted the affairs of the kingdom with great prudence and vigour, he died on the 9th of December 1706.

om John .

Dom John V. succeeded his father; and though he was then little more than seventeen years of age, he acted with such wisdom and resolution, adhered so steadily to the grand alliance formed against France and Spain, and showed so great resources in his own mind, that though he suffered severe losses during the war, he obtained such terms of peace at Utrecht, that Portugal was in all respects a gainer by the treaty. The two crowns of Spain and Portugal were not, however, thoroughly reconciled until the year 1737; but from this period they became every day more united, which gave much satisfaction to some courts, and no umbrage to any. In this situation of things a treaty was concluded in 1750 with the court of Madrid, by which Nova Colonia, on the river Plata, was ceded to his Catholic majesty, to the great regret of the Portuguese, as well on account of the value of that settlement, as because they apprehended that their possession of the Brazils would by this cession be rendered precarious. On the last of July the same year, this monarch, worn out by infirmities, died in the sixty-first year of his age, and the forty-fourth of his reign.

om Jo- eph I.

He was succeeded by his son Joseph I., who ascended the throne of Portugal under very favourable circumstances; but his reign, although short, was marked by great national calamities. The most remarkable event which occurred was the memorable earthquake, which, in November 1755, destroyed one half of the city of Lisbon, and buried thirty thousand people under the ruins. Two hours had scarcely elapsed after this terrible convulsion, when, to aggravate its horrors, flames burst forth from different quarters of the city, and the conflagration raging with terrific violence for three days, Lisbon was completely desolated. The royal family were fortunate enough to escape; but amongst the victims were the Spanish ambassador, and many other persons of distinction. Britain promptly afforded relief to the sufferers; an act of generosity the more honourable to her, as she had every reason to be dissatisfied with the conduct of the king of Portugal. From the commencement of his reign, he had thrown great obstructions in the way of our commerce, evading treaties, and imposing vexatious imposts; and it seemed perfectly clear, that his object was to annihilate the commercial intercourse which had for so many ages subsisted between the two countries. The same spirit of humanity was evinced by Spain; but both nations received an unworthy return, although Britain had most to complain of. The Spaniards were only treated with silent ingratitude, but the English were detested as heretics.

Scarcely had the agitation which these great calamities gave rise to subsided, when Portugal was again thrown into commotion by a pretended conspiracy against the life of the king. No light has yet been thrown upon this dark transaction. The leading parties involved in it, and the ultimate object which they aimed at, are alike unknown. Suspicion fell on various classes of persons, particularly on certain ecclesiastics, who were said to have been incensed at the reform introduced by Dom Joseph; on the creatures of Spain, who aspired to the reunion of the two kingdoms under one sceptre; on the Jesuits, who were represented as indignant at the restriction of their ancient privileges; and on a prince of the royal family. All that is known with certainty is, that the scaffold flowed with noble blood; and that the Jesuits, against whom Pombal had artfully inflamed the passions of the multitude, were stripped of their possessions, whilst their expulsion was decreed by the crown. In fact, the members of the company of Jesus were supposed to be at the bottom of every calamity; whether it was a dispensation of Providence, or an act of human depravity. Even the earthquake was boldly ascribed to them. Pombal had sworn their destruction, and the gross ignorance of the people ministered to his vengeance. Another occurrence of this reign was a rupture with the see of Rome, every servant of the pope being expelled from Portugal, and all intercourse between the two courts suspended for about two years. A more important event was the invasion of the country by Spain. This aggression originated in the refusal of the king to join the alliance of France and Spain against England. War was immediately declared against him, and troops marched to the frontiers of his kingdom. The ally whom he had so long neglected, and even deliberately ill used, was appealed to, and not in vain. Troops, arms, and all necessary munitions of war, arrived from Britain; and although the invaders succeeded in capturing Miranda, Braganza, and Almeida, their triumphs were speedily put a stop to by the combined forces of Britain and Portugal. At the instance of the British cabinet, the Count de Lippe was brought from Germany to assume the command of the whole army. This commander was ably assisted in his operations by General Burgoyne, and they had soon the glory of freeing the country from the Spanish army. The consequence of this triumph was a peace, solicited and obtained by the two hostile courts, now hopless of success, and in apprehension of fresh disasters.

The remainder of this king's reign, extending from the year 1763 to 1777, was occupied by the introduction of measures for social, agricultural, and commercial improvement. He laboured to improve the police and judicial administration, and not without success. He founded schools in the large towns, and improved the system of study in the university of Coimbra. He encouraged agriculture, the fisheries, and trade with the colonies; but in attempting to give a stimulus to home manufactures, by laying such duties on articles of British produce as amounted to an almost total exclusion of them from the Portuguese market, he acted with equal short-sightedness and ingratitude. One monument to his honour, more noble than the statue of bronze which his grateful subjects erected to him in Lisbon during his life-time, remains to be mentioned. This was a decree by which the grandsons of slaves, and all who should be born after the date thereof, were declared free. Although this benefit was confined to Portugal alone, yet, considering the state of matters at the time it was conferred, it must be regarded as an amazing stride in the career of improvement. Joseph I. died in 1777, and was mourned by his people as the best monarch who had swayed the sceptre of Portugal since the days of Philip I. It must, however, be added, that the administration of Pombal threw a false splendour on the reign of this monarch. In principle a freethinker, in profession a reformer, and in character a cruel and cold-blooded tyrant, this man was lauded to the skies by the infidel philosophers of France, because he had expelled the Jesuits from Portugal with every circumstance of barbarity and iniquity. But few or none of his pretended reforms survived his fall, which was hailed with satisfaction by the whole nation; and his name is now remembered only in connection with some of the darkest and foulest deeds recorded in the historical annals of Portugal.

Maria.

Joseph was succeeded by his daughter Maria, whom the necessities of state had induced her father to give in marriage to his own brother. Such revolting connections are unhappily far from rare in the modern history of Portugal. Some attempts were made to exclude her in favour of a nephew, but they proved completely abortive. Though the abilities of this queen were limited, yet she was actuated by good intentions. Her administration was feeble, but upon the whole beneficial. She followed the example of her father in encouraging national industry and reforming the administration of justice. She founded the Academy of Sciences, and introduced into the convents of friars a compulsory form of education, embracing useful literature, philosophy, and the sciences. She likewise endowed several admirable charitable institutions, and went so far in judicial reform as to abolish the law of imprisonment for debt. In short, had her foreign policy resembled her domestic administration, Portugal would have had no reason to complain of her. Maria was forced into a family compact by her powerful neighbours of France and Spain, by which the influence of the latter was strengthened and confirmed, whilst in the same degree that of England was weakened. This alliance was accompanied by a treaty of limits, which fixed the boundaries of Brazil, Paraguay, and Peru, the arrangement being peculiarly favourable to Spain.

In the year 1792 the queen exhibited symptoms of mental alienation, and John Maria Joseph, prince of Brazil, was appointed regent. One of the first acts of his administration was a declaration of war against the French republic, a step which he was induced to take from his connection with England. But commercial distress, the accumulating debt of the country, and the menacing language which France compelled Spain to adopt towards her neighbour, led to a peace in 1797. In 1799 the malady of the queen appearing to be incurable, the prince was confirmed in the regency, with full regal powers; but he made no change in the policy of the government. The same year he was again encouraged to arm against French aggression, in alliance with England and Russia; the victorious career of the revolutionists having received a severe, although, as it proved, only a temporary check. But the glory of the French arms was restored by the genius of Napoleon. After this conqueror had fully confirmed his ascendency, Spain was under the necessity of declaring war against Portugal in the year 1801; but it was soon terminated by the treaty of Badajoz, in consequence of which Portugal was compelled to cede Olivenza to Spain, and likewise to pay a considerable sum of money. After this the prince enjoyed but a mere shadow of power, and at considerable sacrifices maintained a nominal independence, until at last, in 1807, a hostile army under Marshal Junot invaded Portugal; and the house of Braganza was declared by Napoleon to have forfeited the throne. This bold declaration was owing to the prince having refused to seize the English property in his dominions. Having embarked with his family for Brazil, the French general immediately afterwards took possession of his capital, and Portugal sank into the condition of an appendage of France.

General Junot issued a proclamation, in which he declared that justice should be duly administered, tranquillity preserved, and the future happiness of the people solicitously guarded. But these professions were far from satisfying a people of whom the lower classes were dying of absolute want, and two thirds of the merchants were bankrupt. A British force under the Duke of Wellington (then Sir Arthur Wellesley) was promptly despatched to Portugal, where it was joined by a considerable body of national troops, now mustered in the northern provinces, and determined to maintain the struggle for freedom. A junta was immediately established in Oporto, to conduct the government. After some sharp skirmishing between the two armies, the decisive battle of Vimiero,[1] which was fought on the 21st of August 1808, overthrew the power of France in Portugal. The convention of Cintra followed, and the country was evacuated by the French troops. The immediate consequences of this convention, which at the time was severely censured, were highly beneficial. The government displayed an energy which restored subordination, and was felt all over the kingdom. A levy *en masse* of the whole male inhabitants, from fifteen to sixty years of age, was demanded; but it does not appear that the call was responded to with much alacrity. Towards the close of the year 1808, Madrid having surrendered, and the British army under Sir John Moore having been compelled to retreat through the mountains of Galicia to Corunna, the subjugation of Portugal was again resolved upon by the French. The intelligence of the approaching invasion at first spread consternation and dismay throughout Portugal, for it was in no condition to offer any serious resistance to the force of the enemy that menaced the frontiers. But fresh reinforcements arrived from Britain, and General Beresford, who had been appointed commander-in-chief of the armies of Portugal, having established a system of subordination and discipline amongst the troops, confidence was in a great measure restored before a blow could be struck.

Marshal Soult entered the kingdom of Portugal at the head of the French army, after dispersing the Spanish force in Galicia. He was feebly opposed by the Portuguese, who, however, displayed a laudable eagerness to fight. Their commander, General Freyre, was opposed to a regular engagement; but his unruly troops rose in mutiny, and massacred both him and his supporters, under the suspicion of treachery. They were led against the enemy by Baron Eben, a German in the British service, and the battle of Carvalho da Este was fought and lost. Soult then invested Oporto, and although the city had been strongly fortified and garrisoned, it was carried by assault on the 29th of March 1809, after a feeble defence of only three days. Immediately on entering the town, the French soldiery commenced an indiscriminate slaughter of the inhabitants; and although their commander used every effort to repress their fury, the plunder and licentiousness had continued a day and a night before subordination could be restored. The defeat of the Spanish army at Medellin opened an easy road to Lisbon; but the French force was divided into three separate bodies, under three independent commanders, Soult, Victor, and Lapisse, though, from fear of being separately committed, the whole remained inactive, or only engaged in insignificant manœuvres. Each commander appears to have waited for intelligence as to the movements of the others, and by this delay the capital was saved. Such was the situation of affairs when Sir Arthur Wellesley landed at Lisbon on the 23d of April, and assumed the chief command of the armies of England and Portugal. By a series of brilliant manœuvres, the British commander compelled the French to abandon Portugal. But Napoleon being pledged to his people and the world to conquer that country, early in 1810 an army of seventy-two thousand men was assembled in the vicinity of Salamanca, and the command of it intrusted to Marshal Massena. After clearing his way to Portugal, by the capture of several strongly-fortified places, the French general advanced upon Lisbon. But his vigilant enemy had well employed the time afforded him, by preparing a secure asylum for his troops, by which he at once kept his footing in the peninsula, and defended Lisbon against a greatly superior force. This formidable defensive position is celebrated in military annals by the name of the lines of Torres Vedras. The advance of Massena, the battle of Busaco, the stand made at Torres Vedras, the retreat of the French, and their final evacuation of Portugal, will be found described in the article BRITAIN. It is true, that in the subsequent operations of the war, some parts of the kingdom were included in the theatre of hostilities, yet they never extended much beyond the frontiers. During the remainder of the war, however, the troops of Portugal bore an active and creditable part in almost every encounter with the enemy.

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[1] The operations of the British army in Portugal and Spain having been already narrated at sufficient length in the article BRITAIN, no details will here be given.

John VI.

On the death of Maria, John VI. ascended the throne of Portugal and Brazil. The establishment of the court of Lisbon in an American settlement, though productive of little good to the mother country, led to important results. In the first place, it induced Brazil to withdraw itself from dependence on England; and, secondly, it paved the way for that colony erecting itself into a separate state. But the influence of England in Portugal continued, and the condition of the kingdom for the present remained essentially unchanged by the transference. The peace of Paris, concluded in May 1814, which, it was believed, would place everything on a proper basis, did not realize the expectations of the nation. Spain evaded the restitution of Olivenza, which had been provided for by the congress of Vienna; whilst, at the same time, Portugal was required to restore French Guiana to France. The court of Rio therefore took possession of the Banda Oriental; but an account of these transactions has been given in another part of this work (See BRAZIL.) These circumstances rendered the condition of Portugal far from tranquil. The country felt that the order of things had been inverted, and the parent state had become a dependent on her colony. A conspiracy of a very extensive nature was timeously discovered in the army, and its progress checked; but the spirit which generated it was not extinguished. In short, everything was ripening for a fundamental change in the administration and constitution of government; and the Portuguese people were soon afforded an opportunity of showing their dislike of the absence of the court, and the predominance of English influence. The continual bickerings between the commander of the forces and the regency induced Marshal Beresford to repair to Rio de Janeiro, to obtain fresh instructions, and, it might be, fresh powers, from the king; but during his absence that revolution burst forth which completely changed the whole political aspect of the kingdom.

The first symptoms of this revolution were exhibited at Oporto on the 24th of August 1820, both the citizens and the army acting in concert. The soldiers swore fealty to the king, the cortes, and the constitution which might be adopted, and the civil authorities declared in favour of the measure. A junta of thirteen members was chosen by acclamation; and a declaration was addressed to the nation, stating, that the assembling of the cortes and the adoption of a new constitution were the only means of saving the state. On the 15th of September, the day on which it was usual to celebrate the deliverance of Portugal from France, the regency in Lisbon, fearing to assemble such a multitude of people as generally met on that day, resolved to omit the ceremony. But the troops and the citizens met, and deposed the government; declared for the king, the cortes, and the constitution; and installed a temporary council as a provisional government. Thus a complete revolution was effected, without either violence or bloodshed. The provisional government formed a union with the junta of Oporto on the 1st of October; and one of the earliest acts of this united body was to despatch Count Palmella, the head of the royal regency, to Brazil, with an account of the transactions which had just taken place, and a petition that either the king or the prince royal would return to Europe and assume the sovereignty of Portugal. In the mean while, dissensions of the most inveterate description arose amongst the members of the two juntas. One party, being eager for the immediate adoption of the constitution which had been given to Spain, compelled the supreme junta to declare for, and oblige the troops to take the oath of fealty to, that constitution. But the ascendency of this party was of short duration, and ultimately it was agreed that, for the present, no part of the Spanish constitution should be in force except that which related to the mode of electing the cortes. This was to choose one deputy for every thirty thousand inhabitants. Clergymen, lawyers, and officers, were the sorts of persons who were chiefly elected, few men of wealth or family being chosen. On the 26th of January 1821, the cortes met, and named a regency and ministry, declared the late insurrections legal and necessary, and abolished the inquisition. On the 9th of March, the articles of the new constitution were adopted almost unanimously. By these, freedom of person and property was guaranteed, and the liberty of the press, legal equality, the abolition of privileges, the admission of all citizens to all offices, and the sovereignty of the nation, were secured. One chamber and a conditional royal veto were likewise resolved upon.

John VI. returned from America, leaving his eldest son, Dom Pedro, viceroy or regent of Brazil; but the aged monarch found, on his arrival in Europe, greater troubles than those from which he had fled. He was under the necessity of acceding to certain restrictions on his power, imposed by the cortes, before he was permitted to disembark. On landing, he swore to observe the new constitution, and concurred in all the succeeding acts of the cortes. To add to his disquiet, Dom Pedro accepted the dignity of constitutional Emperor of Brazil, in May 1822, and a complete separation took place between the two countries. The constitution of Portugal was finally completed and sworn to by the king on the 1st of October 1822; and, shortly afterwards, the session of this extraordinary cortes closed. The members of the old cortes occupied several months in reorganizing the different departments of the administration; but measures were rapidly maturing for the total overthrow of the new order of things. After several sanguinary engagements, the insurgents were driven from the northern provinces into Spain, and a Portuguese regency was established at Valladolid in May 1823. At the head of the plot for abolishing the new constitution was the queen, a Spanish Infanta; and several of the nobility and clergy were likewise engaged in it. Everything was now ripe for execution. Dom Miguel violated the promise which he had solemnly given to his father, by becoming the leader of the counter-revolutionists, and inviting the nation to rise under the royal standard against the anarchical policy of the cortes. The greater part of the troops declared for the Infant, and John VI., yielding to the force of circumstances, named a new ministry, and declared the constitution of 1822 null and void. Sixty members of the cortes protested against this proceeding; but the king, a mere puppet in the hands of his son, was borne along by the force of the current, without being able to give any effectual check to its course.

The events which subsequently occurred in Portugal are still too recent to have yet assumed their just historical proportions. The object of the queen and the Infant was to induce the king to resume absolute power; but John VI. firmly declared his resolution not to comply with this request. The counter-revolutionists, however, began to act independently of his authority. The national guards and militia were disarmed, a censorship of the press was established, many of the staunchest constitutionalists were disposed of by imprisonment or expatriation, and the highest offices were conferred on the absolutists. Finally, a junta, with Palmella at its head, was organized, to draw up a constitution adapted to a representative monarchy. The queen and the Infant, with their followers, exerted their whole energies to prevent the establishment of a constitution. Palmella and his coadjutors drew up a constitutional charter. By this act he rendered himself obnoxious both to the queen and Dom Miguel, as well as to the absolutist party; and the king, probably more in compliance with their wishes than from his own conviction that the plan was bad, rejected it. The intrigues of the absolutists still continued. Dom Miguel was appointed commander-in-chief of the army, and, having obtained this office, determined at one blow to extinguish all the hopes of the constitutionalists, and to put an end to the system of moderation, according to which the king continued to act. Upon the 30th of April 1824, Miguel called the troops to arms, and issued proclamations, in which he declared it as his intention to complete the work of the 27th May 1823, and to emancipate the king from the control of free-masons and others by whom he was surrounded. The ministers and other civil officers, to the number of one hundred persons, were on the same day put under arrest; but when the king ascertained what had occurred, he declared that the whole had been done without his orders. As an excuse for his conduct, the Infant said that he had taken these steps for the purpose of frustrating a conspiracy which had been formed against the king's life. On the representations of the foreign ambassadors, the individuals imprisoned were released; and on the 3d of May the king issued a decree, commanding an immediate investigation of the pretended treason. He also pardoned the Infant for his usurpation of the royal name; but this incorrigible person still acted on his own authority, as if he were absolute sovereign, continuing to arrest obnoxious or suspected individuals. John, finding himself in danger of falling a victim to the intrigues of his son, contrived to escape on board of an English vessel which lay in the Tagus. He deprived the Infant of his command, and summoned him into his presence. The prince obeyed, and having confessed his various delinquencies, received the royal pardon, with permission to travel. The king returned on shore, proclaimed an act of amnesty in favour of the adherents of the cortes of 1820, and, reviving the old constitution of the estates, summoned the cortes of Lamego. A new junta was appointed to prepare a constitution; but the convocation of the old cortes was resisted, and conspiracies were formed against the king and his ministers. The latter were themselves far from being unanimous, chiefly in regard to Brazil, so that a new ministry was appointed in January 1825. Portugal and Brazil assumed a hostile attitude, but at length John VI. concluded a treaty with the emperor Dom Pedro I. of Brazil, in which he acknowledged the entire independence of that country, and resigned the sovereignty of it to his son, reserving for himself only the title of emperor. This good-natured monarch, who was incompetent to struggle with the troubles of his age, and the political degeneracy of his nation, died on the 10th of March 1826, having previously appointed his daughter Isabella regent of Portugal.

Isabella for a short time governed Portugal in the name of the emperor of Brazil, Dom Pedro, who was the legitimate successor to both the European and American possessions of the house of Braganza. On the 23d of April 1826 he granted a constitution to Portugal, which established two chambers, and in some other respects resembled the French charter. Not long afterwards, he surrendered Portugal to his daughter, Donna Maria, as an independent queen, on condition of her marrying her uncle, Dom Miguel. The prince at once agreed to this arrangement, but, with his characteristic duplicity, resolved on evading its conditions. The absolutists, of whom he was the recognised chief, were still very strong in the country; and a party was formed, the very object of which was to overthrow the constitution, and proclaim Dom Miguel absolute king of Portugal. The attempt was made, but it proved unsuccessful. A strong British army was landed at Lisbon, and the country, thus overawed, was in some measure restored to tranquillity. Spain, which had secretly fomented the insurrection, was now forced to yield. In July 1827, Dom Miguel was appointed by his brother lieutenant and regent of the kingdom. The prince immediately quitted Vienna and returned to Portugal, taking Paris and London on his way. He was much caressed whilst in England, and pledged himself to abide by the terms required by Pedro. He arrived in Lisbon on the 26th of February 1828, and immediately assumed the administration of the government, at the same time taking the oath to maintain the constitution. But oaths were in his eyes a mere formality of state, involving no moral obligation. He assumed the sceptre as absolute king; changed the ministry to make room for his tools; dissolved the chamber of deputies, which was much too liberal for his views; altered the mode of election; and, in short, restored the reign of absolutism. The recall of the British troops removed another obstacle from his path. He convoked the ancient cortes of Lamego, and was in a fair way of carrying everything before him. But the military in general were unfavourable to his projects. The garrison of Oporto declared for Dom Pedro and the charter; other bodies of troops followed their example; and a corps of six thousand men advanced towards the capital. But they were defeated by a superior force, and the efforts of the constitutionalists were for the present baffled.

The object of Dom Miguel was now to consolidate his power, and get himself proclaimed king. The cortes met, and all who were likely to oppose him having been carefully consigned to dungeons, or driven into exile, this body unanimously declared Dom Miguel lawful king of Portugal and the two Algarves. The pretext by which the cortes endeavoured to vindicate its conduct was, that as Dom Pedro had become a foreigner, he had neither a right to succeed himself, nor to appoint a successor. On the 4th of July 1828, Dom Miguel confirmed the decree of the cortes, and assumed the title, as he had already done the powers, of royalty. The punishment of those implicated in the Oporto insurrection followed as a matter of course. An expedition was likewise sent against the refractory islands, which had refused to acknowledge the usurper; and Madeira and the Azores were, with one exception, reduced. The whole dominions of Portugal now became a scene of terror, distrust, and misery, under the sway of this hypocritical and merciless usurper.

In the meanwhile, Donna Maria had set sail from Brazil for Europe; but on arriving before Gibraltar, she found that, under actual circumstances, it would be injudicious, if not dangerous, to land at Lisbon, and accordingly steered for the English shores. She remained some time in London, and during her stay was entertained as queen of Portugal. In August 1829 she returned to Brazil, in which a revolution suddenly deprived her father of his American empire. Having abdicated a crown which he could no longer retain, in favour of his infant son, the ex-emperor sailed for Europe with his daughter, to assert her claims to the throne of Portugal. Under the title of Duke of Braganza he was hospitably received in England, and instantly set to work in making arrangements for effecting the dethronement of Dom Miguel. The usurper still pursued the same course of oppression, and, not content with confining and despoiling his own countrymen, he extended his outrages to British and French subjects. In the year 1830 it was calculated that forty thousand individuals were under arrest for political causes alone; and that five thousand persons were concealed in hiding-places in different parts of the country. How many had been devoted to destruction by being sent to the fatal shores of Africa, and how many had voluntarily exiled themselves, it is impossible to estimate. The British government demanded redress for the acts of violence committed against its subjects; and, on this being refused, a British fleet entered the Tagus, and terrified the tyrant into compliance. France acted in a similar manner, and with even more success; demanding an indemnity for the expenses incurred by the expedition. Even the United States despatched a fleet to Lisbon to obtain satisfaction for injuries done to American commerce. But these repeated humiliations wrought no change in the policy of Dom Miguel. The petty insurrections which frequently broke out were speedily suppressed by the vigour of the government, or the want of concert in the insurgents; and hence these ebullitions of popular indignation caused him little uneasiness. But his finances were now falling into inextricable confusion. The revenue scarcely sufficing for the household expenses and the maintenance of the troops, the usurper was driven to all manner of expedients to relieve his necessities. The island of Terceira, one of the Azores, resisted his claims; and here a regency was formally installed, with the Marquis of Palmella at its head. From this spot Dom Pedro issued a decree in favour of his daughter Donna Maria, at the same time representing Dom Miguel in his true character, as a rebel and perjured usurper.

Although neither the government of France nor that of England gave open assistance to Dom Pedro, both abstained from opposing any obstacles to his measures of recruiting. Many officers of each nation enlisted in his ranks; and towards the end of December three hundred half-pay officers and volunteers sailed for Belleisle on the coast of France, which had been fixed upon as the place of rendezvous. The intelligence of these preparations, whilst it gave encouragement to the constitutionalists, was productive of great alarm to Dom Miguel, who soon discovered that a considerable portion of his own army was not to be trusted. Lisbon became the scene of anarchy, violence, and bloodshed. A regiment of the line broke out into open mutiny, and, dividing itself into three bodies, marched upon three different points, where other troops were stationed, expecting to be joined by them. But they were sadly disappointed in this expectation. Several bloody conflicts took place, and the insurrection was ultimately suppressed. Many persons were shot for treason, and every dungeon and fortress in the kingdom was filled with suspected persons. Meanwhile the island of St Michael's was captured by a force from Terceira, under Villa Flor, one of the members of the regency. Afraid that Madeira would be the next object of attack, Dom Miguel sent a small armament for its defence; indeed a large one could not well be spared at a time when the preparations of Dom Pedro threatened to bring the contest nearer home. This prince had prosecuted his measures with great activity and perseverance; nevertheless, his means appeared altogether inadequate for the conquest of a kingdom. His levies consisted of a motley group of raw recruits, men of desperate fortunes or suspicious characters, idle persons whose object was plunder, disbanded troops from Brazil, Portuguese refugees, and the regiments which had so successfully maintained the cause of the young queen in the Azores. But a kingdom was at stake, and Pedro resolved to hazard a descent upon Portugal. The expedition sailed from the island of St Michael on the 27th of June 1832. It consisted of two frigates, three corvettes, three armed brigs, and four schooners, besides transports, and a number of gun-boats to cover the landing. An officer who held a commission in the British army undertook the command of the naval department. He had been deprived of his rank as a British officer, but became a Portuguese admiral. The whole army on board did not amount to ten thousand men, scantily provided with artillery, and still more scantily with cavalry.

Dom Miguel made every preparation in his power to repulse the threatened attack. On the 8th of July Dom Pedro appeared before Oporto, landed his troops, and took possession of the town, without the loss of a single man. The advantages likely to result from the capture of the second city in the kingdom need not be pointed out, nor was Dom Miguel ignorant of them. He acted with decision, and immediately menaced Oporto from two points. On the 22d of July an action took place, in which his troops were repulsed, and compelled to fall back; but, on the other hand, Dom Pedro was not in a condition to follow up the victory. Another attempt in a different quarter was with more difficulty repelled; but the most discouraging circumstance for the invaders was the utter disappointment of the hopes they had entertained that the population of the country would rise in their favour, and that the army of Dom Miguel would desert its master.

The operations of the naval squadron were attended with little success. Several partial engagements took place between the fleet of Dom Miguel and that of the young queen under Sartorius; but no advantage was gained on either side. Dom Pedro had continued to fortify Oporto from the period of his landing; whilst Miguel, with equal industry, was increasing his army, the greater part of which lay on the north side of the Douro. On the 8th of September the Miguelites made an attack upon Villa Nova, the suburb of Oporto, which they carried; and the possession of this place enabled them to harass the city with a constant fire both of musketry and artillery. An attempt to recover this position utterly failed; but a convent which formed part of it still held out against all the efforts of the Miguelites. The city began to be seriously injured by the incessant fire which was kept up from Villa Nova, and all attempts to dislodge the Miguelites from their position proved abortive. On the 29th of September Dom Miguel made a general assault upon the works with which Oporto was surrounded; but, after manfully maintaining the contest for seven hours, he was compelled to retreat to his former positions. The commanders of Dom Miguel now changed their tactics. Finding that it was impossible to carry Oporto by storm, they determined to prevent all supplies from reaching the city, by erecting batteries on the Douro, so as to command the bar and channel, and thus prevent all vessels from approaching. They effected their purpose, and Dom Pedro found himself reduced to the greatest difficulties.

The operations of 1833, like those of the preceding year, consisted in partial bombardments across the river, or engagements of detachments, occasionally varied by more regular attacks and sallies to destroy works already erected, or prevent new ones from being raised. The casualties were not great on either side, nor was any permanent change effected in the relative situation of the armies. Dom Pedro began the year by placing at the head of his troops the French general Solignac, whom he had created a marshal. A few months afterwards he had a quarrel with his admiral, Sartorius, which for a time threatened serious consequences; but the naval commander being ultimately removed, his place was supplied by another British officer, Captain, now made Admiral Napier. In a short time the latter inflicted a severe blow on Dom Miguel, by the capture of several of his largest vessels, in as gallant a style as any thing recorded in naval history. In short, the fleet of the usurper was utterly annihilated, and he had now only the land force to look to. Previously to this achievement, a body of queen's troops had landed at another point of the coast, and in a few days the whole of the Algarves declared for Donna Maria. This small army, under the command of Villa Flor, now Duke of Terceira, marched upon Lisbon, and on the way completely routed a greatly superior force. The capital was deserted by the garrison; the inhabitants rose *en masse*, and declared Donna Maria their lawful sovereign; and the Duke of Terceira entering Lisbon in triumph, hoisted the queen's colours on the citadel. Dom Pedro instantly set sail from Oporto to assume the government, and no sooner had the intelligence reached France and England, than both immediately acknowledged Donna Maria as queen of Portugal.

Great preparations were made for the defence of Lisbon against the Miguelite army, 18,000 strong, which, under Marshal Bourmont, an experienced general, was now advancing towards the capital. Several attacks were made on the defences during the rest of the year 1833, but the results were unimportant. The liberation of Lisbon led to the recovery of the Cape de Verd Islands, and immediately afterwards Bonavista proclaimed the queen and the constitutional charter. The political measures of Dom Pedro, after assuming the government at Lisbon, were not looked on with a favourable eye. He confiscated the property of all who had served under Dom Miguel, and was guilty of some other arbitrary acts, which did not tend to strengthen his cause.

The affairs of Dom Miguel now began to wear a very unpromising appearance. His authority, indeed, was recognised over a large tract of country; but his navy, which secured him reinforcements from abroad, was destroyed, and events had taken place in Spain which prevented the government of that country from affording him any assistance. The first military operation of importance which took place in 1834 was the capture of Leiria, an important town between Lisbon and Coimbra, which capitulated to the queen's troops on the 18th of February. A battle was lost by the Miguelites near Almoster, where Saldanha was posted; and towns and provinces began to declare for the queen so rapidly, that the cause of the usurper became desperate. He shut himself up at Santarem with a view of keeping up his communications with the frontiers of Spain, whence he expected aid. But from this very point destruction awaited him. It was a singular coincidence, that in Spain as well as in Portugal, an infant queen was supporting her cause by favouring popular privileges, with an uncle for her rival, as a representative of more despotic principles of government. The cause of the two queens being so far the same, a community of interest led to an alliance, to which the courts of Britain and France became parties. Each was recognised as lawful successor to the throne to which she aspired, and they both agreed to employ their arms jointly against their two rivals. Don Carlos was compelled to fly from Spain into Portugal, and thither he was pursued by a Spanish army, which proved even more fatal to Dom Miguel than to Don Carlos. The Miguelites, seeing all hope lost, rapidly disbanded, and only the miserable remnant of an army remained attached to the usurper. A suspension of arms was agreed to; and on the 26th of May a convention was entered into, by which Miguel formally consented to abandon the country. The terms granted him were, that he should never again set foot either in Portugal or Spain, nor in any way concur in disturbing these kingdoms; that he should leave the country within fifteen days; that he should have a pension of about L.15,000, and be permitted to dispose of his personal property, after restoring the crown jewels and other articles; and, finally, that, by his command, the troops still adhering to his cause should instantly lay down their arms, and the fortresses surrender to the queen. On the 2d of June he embarked for Genoa, where he had no sooner arrived than he issued a declaration, declaring that he had acted under compulsion in relinquishing the throne, and that the transaction was null and void.

The civil war being thus terminated, and the authority of the queen acknowledged all over the kingdom, an extraordinary cortes was assembled on the 14th of August. Without the intervention of this assembly, however, the government had previously adopted legislative measures of great moment. It had declared free trade with all countries; fixed the duties on all foreign imports at fifteen per cent. *ad valorem;* reduced all religious houses and regular orders of monks, incorporating their estates with the national domains; changed the state of the currency, and abolished paper money; and made various other sweeping alterations. The measures were well meant, but they were harsh and despotic notwithstanding. After the meeting of cortes, one of the first proceedings of the legislature was to consider how the executive power should be exercised during the minority of the queen. The regency was ultimately conferred on Dom Pedro, but he did not long enjoy it. He expired on the 22d of September 1834, having, during the latter years of his life, acted a part which the earlier stages of his career gave the world little reason to expect. Previously to this, the queen had set about the formation of a new ministry, in which she united some of the more moderate constitutionalists with the former ministers. Her marriage with the Duke of Leuchtenberg, the son of Eugene Beauharnois, and the brother of Dom Pedro's wife, was soon afterwards resolved upon. A bill to exclude Dom Miguel and his descendants from the throne of Portugal was passed without one dissentient voice. The budget for the year 1834 showed a considerable deficit, and this formed an excuse for treating the British auxiliaries, to whom they owed so much, with the most shameful and disgusting ingratitude.

During the year 1835, Portugal presented a peaceful and even prosperous picture, darkened a little by the intrigues of political parties. The principal object of the cortes was to reduce the public debt, or to convert it into securities which should bear a lower rate of interest than that then paid. The fund which was principally looked to for accomplishing this object was the national property, and measures were adopted for effecting sales thereof. The budget for the year ending 30th June 1836 stated the expected receipts at 8,420,257,408 milreis, and the expenditure at 12,744,161,266, being a revenue of about L.2,200,000, and an expenditure of more than L.3,000,000. No new taxes were, however, imposed to cover the deficit, because it was expected that the expenditure would decrease, whilst the receipts would remain stationary or rise.

Prince Augustus of Leuchtenberg, the husband of the young queen, having arrived in Portugal in the beginning of the year 1835, was appointed commander-in-chief of the Portuguese army, a nomination which gave rise to much contention. But death soon cut short the discussion, for the young prince expired on the 28th of March. The chambers, however, did not allow the queen to indulge long in the sorrows of widowhood. The constitutional system depended greatly on a direct succession to the throne, and before the end of the year the queen's second marriage was arranged. The bridegroom was selected from the house of Saxe-Cobourg (a great nursery for the supply of such wants), and he had the honour to be a nephew of the king of the Belgians.

On the 8th of April 1836, Prince Ferdinand of Saxe-Cobourg arrived at Lisbon, and on the following day was formally united to his royal spouse. Government now became extremely annoyed by the question, whether the king should be appointed to the command of the army, when it turned out that this was one of the special conditions of the marriage treaty. The proceeding proved very unpopular, not only with politicians, but the country, and materially hastened a revolution, in which the ministry and the constitution were shipwrecked together. It does not appear, however, that the government anticipated any serious changes, as the country exhibited no dangerous symptoms of discontent, although a good deal irritated by the appointment which the queen had made. Yet the revolutionary plot must have been arranged beforehand, for even the troops of the line were seduced. On the night of the 9th of September 1836, the drums of the national guards beat to arms, and they were soon joined by the garrisons and many influential civilians. An address to the queen was drawn up, requesting her majesty forthwith to dismiss the ministry, to annul the charter, and to proclaim the constitution of 1820. The queen at first hesitated to yield to force, and to recognise statements as to the alleged jeopardy to which the nation was exposed; but she was ultimately compelled to give way. The political constitution of the 23d of September 1822 was declared to be in vigour: but it was at the same time agreed that it should undergo such modifications as circumstances had rendered necessary. A new ministry was immediately appointed, and Prince Ferdinand was deprived of his military commission. But neither the great body of the people nor the more influential classes showed any indications of accordance with the remodellers of government. Almost all the nobility, the superior clergy, and an immense number of persons holding official situations of greater or of less importance, refused peremptorily to take the oaths to the new constitution. The peers, whose existence as a separate legislative assembly was thus abolished, protested to the queen against the measure, and called for vengeance on those who had compelled her majesty to declare it in force. But this only served to irritate the revolutionists. Not long afterwards a counter-revolution was attempted. Commenced without any well-concerted plan, it was prosecuted without energy, and the results were altogether unimportant. At last negotiations being entered into between the queen and the rebels, it was proposed by the court, first, that the general cortes should be immediately convoked, but that the members should be furnished with special powers to make such alterations in the charter of 1820 as were deemed necessary to secure the liberties of the nation and the prerogatives of the crown; and, secondly, that the Chamber of Peers, as it was instituted before the revolution of the 10th of September, should vote upon these alterations, with the exception of those which might relate to the organization of the chambers. To the latter proposition the rebels refused their assent. They likewise demanded of the queen to dismiss her ministers, and form a new cabinet; and she was under the necessity of complying with their demands. Her majesty, indeed, became partially a prisoner in the hands of the democrats, and many of the most distinguished persons of her court sought refuge in voluntary exile.

The principal events which followed these changes were, the economising of the expenditure, the imposition of a tax for the support of the priesthood, the introduction of a uniform system of duties on vessels sailing from Portuguese harbours, the abolition of the slave-trade, and other measures of more or less moment, which had for their object the pacification of the country and the promotion of the general welfare. During the years 1837 and 1838, some provinces of Portugal were kept in constant terror, and, to a certain extent, ravaged by rebel banditti, whose ostensible object was to excite a rising in favour of Dom Miguel. The most noted of these guerilla chiefs was Remechido, who contrived to muster a formidable gang, and, by his daring exploits, to spread dismay throughout Algarve, the scene of his depredations. A military force was at length sent against him, by which the rebels were completely routed on the 28th of July 1838, and their leader, being taken prisoner, unceremoniously shot.

STATISTICS.

Boundaries and extent.

Portugal, the most westerly kingdom of Europe, lies between 36° 55′ and 42° 13′ of north latitude, and between 6° 15′ and 8° 55′ of longitude west from Greenwich. According to the geographer Ebeling, its length from north to south is 301 geographical miles, and its breadth from east to west is 128 miles. It is bounded on the north and east by the Spanish provinces of Galicia, Valladolid, Salamanca, Estremadura, and Seville, and on the south and west by the Atlantic Ocean. It has the figure of a parallelogram, with its longest side from north to south.

Coast.

Portugal has a coast-line of nearly five hundred miles in length, the only province not washed by the ocean being Tras-os-Montes, and Alemtejo is less so than the remaining four. On the north the coast is low at first, but it afterwards becomes rugged and steep. In Beira it again gets flat, sandy, and marshy; in Estremadura it is in one part steep, and in another almost a dead level, and very insecure; in Alemtejo it is low, being full of rocks and shallows; and although at Cape St Vincent it is high and rocky, as we proceed towards the Spanish frontier the country sinks into low sandy downs. The promontories most worthy of notice are, Mondego in Beira; Carvoeiro de Rocha and Espichel in Estremadura; and San Vincente, Carvoeiro, and Santa Maria, in Algarve. On the low coasts there are inlets of the sea, which afford opportunities for the formation of a number of excellent harbours.

Mountains.

Portugal is only separated from Spain politically, not by natural boundaries or peculiarities. Hence, in all its physical relations it is to be considered as a westerly continuation of that country. The principal chains of mountains are prolongations of those which traverse Spain. In the north, between the Minho and Douro, the country is intersected in various directions by the southerly and westerly procession of the Galician and Asturian mountain ranges, which terminate at the sea in a steep and broken coast. The provinces situated in this quarter are alternating mountain and high table-land, a continuation of the lofty table-land of Old Castille and Leon. The Serra de Montezinho, near the northern frontier, is a very lofty range, on the summits of which snow not unfrequently remains during the whole year. The lofty peak of Gaviarra, however, which forms part of the Serra de Suazo, is crowned with perpetual snow. This range runs parallel with the river Lima to the sea, where it terminates under the name of the Serra de Estrica. On the left bank of the Lima extends the Serra de Gerez, in the province of Entre Minho e Douro, and, passing into Tras-os-Montes, declines towards the Lower Douro, where it bears the name of the Serra de San Catarina. In this last-named province is the Serra de Amarao, on the left bank of the Tamega, and stretching down almost to the Douro. To the east of it is the plateau of Guarda, between two and three thousand feet in height, and which on the north-east is bounded by the Serra de Montezinho. In the province of Beira extends the Serra de Estrella, a continuation of a chain which traverses Leon and Castille. This mountain ridge consists of granite and layers of sandstone. It presents a shattered and savage aspect, is covered with snow during the greater portion of the year, and in its ramifications encloses the river Mondego. Its highest summits are those of Cantaro Delgado and the Malao da Serra. Northwards it declines gently towards the Vouga, and stretches in a westerly direction to the gates of Coimbra under the name of the Serra de Alcoba. The southerly branch runs through the province of Estremadura, to the mouth of the Tagus, forming the granite mountains of Cintra, which terminate in the sea at the Cabo de Roca. To the south of the mouth of the Tagus stretches the Serra de Arabida, an inferior range. Between the Tagus and the Guadiana the country is elevated, but, gradually sinking towards the Spanish province of Estremadura, is bounded on the south by a continuation of the Sierra Morena of Spain, which mountain chain is here penetrated by the river Guadiana. The Serra de Caldeirao, which afterwards bears the name of the Serra de Monchique, a ramification of the gigantic Morena, extends in a westerly direction to the sea, where it terminates in Cape St Vincent, and completely encloses Algarve. This serra only yields in height to that of Estrella, and to those of Suazo and Montezinho. Its loftiest peaks are Foya and Picota.

Portugal is therefore a mountainous country throughout, but its profusion of hills and mountains embosom innumerable beautiful and highly-cultivated valleys, and form several fine tracts of table-land. There are, however, two plains of some extent; one to the south of the Tagus, of which that of Santarem forms a continuation, and one on the mouth of the Vouga.

Rivers.

Portugal receives its principal rivers from Spain. The largest are the Tagus, the Guadiana, the Douro, the Lima, and the Minho. The Tagus originates in the Sierra d'Albaracin, on the borders of Cuença and Aragon, flows at first in a northerly direction, and then turns to the south, but during the most part of its course its general bearing is westerly. After traversing several Spanish provinces, it enters the Portuguese territory near the point where it receives the Sever, separates the provinces of Beira and Alemtejo, and after dividing Portuguese Estremadura into two unequal parts, falls into the Atlantic. It receives the waters collected between two parallel ranges of mountains, flows through a mountainous country, and its current is much broken by rocks and cataracts. Its waters are turbid, and annually overflow and fertilize the extensive plains in the environs of Santarem and Villa Franca. Lower down it forms many marshes of considerable extent, which yield a large revenue. The length of its course is four hundred and fifty miles. It is affected by the tide a considerable distance above Lisbon, but is only navigable to Abrantes. Its width is so great near its mouth as to make it resemble a vast lake or arm of the sea; and at Lisbon it forms one of the finest and safest harbours in the world. The tributaries which it receives on the north are the Elga, the Ponsal, and the Zezere ; and those from the south are the Sever, the Sorraya, erroneously called Zatas in most maps, and the Canha; but none of these are navigable. The rivers worthy of notice which have their source in Portugal are the Cavado, Ave, Vouga, Mondego, Saado, Odemira, Portimao, and Rio Quarteira. The Cavado rises in the Serra de Gerez, and after traversing the province of Minho, discharges itself near Esposenda, being only navigable for seven miles. The Vouga has its source in Beira, and after traversing this province, enters the ocean below Aveira. The Mondego issues in the Estrella, crosses Beira and the plains of Coimbra, and finally joins the ocean near Figueira and Buareos. This is the largest of the rivers belonging exclusively to Portugal, and it is navigable for sixty miles, except in summer, when its waters considerably diminish. Its sands occasionally yield particles of gold. The Saado or Sadao has its source in Alemtejo in the Serra de Monchique, and flows with a north-westerly course towards Estremadura. It becomes navigable from Porto de Rey, and enters the ocean by a large bay to the south of Setubal. The same Serra gives rise to the Odemeira and Portimao, the former being navigable to the town of the same name, and the latter as far up as Silves. The Rio Quarteira has its source in the Serra de Caldeirao, and forms at its mouth the small port which bears its name. These rivers, when swollen by the winter rains, overflow their banks, much to the advantage of the country, for the waters leave a rich deposit behind them. In summer they are very low, and many of the smaller rivers of Portugal are dried up during that season. They are in general much obstructed by rocks and bars of sand at their mouths, by which navigation is greatly impeded.

Lakes and springs.

Portugal possesses no navigable canals worthy of notice. On the coast, especially in Alemtejo and Beira, there are morasses, lakes, and inferior inland seas, none of them being of great circumference. Several mountain lakes on the Serra de Estrella are tepid, throwing up bubbles, without, however, materially troubling the waters, which are of crystal clearness. Portugal is rich in medicinal springs, some of which are used for baths. They consist of gaseous and saline mineral waters, and of sulphureous and chalybeate springs. The most celebrated sulphur and warm baths are the Caldas de Gerez in Minho, the Rainha and the Oeiras in Estremadura, those of Chaves and Anciaes in Tras-os-Montes, of San Pedro do Sul and Penagarcia in Beira, and of Monchique in Algarve. The best chalybeates are at Torro de Moncorvo in Tras-os-Montes, those of Amaranha and Guimaraens in Minho, and of Villas in Estremadura.

Geology and mines.

Granite composes the highest mountains of Portugal. The entire province of Minho, and the northern portion of Tras-os-Montes, are formed of it; and, besides, it is found in many other parts of the kingdom. Schistus rock, lying over the granite, also covers a large portion of the country. It forms the frontier mountains of Algarve, those of moderate height in Alemtejo, those of Beira in the environs of Castello Branco, and the chain which accompanies the course of the Douro. The primitive calcareous formation forms a continuation of the mountains between Lisbon and Coimbra, as the Serra de Lousaa, Porto de Moz, and Monte Junto, with the Serra de Arrabida, and the mountain chain which reaches to Algarve. Coal is met with in this formation near Buareos, mineral coal at Cape Espichel, and sandstone is sometimes found covering it. The rocks near Lisbon and at Cape St Vincent are of the tertiary formation, more or less mingled with trap. When the granitic rocks blend with schistus, it is by layers; and it is connected with the latter by a stratification, resembling micaceous schistus. The calcareous structure is changed in Tras-os-Montes into a true micaceous schistus; and it is only here that mountains of the latter are seen in a pure state.

Tin mines appear to have been wrought by the Carthaginians in this part of the peninsula; and it is affirmed that mines of tin-stone existed in some granitic mountains of Beira. Mines of gold and silver were wrought in this country by the Romans. During the last century lead ores were worked near Mogadouro, in Tras-os-Montes, and in the vicinity of Longroiva, on the banks of the Rio Prisco. In Tras-os-Montes a silver-mine was wrought in the year 1628. Mines of plumbago occur near Mogadouro, and iron-mines in the same country, near Figueira and Torre de Moncorvo. The iron forge of Chapacunha is supplied from them. In Estremadura there are two very old establishments of the same kind, one in the district of Thomar, and the other in that of Figuero dos Vinhos. On the frontier of that province, and of its neighbour Beira, are situated the mines of red oxyde of iron by which they are supplied. Iron indeed is one of the most abundant minerals in the country. The mountains in the neighbourhood of Oporto everywhere give indications of copper and other ores; and at Couna there is a deposit of cinnabar. In Portugal there are also mines of antimony, bismuth, and arsenic. Some of the rivers of this country, as well as those of Spain, are washed for the gold which they contain ; and it is said that in this way large quantities of the precious metal were formerly collected. The river Tagus was anciently celebrated for the particles of gold which were found mingled with its sands; but its greatest riches are now borne on its bosom. Indeed, none of the streams yields a quantity worth much above the labour of collecting it. There is only one gold-mine in Portugal, situated in a place called Adissa, in the district of St Ubes; but its annual produce is a mere trifle, not reaching twenty pounds weight at an average. Two coal-mines exist; one near Figueira, and the other near Oporto. The country abounds with most beautiful marbles, but they are comparatively little wrought, from the expenses required to bring them to market. Precious stones are found in Portugal, and also quarries of limestone, gypsum, slate, freestone, millstone, black agate, together with immense beds of pyrites and marcasites, potters' and porcelain clay, and pits of common salt.

imate
l soil.

Various causes conspire to produce great differences in the climate of Portugal in different situations. The most obvious one is the inequality of the soil; but vicinity to the ocean, and to mountain ranges, which afford shelter from the winds, or expose to the direct influence of the sun, also greatly affect the temperature. The mountain chains in the northern part of the country are very rugged and cold, the limits of perpetual snow being in this latitude under eight thousand feet. This cold region comprises a considerable portion of the provinces of Tras-os-Montes and Beira, and the whole of the northern frontiers of Minho. It is to be observed as a general rule, that the sea-coast of these provinces, as well as that of all the others, is very warm, the heat of summer, however, being tempered by the sea-breezes. The elevated plains and mountains are sterile, and destitute of wood; but the valleys and other low situations have a mild and agreeable climate, and are for the most part very fruitful. A great part of Minho is especially deserving of notice for its delightful climate. Estremadura, on the other hand, is very hot in summer and very cold in winter; but the high land throughout the whole southern portion of Portugal has an exceedingly agreeable temperature, equally removed from excessive heat in summer and severe cold in winter. Algarve alone has an African climate, but the excessive heat is greatly tempered by the sea-breezes. Some striking anomalies occur, such as intense summer heats in elevated situations; but they are to be accounted for from the position and nature of the mountain ranges which environ them, and their distance from the ocean. The warmer parts of Portugal have a short winter and a double spring. The first, which commences in February, is a delightful season. The succeeding months are variable, being in some years hot and dry, and in others cold and rainy. Harvest is gathered in June. Summer commences in the last week of July, and continues till the beginning of September. The heat is then very great, parching up all the vegetation on the plains and sea-coast, so that it is necessary to water plants to preserve them from destruction. But even during this hot season the evenings and nights are fresh and cool, and the table-lands and other elevated parts enjoy a modification of temperature. Rain begins to fall early in October, and the vegetation of spring immediately succeeds to that of autumn. Winter lasts from the end of November till February, but the cold is seldom excessive, except in very elevated situations. In December heavy rains descend, accompanied by violent whirlwinds; it is during this period that the rivers are so liable to overflow their banks. The climate of Portugal, in general, may be pronounced salubrious, particularly along the coasts and on the table-lands. Fevers of various kinds appear to be the diseases most prevalent, but there are disorders peculiar to different localities. Almost all the mountain chains of Portugal show, in extinct and shattered craters, their former volcanic activity; and in many districts, in the country around Lisbon for instance, earthquakes are not unfrequently felt in harvest and winter. The fearful convulsion which destroyed the capital has already been mentioned in the preceding historical sketch. Portugal is rarely visited by violent storms, and thunder is only heard during autumn and winter.

Productions.

From the great differences of level which Portugal presents, it abounds in every variety of vegetable productions. Forests of birch, oak, and chestnut are abundant; and fruit is everywhere plentiful. Orchards are met with at the foot of large mountain chains; and lower down may be found the cork-tree, kermes, fir, lemon, and orange. The olive is widely distributed, and the vine is cultivated to a great extent. In the warmest regions we find the aloe of America and the date of Africa. Figs, raisins, almonds, melons, water-melons, plums, cherries, peaches, apples, pears, and chestnuts, are all objects of attention. Of grains, those chiefly raised are maize, barley, wheat, and rye; rice is likewise an object of attention in some parts. Potatoes and other vegetables are partially cultivated, together with hemp, flax, and cotton. The Flora of Portugal, although abundant in some parts, presents little that is remarkable. None of the plants of France or Spain, and only a few of those of Italy and Sicily, are found. In the cold regions a few plants similar to those in the west of England are met with. In the warmer districts poppies thrive well, and the coasts of Beira and Estremadura, with the low sandy plains of Alemtejo, are adorned with the cistus and many varieties of heath. On the northern mountains is a tree peculiar to them, which is called azerino.

Agriculture.

Portugal is behind almost every nation of Europe in agriculture; and the various improvements which are general elsewhere have here been slowly and but recently introduced. The soil is neither manured nor tilled as it ought to be. The plough is composed of three pieces of wood awkwardly fastened together, and imperfectly aided by the clumsy machinery of wheels. The districts best cultivated are the valleys of the Minho, those of the Oporto wine company of Upper Douro, and some portions of Tras-os-Montes and Beira; the remaining territory remains comparatively uncultivated. Where the soil is properly laboured and attended to, abundant crops of wheat, barley, maize, rice, and rye are produced. But enough is not raised to supply home consumption, about one fifteenth of the quantity used being imported. Artificial meadows are almost unknown, except in Minho. The cultivation of potatoes, however, has rapidly extended over the country, and hemp and flax of excellent quality are raised. But the chief attention of the Portuguese husbandman is directed to the production of those articles which find their most ready vent in foreign countries, or which are raised with the least labour. Of the first sort is their wine, which is produced chiefly in the northern provinces. The quantity usually made is about 80,000 pipes of red, and 60,000 pipes of white. The productions that require but little labour, such as chestnuts, almonds, oranges, lemons, and citrons, are also profusely raised, and, with the onions and garlic, form no small proportion of the aliment of the inhabitants. Olive-trees are plentiful, and the oil expressed from their fruit forms an important article of sustenance; and, though not of a quality or flavour that is relished for the table in foreign countries, it is a considerable article of export.

Animals.

Generally speaking, cattle are not abundant in Portugal; for, with the exception of the grazing lands of the Minho, the Estrella, and Monte Junto, and a few other places, in which a beautiful and large breed of cattle is reared, the feeding is decidedly bad. Very little cheese or butter is made, these articles being mostly imported from England and Holland. Horses are far from being numerous, and they are of a small size, but very active. Mules, however, are of a first-rate breed, and they, in a great measure, compensate the deficiency. Sheep are reared to some extent, and their wool is inferior to none but that of Spain. There are numerous herds of goats, and abundance of swine of a peculiar species. Poultry are plentiful; and bees are bred to some extent. The rearing of silk-worms was once a considerable branch of industry; but the great injury sustained by the mulberry plantations during war has subjected it to many fluctuations. Birds are not numerous; but of wolves, wild cats, wild goats, wild boars, stags, and some other species of large game, there are a few in certain localities. Hares are rare, and rabbits are not so numerous as in Spain. Amphibious reptiles are not common, but vipers and venomous serpents abound in the mountains; the other parts of the country, however, appear to be free from them. There are several species of lizards; the insects of Northern Africa occur on the heaths; the butterflies of the south of France on the sides of the Estrella; and the scarabæi of the north are found on the mountains of Northern Portugal. The rivers are amply stocked with fish, and the coasts literally swarm with them. Pilchards are caught in immense quantities. Another very common fish is the pescada, a species of the gadus. Besides these, the kinds in greatest esteem and abundance are the sea and river eel, the sole, rodovalho, savel, ruivo, safio, cavalla, espada, and others.

Manufactures.

The manufactures of Portugal are comparatively unimportant; but the country has in general been underrated in this respect. No comparison can be instituted between its products of this sort and those of more industrious states; but if, notwithstanding the advantages England enjoys, the Portuguese have been able to compete with the English in different manufactures, it may be concluded that industry cannot be at so very low an ebb as is often asserted. However, almost all the finer fabrics are imported. At Alcobaça and Tomar cottons, at Guarda woollens, and at Guimaraens linens, are manufactured. The best goods that are made in the kingdom, as compared with those of other countries, are the cambrics, shirting and table linens, and sewing threads. Glass is manufactured at Leiria, and silk, paper, and other articles elsewhere; whilst in Lisbon there are manufactories of arms, cordage, hats, chocolate, earthenware, tin, copper, lace, mats, ribbands, soap, silk, cottons, with distilleries, tanneries, sugar refineries, and founderies. The Portuguese display considerable skill in working in gold and silver plate; and their taste in cabinet-work is said to be now much improved. Generally speaking, they manufacture most articles of recognised necessity with more or less skill. But neither the mines nor the fisheries are at all attended to as they ought to be. If the former were wrought, their produce might form important articles of commerce; and if the latter were prosecuted, as much fish might be caught as would render the importation of this article unnecessary.

Commerce.

The separation of Brazil from Portugal, together with the loss of her Indian possessions, have reduced the commerce of this country to a mere fragment of what it once was when her ports were the medium through which much of the produce of the east and of the west passed to other countries. Political events have also tended materially to depress the foreign trade of Portugal. Previously to 1820 it was very considerable, but since that memorable epoch in the annals of the country, it has sunk, comparatively speaking, to nothing. The chief articles of exportation are wines, lemons, oranges, figs, almonds, and other dried fruits; salt, oil, sumach, wool, and corkwood. The chief goods imported are wheat and other grains, dried cod, salted meat, butter, cheese, horses, oxen, mules, and other animals, medicinal and drying drugs, linseed-oil, planks, and other kinds of prepared wood, iron, steel, lead, tin, brass, copper, charcoal, tar and pitch, flax, hemp, and silk. Numerous articles of foreign manufacture were wont to be imported, and afterwards re-exported to foreign possessions; but this trade is of course annihilated, or nearly so.

There is a great deficiency of authentic documents regarding the commerce of Portugal. Those which can be relied on relate to periods too far back to admit of their being taken as evidence of the present state of trade, and those of a more recent date are imperfect. The following is a statement of the quantities of British and Irish produce and manufactures imported into Portugal in the year 1835; the declared value is given:—Apparel, slops, and haberdashery, L.13,938; arms and ammunition, L.1293; bacon and hams, L.1479; beef and pork, L.1454; beer and ale, L.2369; printed books, L.935; brass and copper manufactures, L.10,730; butter and cheese, L.94,052; coals, culm, and cinders, L.1561; cordage, L.165; cotton manufactures, L.796,002; hosiery, lace, and small wares, L.20,998; cotton, twist, and yarn, L.13,338; earthenware of all sorts, L.5171; woollen manufactures, L.350,715; fish, herrings, L.122; glass, L.11,753; hardwares and cutlery, L.31,469; hats, L.1990; iron and steel, L.49,484; lead and shot, L.8118; leather, L.6138; saddlery and harness, L.3212; linen manufactures, L.36,184; machinery and mill-work, L.5346; painters' colours, L.3805; plate, jewellery, and watches, L.1281; silk manufactures, L.19,485; soap and candles, L.482; stationery, L.9376; refined sugar, L.6840; tin, L.410; tin and pewter wares and tin plates, L.4176; woollen and worsted yarn, L.680; salt, L.150; all other articles, L.39,625. The total declared value of the whole was L.1,554,326. This was rather less than the amount of exports to Portugal during 1834, but more than for any preceding year. The goods imported from France in 1835 were, French and foreign merchandise, raw produce, L.42,284; manufactures, L.236,374; French merchandise, raw produce, L.27,247; manufactures, L.195,546. The total amount was L.501,453, about one third of that of Great Britain. The goods sent to the Portuguese dependencies are included. Portugal exported to Great Britain in 1835, wines of Portugal, 4,163,719 gallons; sheep's wool, 680,956 lbs.; bees' wax, eighteen cwts.; brandy, 1084 gallons; 2385 goats' skins; sumach, forty cwts.; raisins, twenty-four cwts.; olive oil, 270 gallons; oranges and lemons, 95,656 packages; figs, 828 cwts.; bark for tanning or dyeing, 1015 cwts.; cork, 59,910 cwts.; wheat 2157 quarters; and a few other articles. During the same year Portugal sent to France, raw materials and manufactures to the value of L.38,805; articles in a state fit for use or for consumption, L.41,425; total amount, L.80,231. But Portugal carries on trade with many other countries besides Great Britain and France. For her own products she receives from the Netherlands grain, cheese, colours, and dye-stuffs; from the north of Germany grain, linen, iron, tin, brass, and other metallic articles, and toys; from Denmark, grain and timber; from Sweden, grain, iron, steel, copper, and tar; from Russia, grain, hemp, flax, canvass, linen, cordage and tackling, timber, tar, tallow, furs, and the like; from Dantzig, grain, hemp, and timber. There is likewise a considerable intercourse with the United States, the foreign colonies of the kingdom, Brazil, and other places; but we have no data from which to estimate the extent and value of the foreign commerce. The internal trade, at the best unimportant, suffers from the want of good roads. Canals there are none, and the few navigable rivers are not so at all times, so that until proper roads are made or canals formed, the inland commerce of Portugal must continue to be very limited.

Government, laws and religion.

The government of Portugal, once of the most absolute kind, is now a limited monarchy. The succession is hereditary, and extends to both sexes. The constitution of the kingdom, a sketch of which was laid before the cortes on the 7th of March 1837, is nearly a verbatim copy of that of 1822, an outline of which has already been given. The exceptions relate to the appointment of the senators, and the separation of the counsellors of state. The mode of election now adopted is the direct instead of the indirect. It is further provided, that no deputy can hold a public situation, and no officer in his district, no bishop in his diocese, nor any priest in his parish, is allowed to be chosen. The king and the royal princes are declared incapable of holding the chief command of the army or navy. The cortes have the right to choose a new dynasty should the reigning family become extinct. If the assembly of the cortes is dissolved, a new one must be called together within thirty days at the latest. The authority of the cortes is so great that the power of the sovereign is little more than nominal. The management of the affairs of the nation belongs to the counsel of state. There are six ministers, one for each of the departments of foreign affairs, the interior, finance, war and the colonies, marine, and justice. There are also boards of trade, of navigation, of agriculture, and of manufactures.

For the administration of justice there are two supreme courts of appeal; one at Lisbon, and the other at Oporto. There is also one for each of the provinces of Estremadura, Alemtejo, Algarve, Minho, Tras-os-Montes, Beira, and one for the comarca of Castello Branco in Beira. A court of cassation has been established in the capital. In criminal cases the proceedings are public; in civil matters the parties have the privilege of appointing an arbitrator, who is chosen from a society belonging to each city. Each of the six districts of the kingdom is divided into comarcas or jurisdictions, which are again subdivided into ciudades, villas, and provincial under-courts of justice, called concelhos, houras, contos, julgados, and behetrias, these being distributed in correiçoes, over which a corregidor presides as head judge, and who has a right to speak in the second instance, or court of judicature. The sub-judges are in individual places *juizes de fora;* but in all civil and criminal cases they speak in the first instance. In large towns the civil and criminal jurisdiction is under two *juizes da fora,* one of whom bears the title of *juiz da civel,* and the other that of *juiz da crime.* There are also in the towns and villages *juizes ordinarios,* or *juizes da paz,* a sort of justices of the peace. The number of persons connected with the administration of justice, those who have seats in courts, as judges, advocates, and others, is very great, and the course of law is tedious and expensive. The standard authority in matters of law and justice is the royal ordinances which Alphonso V. collected, and Emanuel I. printed. When this juridical code is not sufficient, the Roman law is appealed to; and in ecclesiastical matters the canon law is the recognised authority. The religion of the state is the Roman Catholic; but the exercise of all other forms of religion is permitted to foreigners. The supreme head of the clergy is the patriarch of Lisbon, who is always a cardinal. There are fourteen bishops under the archbishops of Braga and Evora, the former bearing the title of primate of the kingdom. The number of ecclesiastics and religious houses was at one time very great. In 1822 there were 132 nunneries, with 2980 nuns, 912 pupils and novices, and 1971 servant-women; and their revenue amounted to 432,189 milreis. The number of monasteries was 346, containing 5830 persons, who enjoyed an income of 784,513 milreis. The regular orders of monks have been reduced, and some other alterations relating to the church have taken place since Balbi published his Statistical Essay on Portugal, from which the above facts are taken; but we have no authentic data from which to draw up a correct statement of the present condition of ecclesiastical matters in Portugal. Religion has shared in the political fluctuations of the times.

Population and division.

The following is a tabular view of the statistics of Portugal for the year 1835. The number of square miles and fire-places in the provinces and districts is given on the authority of official documents. The population has been estimated by multiplying the number of fire-places by four and a half, which is reckoned a fair average number of souls for each hearth.

	German Geographical Square Miles.[1]	Population.	Fire-Places.
In Europe.			
Province of Minho.................	126·	872,406	193,868
Province of Tras-os-Montes.....	191·75	331,213	73,603
Province of Upper Beira }	405·	{ 996,345	221,410
Province of Lower Beira }		{ 109,215	24,270
Province of Estremadura.,.......	416·68	790,655	175,701
Province of Alemtejo.............	483·75	314,311	69,847
Province of Algarve...............	99·	135,261	30,058
	1,722·18	3,549,406	788,757
To these there is to be added the			
Eastern District of the Azores..	18·	90,000	20,000
Western District of the Azores	38·82	135,000	30,000
District of Madeira.........	18·50	112.500	25,000
District of Cape Verd Islands...	149·	54,000	12,000
	224·32	391,500	87,000
In Africa.			
The settlement on the coast of Guinea........................	19·5	20,000	
The settlement of Angola........	14,750·	376,000	
The settlement of Mozambique	13,500·	286,700	
	28,269·5	576,300	
In Asia.			
Government of Goa	223·	417,900	
Government of Dilli and Timor	85·	120,000	
Government of Macao............	4·5	38,400	
		576.300	

The principal cities and towns having above 10,000 inhabitants are, Lisbon, 250,000; Oporto, 80,000; Elvas, 18,000; Coimbra, 15,200; Setuval, 14,820; Braga, 14,400; Evora, 10,500; Ovar, 10,300. In the colonies, Funchal, 20,000; Villa Nova de Goa, 18,500; Ponta Delgata, 18,000; Soanda de S. Paola, 18,000; Angra, 15,000; Cacheu, 15,000; S. Salvadore, 15,000; Mozambique, 12,340; Macao, 12,000.

The national varieties of the population are, Portuguese, 3,397,050; Free Blacks, 595,000; Gallegos, 50,000; Hindus and Malays, 420,000; Negro Slaves, 20,000; Chinese, 64,800.

The varieties of religion amongst the population are, Catholics, 3,782,050; Brahmins and Buddhists, 400,000; Foiten, 64,800; Fetishes, 400,000.

Instruction.

In the year 1822 the statistics of education in Portugal stood thus. The university of Coimbra, founded in 1279, with six faculties, a preparatory college, sixteen hundred students; eight hundred and eighty-three elementary schools; three hundred and twenty-two Latin, and twenty-one Greek and rhetorical schools, together with twenty-seven for theoretical and moral philosophy. The total number of scholars, exclusive of students, was 31,280. To these are to be added the following establishments; the marine and royal academy at Oporto, which had three hundred and twenty-five scholars; the academy of Lisbon, with about as many pupils; the trades' school at Lisbon, with a hundred and fifty scholars; the Lisbon royal school for engineering, artillery, and drawing, with eighty scholars; and the military school at Luz, near the capital, with two hundred students. At Lisbon there are also a royal college for the nobility, and royal schools for the Arabic language, drawing, and architecture, and another for statuary; also an institution for instruction in copperplate engraving, an academy for teaching music, and some others. Surgery is taught at the university of

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[1] A German geographical mile is nearly equal to 4¾ths English miles.

Coimbra, and in several royal schools; in St Joseph's hospital in Lisbon; and in hospitals at Oporto, Elvas, and Chaves. The military school for mutual instruction, which the children of citizens are permitted to attend, had two thousand five hundred and sixteen scholars. There are other academies for instruction in science, geography, Portuguese history, navigation, marine affairs, artillery, and fortification; an institution for the encouragement of literature and other branches of knowledge at Lisbon; an academy for history and antiquities at Santarem; and an academy for scientific instruction in the small county-town of Tomar in Santarem. Portugal has seven botanic gardens, but some of them are of a very humble description; twelve museums of natural curiosities, open to the public; twelve collections of coins and other antiquities; eight observatories; a royal library at Lisbon, with eighty thousand volumes; and the university library of Coimbra, with sixty thousand volumes. In the fine arts the Portuguese have made but little advancement. There are comparatively few printing-presses in the country; and book-printing establishments on a respectable scale are only to be met with in Lisbon, Oporto, and Coimbra. Works of fiction, and books for edification in the Catholic faith, constitute half the yearly literary produce of the Portuguese. On account of their poverty, it has been customary to print scientific works at the royal expense. It is difficult to say whether the press be free in Portugal, at least according to our ideas of freedom. Liberty of the press was established by a decree in the year 1823; but the cortes annulled it, and appointed a commission of censorship.

Knights, royal titles, &c.

There are seven orders of knighthood in Portugal, viz. the military order of Christ, established in 1319; the order of San Jago, for civil merit, founded in 1288; the order of Avis, for military merit, established in 1213; the military order of the tower and sword, founded in 1459, and revived in 1805–1808; the order of Villa Vicosa, or the immaculate conception, founded in 1818; the female order of Santa Isabel, established in 1804; and the order of the faith. In 1749, the king of Portugal received from Benedict XIV. the title of *rex fidelissimus;* and his Most Faithful Majesty styles himself "king of Portugal and Algarve, of both sides of the sea in Africa, lord of Guinea, and of the navigation, conquests, and commerce of Æthiopia, Arabia, Persia, and India." The heir to the throne is styled Prince Royal; his eldest son, Prince of Beira; the other royal children are called Infants and Infantas of Portugal. The present Braganza line of princes commenced with John IV. who was proclaimed king of 1640. The national escutcheon is a silver shield, with five smaller blue shields lying crossways. On each of these are five silver pennies, placed so as to form a Saint Andrew's cross. There is a red border containing the armorial bearings of Algrave, which are seven golden castles with blue towers. On the summit of the royal helmet there is a golden dragon; and the shield contains two dragons, each holding a flag, adorned with the emblems of Portugal and Algarve.

Finances.

The revenues of the state arise from the extensive crown-lands, together with the hereditary estates of the house of Braganza, and the possessions of the first three orders of knights, the greater portion of which belongs to the crown. The other sources from which the government income is derived are, the customs, a property-tax levied from citizen and countryman, the tenth part of the amount of all goods sold, the profits of the "cross-bull," the impost on several requisites of life, the excise, the "decimas" or tithes of the clergy, stamps, lotteries, the mint, and others. Since the separation of Brazil from Portugal, and the attempt of Dom Miguel to maintain the sovereignty he had usurped, a great disproportion has taken place between the expenditure and the income; the latter being sometimes not equal to the half of the former. The consequence has been the accumulation of a national debt of enormous magnitude for so poor a country, and which there appears to be no immediate prospect of the government being able to extinguish, or even to lessen. We have no information that can be relied on as to its exact amount at present; but as it was stated to be three hundred and twenty-four millions of francs in the year 1832, we are rather below than above the mark in estimating it now, 1838, at four hundred millions of francs, or sixteen millions sterling. The income, as well as the expenditure, but particularly the former, has been subject to great fluctuations. These, however, are mainly to be attributed to the unsettled state in which the country remained for so long a period. In the year 1827, the income was 46,843,975 francs, and the expenditure was 62,162,363, so that there appeared a deficit of 15,292,388 francs. In 1829 the revenue was only eighteen millions, whilst the expenses amounted to forty millions of francs. The following is the budget for 1837–1838:

Income............ 9,294 cantos, = 55,764,000 francs.
Expenditure......11,214 = 67,284,000 ditto.

Deficit...............1,920 cantos, = 11,520,000 francs.[1]

Army and navy.

According to a decree dated on the 4th of January 1837, the organized army consists of, the infantry, thirty battalions, twenty of which are infantry of the line, and ten jägers, in all 21,560 men; the cavalry, eight regiments, four being lancers and four jägers, in all 3680 men; and the artillery, four regiments, and three batteries for the neighbouring islands, consisting of 2232 men. The combined military force of Portugal, therefore, amounts to 27,472 men; and there is, besides, an army of militia about 27,000 strong.

According to an official document of the year 1835, the naval force consisted of two ships of the line, four frigates, six brigs, eight schooners and cutters, eight gun-boats, eight transports, eight packet-vessels, and two steam-boats, in all forty-six sail.

People and language

The inhabitants of Portugal are generally a robust, yet not an industrious people. They are enterprising and persevering, patient in adverse circumstances, excessively attached to their own religion and customs, and, though temporary circumstances may seem to indicate the contrary, they retain a high sense of loyalty to their monarch, and of submission to their spiritual superiors. The Portugese language is derived from the Latin, of which it contains a great proportion of words, though mixed with many others of Arabic origin. In the construction of its sentences it very much resembles the Castillian; but the pronunciation of the syllables differs considerably, being in general less guttural; and there are many words introduced which seem peculiar to itself, and the derivation of which it is difficult to trace, though probably they are to be found amongst some of the tribes on the coast of Barbary. (R. R. R.)

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[1] Weimar Almanac for 1838.

PORTUMNA, a small market town, in the county of Galway, Ireland. It is situated within half a-mile of the river Shannon, over which there is a bridge, and consists of a long line of cabins built without any regularity. It possesses a church and a Roman Catholic chapel. It is distant from Dublin 74 miles, and had a population in 1821 of 736, and in 1831 of 1122.

POSEGA, a city of the Sclavonian provinces of the Austrian kingdom of Hungary, the capital of a circle of the same name, which extends over 990 square miles, and comprehends one city, six towns, and 254 villages, with 74,200 inhabitants. The city is on the river Orlgava, and contains 410 houses, with 4220 inhabitants, who grow tobacco and silk. Lat. 45. 21. 30. Long. 17. 37. 25. E.

POSEN, one of the provinces of the kingdom of Prussia. It was formerly a part of Poland, but by the several partitions of that distracted country, and by the treaty of Vienna in the year 1815, has been guaranteed to Prussia. It is bounded on the north by west Prussia, on the east by Russian Poland, on the south by Silesia, and on the west by Brandenburg. It extends in north latitude from 51° 10′ to 53° 27′, and in east longitude from 15° 2′ to 18° 33′, and comprehends 12,836 square miles. It is generally a plain, with few elevations or even undulations. It consists for the most part of a sandy soil, though some of the marshy parts, when drained, form most excellent meadows for fattening cattle, and for the dairy. The chief product of the soil, as well as the chief food of the inhabitants, is rye, of which about ten times as much is grown as of wheat. Barley is to rye as four to ten, and oats as three to ten; thus the rye crops exceed the whole of the other. The agriculture was in a miserable state till the possession of the country was secured to Prussia by the treaty of Vienna, under the tranquillity and security created by which, it has been making surprisingly rapid improvement. Between 1802 and 1815, the stock of cattle had diminished; the cows, sheep, and horses being about one-third less in the latter than in the former year. Since 1815, an augmentation has again taken place, and the stock of that description in 1832, was found to have more than doubled. Many of the marshes had been drained and converted into excellent pasture, especially an extensive tract, by the construction of the Bromberg canal, which has improved the soil and formed a good communication through the Vistula with the Baltic sea. The forests, which cover one-twentieth part of the province, are a considerahle means of occupation, and a source of wealth. There are few manufactures in the province, and those have been mostly introduced by settlers from Germany since 1815. No part of Europe has shewn such an increase in the number of its inhabitants, as the province of Posen, but especially in the government of Bromberg, which is the northern division of it, in the ten years from 1817 to 1826, both years inclusive. By the census of the former years the government of Bromberg contained 261,368 souls, and that of Posen 579,753; and by that of the latter year Bromberg contained 330,235, and Posen 715,712; thus exhibiting an account by which, at the same rate, the population would be doubled in less than thirty-two years. In 1815 the German inhabitants were estimated at 140,000, and the Jews at 48,000, but it is probable their increase has been greater than that of the Poles, who formed the rest of the population. The religion of the Poles is mostly Catholic, that of the Germans chiefly Protestant. The former have a bishop, under the archbishop of Gnesen, with 581 churches, and several monasteries and nunneries, and two ecclesiastical seminaries. The latter have 101 churches, and two public colleges or gymnasiums. The nett revenue furnished by this province to Prussia in 1816, was about L.120,000, one-half arising from the forests, and other national estates, and the remainder from direct taxation. The whole province is divided into the two governments of Posen and Bromberg, and the former is divided into seventeen circles.

Posen, a city, the capital of the Prussian province of the same name. It stands on a plain on the banks of the river Warthe, and is surrounded with walls, beyond which are some extensive suburbs. Having been burned down in 1803, its buildings are in a more modern style than formerly. It contains a cathedral, and twenty-five other Catholic churches, five monasteries, and four nunneries, a Lutheran, Calvinist, and Greek church, an episcopal palace, and theatre, with about 2500 houses, and 28,000 inhabitants. It has but little other trade beyond what arises from being the seat of the provincial government. The manufactures, though increasing and improving, are still insignificant, and mostly in the hands of the Jews, whose numbers in the city amount to near 5000, and who have a synagogue and some schools. Lat. 52. 22. Long. 17. 14. 30. E.

POSIDONIUS, a celebrated Stoic philosopher of Apameia in Syria, was the disciple and successor of Panætius, (Strab. xiv. 655.) The exact date of his birth and death are unknown, but he flourished B. C. 78, and came to Rome B. C. 51. (Suidas.) He resided principally at the island of Rhodes, and his reputation was so high that many of the young Roman nobility attended his lectures. He was visited by Cicero, B. C. 78, (Plut. Cic. 4. Cic. N. D. 1, 3), and by Pompey, B. C. 62. (Plin. vii. and Plut. *Pomp.* 42.) Posidonius went to Rome on an embassy respecting the affairs of the Rhodians, (Plut. Mar. 45), and probably at this time visited Spain, (Strab. xiii. 614), Gaul, (iv. 197), and Liguria, (iii. 165). He lived to the age of eighty-four, (Lucian, Macrob. 20), and was succeeded by his grandson Jason, (Suid.) Cicero (Div. i. 3), alludes to a work of his on divination, in five books; but he was not merely a philosopher, he was also an astronomer and geographer, who is frequently quoted by Strabo. He made an attempt to calculate the circumference of the earth, and also the diameter of the sun. (Strab. ii. 95, 138.) He treated at considerable length the phenomena of tides, and observed that they had diurnal, monthly, and annual periods, like the moon, (138, 174.) The scattered fragments of Posidonius have been collected and published, under the title, *Posidonii Rhodii reliquiæ doctrinæ, collegit atque illustravit J. Bake accedit Vrytlembachii annotatio*, 1810.

POSITION, Centre of. From Archimedes to Doctor Wallis, writers have assumed, that there belongs to every *body* an individual point, where, for most purposes, the whole weight may be conceived to reside; and they have called it the *centre of gravity*. The learned Englishman, however, believed himself the first to accomplish a demonstration from the nature of gravity. (Scholium to Prop. xv. *De Centro Gravitatis.*)

But the same point is admirably connected with other properties and contingencies of the body than its weight; and hence different names have been considered as preferable by many writers, such as *centre of inertia*, &c.

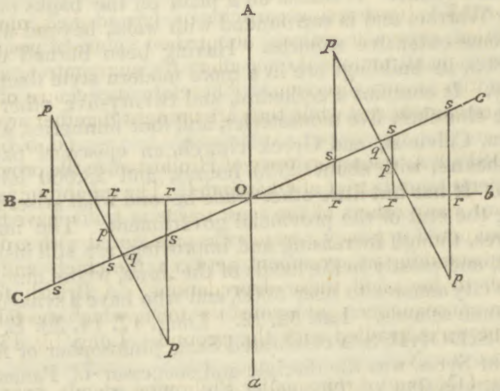
And from viewing a body as composed of physical points, it is found that the relation of this centre to their positions is fertile in some of the most beautiful theorems in the mathematics; whence it has properly received the geometrical designation of the *centre of position.*

We here introduce it in this geometrical character; and shall demonstrate very briefly, but we trust sufficiently, a collection of elegant and most important properties, of which some are virtually proved elsewhere, in a manner more suited to the direct object of their introduction.

If there be any multitude of distinct points in space, it is clear that a plane may move, parallel to any given plane, until the collective distances of the points on one side of it be equal to those on the other.

Let a plane thus situated, relatively to a system of points, be called a plane of equidistance.

Fig. 1.



Suppose two planes of equidistance, A and B, perpendicular to each other. Then, first, we shall find that any plane C which passes through their common section or axis, is also a plane of equidistance to the same system of points. For, let any plane, perpendicular to this axis in O, cut the planes A, B, C, in the straight lines A*a*, B*b*, C*c*, respectively. Then A*a* and B*b* are at right angles. Let a perpendicular from any point of the system meet the plane ABC in *p*. Draw *pq* at right angles to C*c*, and let it be positive when on the same side of the plane C as AO. Also draw *pr* perpendicular to B*b*, and meeting C*c* in *s*; and let *pr* and *rs* be positive when on the same sides of the planes B and C respectively as AO. The triangle *pqs* being given in species, *pq* is as *ps*, that is, as $pr+rs$; so that the sum of the *pq* is as the sum of the *pr* together with that of the *rs*.

But the *pr* are the distances of the points of the system from the plane B, which is a plane of equidistance; and therefore their aggregate is nothing. And again, the *rs* are as the *r*O, which are the distances from the plane A; and, having different signs on the two sides, their aggregate is also nothing. Thus the sum of the *pq* is nothing; and the plane C is a plane of equidistance.

Now let O move along the axis to make ABC a plane of equidistance. Then shall any plane K which passes through O be such a plane.

For let the plane K cut ABC in the line C*c*. The plane ABC, and the plane C, which cuts it perpendicularly in the line C*c*, are planes of equidistance; therefore, by what we have just proved, the plane K which passes through their common axis C*c* is also a plane of equidistance. Thus, to every system of points, there is a point through which every plane is a plane of equidistance. And there cannot be more than one. For if there were two, we might have through them two parallel planes of equidistance, which is manifestly absurd.

This single point has been called the centre of position.

Cor. 1. The difference of the centre of position from any given plane is an average of the distances of the several points of the system; the distances on different sides being distinguished by contrary signs.

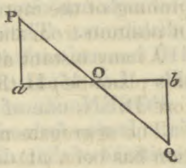
For conceive the parallel plane of equidistance, at the distance D from the given plane. Let the distance of a point of the system from the given plane be denoted by $\text{D}+d$. Then d will vary its sign according as the point of the system and the given plane be on different sides of the plane of equidistance, or on the same side.

Now if there be p points in the system, the aggregate of their distances from the given plane will be $p\text{D}$, together with the aggregate of the d. But the collective d are nothing; so that it will be $p\text{D}$; or D is the average distance.

Cor. 2. If the average distances of the points of a system from three planes, perpendicular or inclined to each other, be given, the centre of position is given. For, by the distances of a point from three such planes, its position in space is given.

Cor. 3. If the centre of position, and the multitude of points in each of two systems be given, the centre of the united systems is found in the straight line joining the given centres at distances from these reciprocally proportional to the multitudes.

Fig. 2.



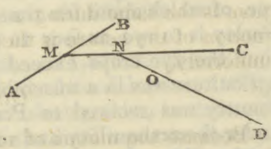
Let P and Q be the centres of position of two systems of p and q points respectively. Let perpendiculars from P and Q meet any plane of equidistance in a and b respectively.

Then $p\,.\,\text{P}a+q\,.\,\text{Q}b$ expresses the collective distances of the points of the united systems from the plane of equidistance, consequently the two terms are of opposite signs and equal magnitude.

And because P*a* and Q*b* are perpendicular to the same plane, they are parallel: so that P*a*, *ab*, *b*Q, are in one plane. Let O be the intersection of PQ and *ab*. Then PO and OQ are as P*a* and Q*b*; and since $p\,.\,\text{P}a=q\,.\,\text{Q}b$, we have also $p\,.\,\text{PO}=q\,.\,\text{QO}$, or $\text{PO} : \text{QO} :: q : p$.

Thus every plane of equidistance passes through the same point O, which is therefore the centre of position.

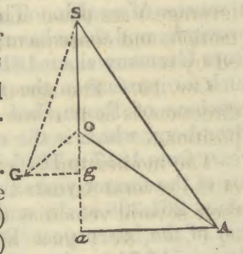
Fig. 3.



Scholium. Hence, if we have any points A, B, C, D, &c., bisecting AB in M, or making $\text{AM}=\frac{1}{2}\text{AB}$; again, making MN to NC as 1 to 2, or $\text{MN}=\frac{1}{3}\text{MC}$; and NO to OD as 1 to 3, or NO== ND, and so on: Then M is the centre of position of the two points A and B; N of the three points A, B, C; O of the four points A, B, C, D, and so on. And as we have proved that there cannot be more than one centre of position to the same system of points, the ultimate point must be the same in whatever order we take the given points into the operation.

Cor. 4. The difference of the squares of the distances of the centre of position from the extremities of any straight line is an average of the difference of the squares of the several points of a system from these extremities.

Fig. 4.



Let SO be the straight line; A a point of a system whose centre of position is G; and A*a* and G*g* perpendicular to the extension of SO. Then $\text{AS}^2-\text{AO}^2=a\text{S}^2-a\text{O}^2=(a\text{S}+a\text{O}).\,\text{OS}$; making *a*S and *a*O negative when measured contrary to the tendency OS.

Hence $\Sigma(\text{AS}^2-\text{AO}^2)=\Sigma(a\text{S}).\,\text{OS}+\Sigma a\text{O}).\text{OS}$. But, if there be p points, $\Sigma(a\text{S})$ is $p.g\text{S}$, and $\Sigma(a\text{O})$ is $p.g\text{O}$. Therefore, $\Sigma(\text{AS}^2-\text{AO}^2)=p.(g\text{S}\times g\text{O}).\text{OS}=p.(\text{GS}^2-\text{GO}^2)$.

Cor. 5. The squares of the distances of any points in space from their centre of position are together less than from any point in the surface of a sphere about this centre, by the square of the radius multiplied by the number of points.

For when G coincides with O, g is also there; and we have $\Sigma(\text{AS}^2-\text{AO}^2)=p.\text{OS}.\text{OS}$, or $p.\text{OS}^2$.

Cor. 6. If A, B, C, &c., express the number of points whose respective centres are in the positions A, B, C; and O be the centre of position of all the points united in one system; then, S being any other point,

$$\text{A.SA}^2+\text{B.SB}+{}^2\text{C.SC}^2=\text{A.OA}^2+\text{B.OB}^2+\text{C.OC}^2+(\text{A}+\text{B}+\text{C})\text{OS}^2.$$

For, by Cor. 4, $\text{A}(\text{SA}^2-\text{OA}^2)+\text{B}(\text{SB}^2-\text{OB}^2)+\text{C}(\text{SC}^2$

$-OC^2$) expresses the excess of the squares of the distances of all the points from S over the squares of their distances from O, which (by the last cor.) is equal to $(A+B+C) . OS^2$.

Cor. 7. In any system of points, the motion of the centre of position, in any given direction, is an average of their several motions in that direction.

For assume a plane perpendicular to the given direction behind all their motions. Let there be p points, and the sum of their distances from the assumed plane, at the beginning of the motion pd. Then the distance of the centre of position from this plane is d.

At any instant afterwards, let their united distances from this plane be pD, that of their centre of position being therefore D.

The aggregate motion of the system in the given direction has been $pD - pd$, or $p(D-d)$, while that of the centre of position has been $D-d$.

Cor. 8. If the several points of a system be uniform as to their motion, the centre of position either rests or moves uniformly.

If it do not rest, whatever be its first tendency, it must persevere in the same. For as it begins without any motion perpendicular to this direction, the aggregate of the motions of the system in any direction perpendicular to this must be nothing, and therefore will continue nothing; so that the centre will never be taken out of its first direction. And as the motion of each point, estimated in this direction, is the same during a given time, the average, or the motion of the centre is the same; so that it traces its path uniformly.

Otherwise.

Because the motion of any point of the system, estimated in three different directions not in the same plane, is uniform in each; that of the centre of position is uniform in these directions, or is nothing. Hence it can have no motion other than uniform in direction and velocity.

Cor. 9. If a body, or system of bodies, be put in motion, and subject to no other disturbance than the action of the parts or bodies upon each other; the centre of position will either rest or move uniformly in a straight line.

For every particle is at first determined to a certain direction and velocity, or put in a condition of uniform motion. And the actions of material particles or bodies upon each other, (whether by impulsion, attraction, impact, or leverage,) are equal and contrary; so that the aggregate motion, and consequently the average motion, is not affected by it.

Cor. 10. The agregate momentum of a system, in any direction, is as if it were all collected into the centre of position.

The momentum in any direction is the united momenta of the several particles. Now, if there be p particles, and their several velocities in a given direction be denoted by v', v'', v''', &c.; these also represent their several momenta; and if we put $pv=v'+v''+v'''+\ldots\ldots$; v is the velocity of the centre of position. Thus the aggregate momentum is as if every particle were in this centre.

Scholium. When the system is connected these parallel momenta compound a force in the given direction, which passes through the centre of position, or centre of gravity; and is equal to the sum of the several forces. So that the impact of the system is as if all were collected in the centre.

Cor. 11. If a body be left to itself in a state of rotation, the axis of rotation will pass through the centre of position.

For when there is rotation, no point out of the axis can either rest or move in a straight line. Therefore the centre of position will be in the axis.

Cor. 12. If attracting particles be left to their mutual attraction, they will coalesce about their centre of position.

For their attractions do not affect the aggregate or average motion in any direction. Therefore the centre of position remains at rest while they are brought together around it. (O. O. O.)

POSITRA, a sea-port town of Hindustan, in the province of Gujerat, and district of Okamindel. The inhabitants, like those of many others of the coast towns in India, have been long addicted to piracy; which was prosecuted with ardour, notwithstanding an agreement between the chiefs and the British to lay aside these depredations. A British force was in consequence sent against the town, which was taken, and the walls levelled with the ground. Long. 69. 17. E. Lat. 22. 23. N.

POSON, one of the smaller Philippine islands, near the west coast of Leyta. Long. 124. 24. E. Lat. 10. 43. N.

POSSESSION ISLAND, in the South Pacific Ocean, discovered by Monsieur Marion in 1772. It is of a round form and mountainous. Long. 41. 40. E. Lat. 46. 30. N. There is another island of this name in the South Pacific Ocean, near the north point of New Holland. It was taken possession of by Captain Cook in the name of Great Britain. Long. 218. 21. E. Lat. 10. 33. N.

POSSESSIVE, in *Grammar*, a term applied to pronouns, which denote the enjoyment or possession of any thing either in particular or in common; as *meus*, mine; *tuus*, thine; *suus*, his own, her own, its own, or their own.

POSTERIOR, a term of relation, implying something behind, or that comes after, another. In this sense it is used in opposition to *prior* and *anterior*.

POSTERN, in fortification, a small gate, usually made in the angle of the flank of a bastion, or in that of the curtain, or near the orillon, and descending into the ditch; by which the garrison can march in and out, unperceived by the enemy, either to relieve the works, or to make sallies against an enemy. The word is also used in general for any private or back door.

POST-HORSE, a rocky inlet in the Eastern seas, near the west coast of the island of Celebes. Long. 119. 18. E. Lat. 5. N.

POSTHUMOUS, a child born after the death of his father, or taken out of the body of a dead mother; and hence frequently applied to the works of an author not published until after his decease.

POSTIL, a name anciently given to a note in the margin of the Bible, and afterwards to one in any other book posterior to the text.

POSTILLIONS, a chain of rocks in the Eastern Seas, about 60 miles in length from north to south. Long. 119. 18. to 119. 54. E. Lat. 6. 15. to 6. 48. S.

POSTLIMINIUM, amongst the Romans, the return of one who had gone to sojourn elsewhere, or had been banished, or taken by an enemy of his own country or state.

POST, a word derived from the Latin *positus*, set or placed. It is used in several different meanings, but all of them referring either immediately or remotely to the primitive sense of *position*. Thus the word post signifies a stake, or piece of timber set upright; a station, particularly a military station; an office or employment; an operation in book-keeping; a conveyance for letters or dispatches; a particular mode of travelling.

POST-OFFICE.

History. It has been usual to trace the origin of posts to a remote antiquity; certain establishments, having something in common with the modern post system, being found to have existed at an early period of the world's history. Herodotus and Xenophon mention that, amongst the ancient Persians, stations were appointed at intervals along the great roads of the empire, where couriers were constantly kept in readiness to convey dispatches and intelligence. Similar institutions, as we learn from Suetonius, were maintained amongst the Romans in the time of Augustus, and such probably existed much earlier.

But although the *name* of the *post* may be traced to this source, (from the Latin word *positus*, whether as applied to the accommodation and means of transport *placed* at intervals for the service of the couriers, or to the couriers themselves, placed or *posted* at the several stations,) such institutions obviously bear but a general resemblance to the post-office of the present times. The couriers were mere state messengers, the communication only to and from the seat of government; nor, as far as appears, was there any regular machinery for the receipt and delivery of letters, so essential to the idea of a modern post establishment.

The posts which were first instituted in the kingdoms of modern Europe, as those by Charlemagne and Louis XI. of France, the Emperor Charles V., and some other sovereigns, differed little, if at all, from those now described. It is indeed probable, that whenever the posts or couriers were appointed to perform their journeys at stated periods (which, as soon as the occasions for employing them became frequent, would be found at once the most economical and effective mode,) such a convenient means of conveying correspondence, though primarily intended only for state purposes, would soon come to be used by individuals. Houses of call, for the receipt and delivery of letters, would in process of time be established by custom, if not by regular appointment; and in this way might grow up the modern post system. The earlier posts instituted in Europe, however, were in general but of temporary duration; their existence being dependent sometimes on occasion, sometimes on the disposition or policy of particular monarchs.

Between the end of the fifteenth and beginning of the seventeenth century, indeed, there were several members, in succession, of the noble family of Taxis in Germany who applied themselves in a remarkable manner to the establishment of posts, and the office of postmaster-general of the empire was eventually conferred on the family as a hereditary fief. As certain posts settled by this family (at a period preceding that in which the modern post system was generally introduced in Europe,) continued permanent, such posts may be considered (unless, indeed, they were at first formed on the modern plan (as affording an instance of transition from the ancient to the modern system. In other cases, however, there is no room for representing the latter as having grown out of any extension, adaptation, or improvement of the former. Thus, in our own country, the insular position of which made our sovereigns less anxious about intelligence from their frontier, nothing of the nature of a public post establishment can be said to have existed, (with an immaterial exception in the reign of Edward IV.) until after the modern form was introduced, the rise of which it is a matter of no difficulty to explain. The conveyance of letters, indeed, is what must inevitably become, in the course of human transactions, as much matter of necessity, as the conveyance of persons or of commodities; and the same circumstances which generate the formation of roads and bridges, and give existence to the trade or occupation of carrier, shipmaster, or innkeeper, must necessarily lead to the employment of the post messenger, under greater or less degrees of system and regularity.

History, more attentive to record the transactions of monarchs, than the steps by which communities effect their advancement and improve their conveniences, furnishes nothing beyond an incidental notice of the modes by which the circulation of correspondence was conducted, before it became matter of state regulation. Of course, however, it is not to be supposed that no such modes existed, or that notices of these are entirely wanting. The conveyance and delivery of letters was often part of the regular occupation of travelling pedlars and others whose business led them to perform stated or frequent journeys. When commerce began to advance, regular conveyances for correspondence were established between some of the principal trading cities, either by the municipal authorities,[1] or by concert of private individuals or associations. A permanent establishment of messengers for the conveyance of letters was attached to the university of Paris, from the beginning of the thirteenth century, and, indeed, was not abolished until the year 1719, long after a general post had been settled in France. Other universities were similarly provided.[2] In some instances powerful and opulent individuals established posts, either as a mercantile speculation, or for the convenience of any district in the prosperity of which they took an interest. But although the conveyance of correspondence was thus brought to some degree of system, or rather prevailed under a variety of systems, even in places where the state authorities had not yet provided any public establishment for this purpose, it is easy to see that communication, especially between more distant places, must have been slow, irregular, and insecure. The advantage and even necessity of having a uniform and legalized system of post conveyance, could not have failed to present itself to the eyes both of subjects and rulers; although it may be a question whether the sovereigns who first established such systems in their dominions were, in general, moved so much by large and enlightened views of public benefit, as by the wish to create, according to the practice so usual in that age, a lucrative trading monopoly in behalf of some of their favourites.

The establishment of the modern post system, then, in regard to the mode of its taking place in some of the principal countries of Europe, is not properly to be viewed as of the nature of a political or civil invention; being merely the assumption, on the part of the state, of the conduct of a particular department of human affairs, which had grown up with the progress of society, but could no longer be competently managed by individuals, whether acting severally or in concert. And accordingly, in acts and ordinances relative to posts, there is not so much in the shape of *offer* of a new species of accommodation, as of *prohibition* against procuring the same accommodation by any other than the offered means.

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[1] Kennedy, in his annals of Aberdeen, mentions that the magistrates of that city, in the year 1590, appointed a person to convey their dispatches to and from Edinburgh and other places of royal residence. This functionary bore the style of *council post*, and was arrayed in a garment of blue cloth with the town's armorial bearings in silver upon the sleeve. Vol. i. p. 262.

[2] In the act of Queen Anne there is a special clause, permitting letters to be sent to and from the universities of Oxford and Cambridge, "in manner as heretofore hath been used, anything herein to the contrary notwithstanding." The privilege has since ceased to exist.

The notices we possess of the early history of the British post-office, are but meagre and indistinct. What they amount to may be stated as follows. There was a chief postmaster of England in the reign of Elizabeth, if not earlier, Randolph having that title assigned him by Camden (1581); but his duties, of which that author takes no notice, probably related but partially, if at all, to the conveyance of correspondence.[1] James I. appointed a postmaster to take charge of the conveyance of letters to and from *foreign parts;* and different persons are named as successively enjoying this office during his reign and that of his son Charles. In 1635 Charles established a letter office for England and Scotland, which may properly be regarded as the origin of the British post-office. The persons to whose management it was committed, were directed to establish, within a limited time, a post from London to Edinburgh, one to Westchester and Holyhead, and another to Plymouth and Exeter; and the journey from London to the termination of each of these lines and back, was appointed to be performed in six days. Bye-posts were ordered to be established, and other principal lines opened up as occasion might arise; and conveyance of letters otherwise than by post was now prohibited within the kingdom, as it had formerly been between the kingdom and places abroad.[2]

In the year 1642, a committee of the House of Commons was appointed to report on certain matters connected with the post-office; and the subject continued afterwards, at intervals, to engage the attention of the House. In 1644, Mr. Edmund Prideaux, who afterwards held the office of attorney-general to the commonwealth, and who had been chairman of the committee of 1642, was elected postmaster-general by resolution of both Houses of Parliament; "in the execution of which office," says Blackstone, "he first established a weekly conveyance of letters into all parts of the nation, thereby saving to the public the charge of maintaining postmasters to the amount of L.7000 per annum."[3] This has been interpreted to mean (whether correctly or not) that the charges of the post-office previously to the improvement effected by Prideaux, exceeded its income by the sum mentioned.[4] Be this as it may, there seems to have been, from the period of these improvements, a considerable profit realised from the posts. Whether from a desire to share in this profit, or for other reasons, the Common Council of London, in the year 1649, set about establishing a separate post-office; an attempt, however, which was promptly put down by a resolution of the House of Commons, declaring that "the office of postmaster is and ought to be in the sole power and disposal of Parliament."

It appears likely, that, originally, any surplus revenue which might be obtained from the posts, was allowed to belong to the postmaster, and even that the charges for postage were fixed by him, although subsequently regulated otherwise. Thus, the proclamation of Charles I. in 1632,[5] forbidding the conveyance of letters abroad otherwise than by the post, refers to the act of his father, by which the post to foreign parts was first established; and narrates, that that act gave to the postmasters "power to take moderate salaries," meaning, it might be supposed, to charge such rates as would afford moderate salaries; and a little later, in regard to the case of Wytherings, from whom the office of postmaster had been sequestrated by proclamation in 1640,[6] we find the Commons in 1642 declaring the sequestration a grievance and illegal, and "that Mr. Wytherings ought to be restored into the possession of his place as postmaster for foreign parts, and to the mean profits received since he was out of possession, deducting the reasonable and usual charge of execution."[7] At a later period, commencing probably about the time when Prideaux held the office of postmaster, it was the custom to farm the revenues of the post-office.[8]

The post rates first established were twopence for a single letter for a distance under 80 miles, fourpence from 80 to 140, and sixpence above 140. About the year 1654, they were fixed at twopence for 80 miles, and threepence for a greater distance.

Under the authority of the Protector and his Parliament, some material changes were again made in regard to the management of the post-office in 1657, by which it was brought nearer to the model under which it has more latterly subsisted. An advantage held forth in an ordinance[9] passed on this occasion, as one that was to be derived from the establishment of posts, is worth noticing, namely, that "they will be the best means to discover and prevent many dangerous and wicked designs against the commonwealth." Possibly a hint from Charles, some twenty years before, as to making the post-office afford this sort of convenience, had not been very well taken. It does not appear, however, that either at this or any subsequent time, the secrecy of correspondence passing through the British post-office, was ever violated to serve the purposes of government.[10]

The arrangements made in 1657 were confirmed, and some further improvements effected, at the Restoration.[11] In 1663, the post-office revenues were assigned to the Duke of York and his heirs male,[12] and again settled, after his accession to the throne, on the king and his successors, thus becoming part of the hereditary revenues of the crown. From this time nothing of importance seems to have occurred in the history of the post-office, until the year 1710, when was passed the statute 9 Anne, ch. 10, which may be called the charter of the British post-office.

In the system of posts established by Charles I. in 1635, provision was made for the conveyance of letters between England and Scotland, but the royal ordinance makes no mention of an *internal* post for the latter kingdom. The postage between the two capitals was then eightpence; in the time of Cromwell it was fourpence. After the Restoration, the postage to Berwick was fixed at threepence. In the latter part of this century, however, there was a postmaster-general in Scotland, and posts on some of the principal lines of road. In 1667, a post was established to pass between Edinburgh and Aberdeen twice a-week, and one about the sametime, between Edinburgh and Inverness once a-week.[1] Somewhat earlier, (in 1662) a post was established between Ireland and Scotland, and the privy council gave Robert Main, then postmaster-general, an allowance of L.200 sterling, to build a packet boat for conveying the mails between Portpatrick and Donaghadee. The postage to Ireland was sixpence. But whatever was effected in these respects in Scotland, seems to have been entirely by the authority of the local executive, or the magistrates of the principal towns; the first legislative act appointing an internal post in Scotland, being that of the 20th of the 5th Session of the 1st Parliament of William III., passed at Edinburgh in 1695. The preamble of this act embodies the statement that, "for the maintenance of mutual correspondence, and preventing of many inconveniences that happen by private posts, several public post-offices have been heretofore erected for carrying and receiving letters by posts, to and from most parts and places of this kingdom." This act, as also that of the 12th Charles II., was repealed (unless so far as re-enacted) by the statute of Anne above referred to.

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[1] The name of *posts*, as already observed, had its origin in relation to an arrangement of *travelling stations*, a relation which it continued to preserve; and before the establishment of *letter* offices, the *postmaster* (a use of the term not yet obsolete), was the person who provided the means of conveyance from one station to another. The necessity of regulation and superintendence in regard to an office of this kind, led to the appointment of a *postmaster-general*, to whom such superintendence was committed. For some time after the establishment of letter-offices, the duties of postmaster, in the earlier and later meaning of the term, were conjoined.

[2] *Fœdera*, tom. xix. p. 649.

[3] *Com.* book i. ch. 8.

[4] It is stated that the revenue in 1644 was estimated at L.5000. *Macpherson's Annals of Commerce*, vol. iii. p. 408.

[5] Rymer's *Fœdera*, tom xix. p. 385.

[6] *Fœdera*, tom. xx. p. 429.

[7] *Journals*, 28th March, 1642.

[8] They were farmed in 1654, by a person named Maubey, or Manley, for L.10,000. In a view of the public revenue made up by a Committee of the Commons in 1659, there is an item, "By postage of letters in farm, L.14,000." *Journals*, vol. vii. p. 627.

[9] Scobell's *Acts*, 1656, p. 511.

[10] It is implied by an *exception* in the declaration made by every post-officer at his entrance into office, that a letter may be opened by warrant of a Secretary of State.

[11] 12th Charles II. c. 35.

[12] 15th Charles II. c. 14.

The act of Queen Anne established a general post-office for, and throughout the kingdom of Great Britain and Ireland, and the colonies in North America and the West Indies, with one master of such office, who was to bear the name and style of her Majesty's postmaster-general. The postmaster-general was empowered to keep one chief letter-office in Edinburgh, one in Dublin, one in New York, and others in the West Indies. In the year 1784, however, about which time there prevailed in Ireland a remarkable jealousy of any assumption of superiority on the part of Britain, an act was passed by the Irish parliament, by which, as well as by certain corresponding acts[2] on the part of the British legislature, the Irish post-office was withdrawn from the government of the British postmaster-general, and placed under an independent officer styled "his Majesty's postmaster-general for Ireland;" but the two offices were, agreeably to the recommendation of the commissioners of revenue inquiry, again consolidated by an act passed in 1831;[3] and at the same time the office of deputy postmaster-general of Scotland was abolished. The whole affairs relating to the post-office throughout the kingdom, were thus put under the direct management of the London board; but the secretaries at Edinburgh and Dublin are still the organs of communication with the country offices, and exercise a general administrative superintendence in their respective divisions of the kingdom.

During the period for which an account has now been given of what may be called the *constitutional* history of the post-office, a very great increase has, as may be supposed, taken place, in the speed of conveyance, and the extent of the communications maintained.

For a considerable time after the first establishment of the post-office, there were no relays of post-boys or horses at different stages; one man and horse accomplishing the whole ride, and taking the necessary rests by the way. The post between Edinburgh and Aberdeen stopped one night at Dundee, and another at Montrose. This system continued in Scotland till about the middle of the last century. Until 1763, the communication between London and Edinburgh was only three times a week; but in that year it was made to be five times a week. At first, the mail was 85 hours in travelling from London to Edinburgh, and 131 hours in returning. In 1757, the time was shortened to 82 hours in the one case, and 85 in the other. Latterly, the journey has been performed by the mail coach, in 42 and 45 hours, the 42 being farther reduced, by the use of the curricle from Morpeth, now discontinued, to 40. Mails are at present conveyed partially by railway, from London to Edinburgh in 33 hours, and from Edinburgh to London in 36.

Until the year 1788, there was no direct mail from London to Glasgow. Previously to that period, the course of post had been five days, the letters being sent round by Edinburgh; and as no mails were dispatched from the latter city upon Sunday, there was in consequence one arrival the less at Glasgow each week. Dr. Cleland[4] tells, that, when a direct mail conveyance was first established (a little before the time now spoken of) from London to Carlisle, the mail for Glasgow, that otherwise would have been the one delayed on Sunday at Edinburgh, was transmitted through Carlisle to Glasgow in four days; notwithstanding which the mails of the other days were allowed for a year to be carried round by Edinburgh; and the delay, the means of saving which was thus shewn in regard to one day in the week, acquiesced in for all the other days.

One of the most remarkable steps which the post-office has made in advance, is usually and justly considered to be the adoption of Mr. Palmer's celebrated plan in 1784. The chief part of this plan, as is well known, was, to have the mails conveyed in charge of an armed guard, by the stage-coaches, (which thus became *mail* coaches) instead of by a boy on horseback, or mail cart, as formerly. The credit due to Mr. Palmer, is not perhaps so properly that of having discovered a means to an end, as that of having conceived and aimed at the end itself; for it is not easy to see how the increased speed and regularity, which were in effect obtained, were bound up in his specific proposal, or how (as the advantages of that proposal are sometimes described) the post-office was at once to borrow regularity from the stage-coaches, and the stage-coaches from the post office. Mr. Palmer's merit really consisted in seeing that a greater degree of speed and regularity in post conveyance was possible, which nobody saw but himself; and in catching the hint from the stage-coaches, which nobody else caught. The advantage of employing the stage-coaches instead of conveyances furnished expressly by the post-office, would seem to resolve mainly into the point of economy.

Mr. Palmer was afterwards appointed controller of the post-office, in which capacity he is understood to have made some important improvements in the internal details and arrangements.

The first mails on Mr. Palmer's plan, were the Bath and Bristol, on the 2d August 1784. Previously to the adoption of this plan, the ordinary speed of the post is said to have been but about three miles and-a-half in an hour. After that, the speed was doubled. At present, the average speed of the mail coaches, is eight miles seven furlongs, the highest reaching to ten miles five furlongs. This is exclusive of stops.

The number of miles travelled over in England and Scotland, by the mail coaches in 1833, was 5,911,006; in 1836 it was 6,643,217.[5]

Mails were first conveyed between Liverpool and Manchester, in 1828. Three communications took place daily between these towns, until September 1835; afterwards there were four, and latterly there have been six, from Liverpool to Manchester, and five the contrary way. The important line of railway connecting London with Birmingham, Liverpool, and Manchester, and extending northwards to Preston, having lately been opened, mails are now regularly transmitted by it from the capital to the various towns in the extensive and populous district through which it passes, and onwards to Scotland and Ireland, from its terminating points in each direction. A travelling post office is conveyed along the

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[1] The former was established by the magistrates of Aberdeen, but was transferred to the direction of the Scotch postmaster-general in 1674.—Kennedy's *Annals*, vol. i. p. 262.

[2] 24 Geo. III. c. 6, 8.

[3] 1 Wm. IV. c. 8.

[4] *Statistical Account of Glasgow.*

[5] *App. to First Report of Postage Com.* 1838, No. 23.

History.

line, in which letters are sorted during the passage, the advantage of which will be afterwards explained. The only, or principal, other line of railway by which mails are at present conveyed, is that connecting Carlisle and Newcastle, but this mode of carriage must of course extend itself as new lines are completed. A late act[1] empowers the postmaster-general to require railway proprietors to carry the mails at a rate fixed by arbitration. The effect of the rapid transmission of correspondence by railway, increased as that rapidity yet may be, if there were added such a reduction of postage as has lately been proposed, would almost be that of bringing the inhabitants of the extremes of the kingdom into personal communication. The revolution which may thus be produced on trade, science, government, and social economy, it is hardly possible to calculate.

In the course of the last twelve or fifteen years, the facilities of communication, both inland and foreign, have been materially extended, by reduction of postage duties and otherwise.

Until the year 1827, letters passing between Britain and Ireland had been charged the added amount of the British and Irish land postage, severally taken. From that year, the rate has been calculated the same as if such letters had been conveyed the whole distance in Great Britain. At the same time, the law which required double postage to be charged on one sheet of paper with two letters written on it, or a letter and invoice, &c. was repealed, and a single sheet declared to be in any case but a single letter.[2]

In the year 1835 it was enacted,[3] that after an agreement shall have been made with the post-office of any foreign kingdom or state, it shall be optional with persons sending letters by post to such foreign kingdom, to pay both the British and foreign postage at the time of sending the same, or to send the same without payment of any part of the postage, or to pay the British postage only: persons residing in foreign kingdoms having the same option. Following out the powers given by this statute, a convention was entered into, and signed at Paris, on the 30th March 1836, between his Britannic Majesty and the King of the French, in which the requisite arrangements are made for giving the proposed option as to payment of postage on all correspondence between France, on the one hand, and Great Britain and Ireland, and those British colonies and possessions where the post-office of Great Britain has established post-offices, on the other. The postage between Paris and the British frontier is fixed at one franc, between London and the French frontier at tenpence, and in proportion for other distances in each kingdom. And though under the present arrangements the option of sending letters *without* payment is confined to those for France alone, letters may be sent through France, paid for the full distance, to any post town in Switzerland, Sardinia, Central Germany, or Bavaria; also to the Southern Italian States, as far as Sarzane, the Italian frontier of Sardinia, and to Austria, Bohemia, Venice, &c., as far as the French frontier offices of Huninguen or Forbach.

By the same statute,[4] the postage on letters sent by private ship from the United Kingdom to places beyond seas, (which until then had been *one-half* of the *packet* rates), was fixed at the uniform rate of eightpence, single, on letters posted at the port, and one shilling if posted at any other part of the kingdom. Letters were at the same time permitted to be sent abroad, from any port, by a private vessel, without passing through the post-office, or from one port to another, within the United Kingdom, by private ship, at a sea postage of eightpence.

In 1835, a post communication was opened up between Britain and India, through the Mediterranean, by which the course of post with that part of the world has been very greatly shortened. Letters for India can also be forwarded through France by steam boats sailing three times a month from Marseilles.

Very important facilities and immunities have recently been given in regard to the transmission of *newspapers*.

At first the transmission of newspapers seems to have been a privilege confined to certain officers in the post-office. In 1763 an act was passed,[5] giving the sanction of law to what then seems to have become the current practice, namely, that of allowing newspapers to be sent free by members of Parliament and certain public officers, when signed on the outside by their hand, or *to* such members at any place of which they had given notice in writing to the postmaster-general. By gradual relaxations, the restrictions on the free transmission of newspapers degenerated into a mere form, that of printing or writing a member's name on the cover; and in 1825 an act[6] was passed, rendering even the observance of this form unnecessary. The same act, as subsequently amended,[7] allowed printed newspapers to be sent to the colonies, by the packet boats, at a postage of one penny halfpenny each paper, and colonial newspapers to be brought to Britain and Ireland, by packet or private ship, at a postage of threepence. In 1834[8] the postage on newspapers sent to the colonies by packet, and on colonial newspapers brought by packet, was wholly taken off. At this time, too, a most important enactment was made in regard to the transmission of newspapers to and from foreign states. Hitherto the power of such transmission (unless at an expense amounting to a prohibition) had been enjoyed exclusively by certain officers in the post-office, from whom individuals could only obtain the accommodation at a considerable charge. By the statute now passed, British and Irish newspapers were allowed to be sent to foreign states, and foreign newspapers received into Britain and Ireland at a postage of twopence for each paper. A later statute[9] extends the accommodation still farther, by a clause authorising the postmaster-general to allow newspapers to pass free to and from such foreign states as grant a corresponding allowance in regard to Britain; or even, if he sees fit, without such a reciprocal arrangement on the part of other states; or to impose in any case an equivalent duty. And, by virtue of these provisions, there is now a free transmission of newspapers between Britain and the following states and places abroad: viz. Hamburg, Bremen, Cuxhaven, Denmark, Spain, Greece, Ionian Islands, Hayti, Buenos Ayres, Brazil, Columbia. British newspapers are sent to France without any charge in this country, but pay four centimes there. Newspapers *from* France are charged one halfpenny in Britain.

At this time also newspapers to or from penny post towns, passing through the general post, were freed from penny postage.

To these facilities for the circulation of newspapers is to be added that arising from the important alteration in the stamp laws, by which the duty on newspapers was reduced, from and after the 15th September 1836, from $3\frac{1}{3}$d. (nominally 4d.) to 1d.[10]

Business and establishments.

In proceeding to give a brief account of the post-office business and establishments, it may not be improper to advert to the new and improved accommodation lately provided for the use of this department, in the metropolis. About the year 1815 the premises in Lombard Street being found, after every possible enlargement, to be quite inadequate for the uses they were required to serve, measures were taken for the erection of a more ample, commodious, and elegant structure. It was not, however, until Septem-

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[1] 1 and 2 Vict. c. 98.

[2] 7th and 8th Geo. IV. c. 21.

[3] 5th and 6th Will. IV. c. 25.

[4] 5th and 6th Will. IV. c. 25.

[5] 4th Geo. III. c. 24.

[6] 6th Geo. IV. c. 68.

[7] 7th and 8th Geo. IV. c. 21.

[8] 4th and 5th Will. IV. c. 44.

[9] 6th and 7th Will. IV. c. 54. (1836.)

[10] 6th and 7th Will. IV. c. 76.

Business and establishments.

ber 1829, that this purpose was finally accomplished, and the new building brought into a state of readiness for the public service. It is constructed of Portland stone, after a design by Mr. Smirke, and is in length about 390 feet, width 130, and height 64. The principal front, towards the west, in St. Martin's-le-grand, is composed of three Ionic porticos, that in the centre surmounted with a pediment. The middle space in the interior, lying between the principal and back entrances, is occupied by a hall of eighty by sixty feet in extent, having a range of columns and pilasters on each side. On the right, or south side of this hall, are the secretary's, accountant's, and receiver-general's chambers, together with the foreign letter and twopenny post-offices. The opposite side contains the inland, the newspaper, and the ship-letter offices. The mails, inwards and outwards, pass through a vestibule on the eastern front, communicating with the inland office. The latter is nearly ninety feet in length, and about fifty-six in width; the letter-carriers', or newspaper office, adjoining the inland, 103 by 35. The building contains a variety of other apartments for the different branches of the service, general and particular. To avoid the inconvenience and confusion of communication, through the public hall, between the departments on each side of it, the letters are conveyed from the one to the other through a tunnel below, by means of a curious machinery contrived on purpose.

The office at St. Martin's-le-grand, may be said to consist of two distinct establishments; one is the *general* post-office, properly so called, or that devoted to the post business of the empire in general; the other is just the post-office of *London*. In the first division, under the post-master-general, are the departments of the secretary, accountant, the dead letter, mail coach offices, &c. The principal departments of the second division, are the *inland* and *twopenny post* offices. The former has charge of the dispatch of the London letters and newspapers, and of those from abroad, passing through London, to all parts of the kingdom. It also manages the delivery of all those arriving at, and destined for London.[1] Subject to this department there are seventy receiving-houses within a circle of three miles from the office. Within this circle letters are taken in and delivered without any charge beyond the general post rates. The inland office employs eighty-four clerks, two hundred and ninety-one subsorters and letter-carriers, and about fifty messengers, stampers, &c. The most arduous business of this department, that requiring the greatest energy and rapidity, is the dispatch of the mails, in number twenty-nine, at eight o'clock each evening. So near has the time up to which letters and newspapers are received, been brought to the hour of dispatch, and such is the increase of business, particularly in regard to newspapers, that it almost exceeds the utmost efforts of the persons engaged to accomplish the duties within the limited space. By an account kept on the 19th February 1838, it was found that of 47,795 letters received at the inland office, up to fifteen minutes before eight, only 9,428 had arrived before half-past five, and 9,842 came in after seven. The sum of 6d. charged on each letter taken in during a limited time each day after the receiving box is shut, amounts to above L.1000 a-year. Sometimes 30,000 newspapers are received within the last fifteen minutes allowed for taking them in. The letters are successively stamped, sorted into divisions corresponding with the principal lines of road, taxed, (or marked with postage, after the necessary examination,)[2] and subdivided for post towns. The amount charged on each postmaster is then told, and entered in his bill, and duplicate preserved. From thirty-five to fifty-five persons are employed in sorting, twenty in taxing, and as many in telling up. The newspapers are sorted by the letter-carriers in their own office: from 120 to 300 being thus employed on different days. Six or more are occupied in examining newspapers, to detect private communications, enclosures, &c. From forty to sixty newspapers are charged daily, the postage amounting to L.100 a-week. After all these operations are finished, the bags are to be filled, tied, sealed, and delivered to the guards. The daily average of letters dispatched from London is 36,000. On Mondays the number is from 40,000 to 50,000. The number of newspapers dispatched from London in the last three months of 1835, was 3,146,127; of 1837, 5,020,230; the one period being previous, the other subsequent, to the reduction of the stamp duty. On Saturdays and Mondays, when the numbers are greatest, (sometimes exceeding 100,000,) it is necessary to engage one or two outside seats on the coaches for their conveyance. Sometimes they are sent separately by the stage-coaches. About 3000 are sent by the Edinburgh mail. The weight of the Edinburgh mail, as ascertained by one evening's trial, was as follows: sacks and bags, 1 cwt. 9 lb. 8 oz.; 2296 newspapers, 2 cwt. 2 qrs. 3 lb. 8 oz.; two stamp parcels, 1 qr. 12 lb.; 484 franks, 1 qr. 19 lb. 15 oz.; 1555 chargeable letters, 1 qr. 6 lb. 14 oz.; in all, 4 cwt. 2 qrs. 23 lb. 13 oz. The weight of the Holyhead mail on the 30th June 1838, was: bags, 1 cwt. 10 lbs.; letters, 1 cwt. 2 qrs. 17 lbs.; Newspapers, 15 cwt. 1 qr. 18 lbs.

In the morning, on the arrival of the mails, the bags are counted and inspected, to ascertain that all have arrived, and with the seals secure; after which they are emptied, and turned inside out, and the amount of the postage marked on the paid letters compared with the account sent by the postmaster. The letters then undergo an examination, in order to its being seen that all have been rightly charged, as single, double, &c. Being then stamped, they are distributed into several larger divisions, as those for the twopenny post, for the window-men, and for the different districts of the town; which last divisions are again subdivided for the walks of individual letter-carriers. Each of the different persons to be engaged in the delivery is then required to tell the amount of postage on that portion of the letters committed to him; and on his reporting an amount corresponding with that brought out by a separate telling previously made, but not communicated, the charge becomes established, and is signed by the party. In case of difference, reference is made to a third person. Each man's letters being then arranged, the delivery commences. The letter-carriers having the more distant walks, are conveyed to the ground by omnibuses, (of which ten are employed for this purpose,) each man being dropped at the commencement of his walk. In the morning duties, there are fifteen persons employed in opening the bags, and checking the accounts; nine in examining letters; fifty sorters; and ten tellers. The number of letters arriving in London daily, is from 30,000 to 40,000.

There is a separate department for dispatch and receipt of foreign mails, and another for the same duties in regard to ship-letter mails. Masters of vessels are allowed 2d. for each letter brought from, or carried abroad.

The number of letters from France in the year 1837, was from 30,000 to 36,000, and about half as many more in transit, through France. Letters expedited to France, from 33,000 to 39,000; in transit through France, from 11,000 to 15,000. Newspapers sent to the continent of Europe, about 30,000 per month; received, about 20,000.

The London penny, or twopenny post, was first set on foot by a person named Murray, an upholsterer, about the year 1683, and by him assigned to one Dockwra. A suit, however, was commenced against the latter by Government, and the management of this post withdrawn from him. But he received an indemnification, and was afterwards appointed controller of the office. The present limits of the twopenny and threepenny posts were fixed in 1831.

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[1] Foreign mails arriving after the general post delivery, are delivered by the twopenny post letter-carriers.

[2] Stamping is performed at the rate of from 100 to 200 letters in a minute; examining and taxing, 33; and sorting, 30.

A *penny* or *twopenny* post-office delivers and collects the correspondence of a particular *portion* of the district belonging to any principal office. In the former respect, (however the duties may be farther subdivided,) it just performs the part of one letter-carrier, with merely the difference of the additional charge on the letters. All letters arriving by the general post at London, for parties residing beyond a circle of three, and within a circle of twelve miles, are transferred to the twopenny post department for delivery; and letters posted for dispatch within the same space, are collected by this department, and transferred to the general post. Such letters are charged 2d. in addition to the general post rates. So far the London twopenny post performs exactly the same functions as any of the penny posts in other parts of the kingdom. It differs from them in so far as it collects and delivers *all* the *local* correspondence, not merely in its own *portion* of the district annexed to the principal office, but in the whole of that district: having its own receiving houses, and its own letter-carriers, within, as well as beyond, the circle of general post delivery. Letters both posted and delivered within the three-mile circle, are charged with a postage of twopence; those crossing beyond it into the space within the wider circle, or *vice versa;* also those both posted and delivered between the inner and outer circles, threepence. The twopenny post subdivides its duties within the three-mile circle, among four branch offices, besides the chief office of the department. The correspondence to and from these, as well as to and from the district beyond the three-mile circle, is conveyed by horse posts, or mail carts. The rides to the country are ten in number, some dividing into two branches, besides four cross rides. There are 209 twopenny post receiving houses[1] within the three-mile circle, and 194 in the country, and 640 letter-carriers and assistants, of whom 270 are employed within the smaller circle. Seven collections and deliveries take place daily within the three-mile circle, and from two to six between it and the outer one. The whole of the twopenny and threepenny post letters, wheresoever collected, are carried to the chief office, and reissued from thence, with exception only of those passing between receiving houses lying in the line of one ride.

The whole number of persons employed on the London general and twopenny post establishment in 1835, was 1338. This includes the country surveyors, 7, and mail guards, 228. In the same year there were 258 persons on the Dublin, and 97 on the Edinburgh establishment.[2] But there has been some increase since.

The number of post-offices is constantly varying. At present they may be stated about as follows: England 649; Scotland 211; Ireland 328: Sub-offices[3] in the three kingdoms, respectively 191—105—102: Penny posts 1085—225—197. *Convention* or *fifth clause* posts in England 50. There are 42 offices in the interior of Jamaica, and 337 in British North America.

There are in England, Scotland, and Ireland, 194 mail coaches and other carriages; 217 saddle-horse posts; 374 mail carts, and 806 foot posts.

The following are the numbers of letters and newspapers posted at all the offices throughout the United Kingdom, in the week commencing 15th January 1838:

General post letters, paid,		164,719
... unpaid,		776,543
Penny post, ... paid,		16,998
... unpaid,		123,773
Privileged,		122,901
Total,		1,204,935
Of which		
For England,	916,815	
... Scotland,	128,584	
... Ireland,	159,536	
		1,204,935
Total newspapers,		842,646

London twopenny post, (not included above,) total letters, 231,900; newspapers, 10,724.

In the week commencing 29th January, the total number was (including the London twopenny post) 1,550,620,—the postage amounting to L.45,509: Newspapers 858,927. In the week commencing 5th March, the proportion of the classes of general post letters was, (in the united kingdom), single, 699,182; double, 38,562; treble, 11,358; ounce, 1,908; above an ounce, 2447.

The number of charged newspapers returned to the dead-letter office in London in 1837, was above 19,000. The number of undelivered letters, opened and returned to the writers, are about 20,000 in a month.

The total number of ship-letters (*i. e.* letters by *private* ship, not post-office packets,) both sent and received through all the posts in the kingdom was,

For the year ending 5th January 1834,	1,044,000
... 1838,	1,547,000

The two principal ship-letter ports are Liverpool and Hull; the former being the great channel (by the weekly packets) to America; the latter (by the steam-boats to Hamburgh twice a-week,) to Germany and the north of Europe. The number of letters sent by these, was,

	Liverpool.	Hull.
For the year ending 5th January 1834,	15,318	15,797
... 1838,	63,116	47,457

The regular mail packets for the conveyance of foreign and colonial correspondence are as follows:—

To France, every day except Sunday, by Dover and Calais, (steam). To Belgium, by Dover and Ostend, four times a-week, (steam). To Hamburgh from London, twice a-week, and to Holland by London and Rotterdam, twice a-week. (These two mails are conveyed by contract in private steam-vessels.)

From Falmouth, to Lisbon, Cadiz, and Gibraltar, once a-week, (steam). From Gibraltar to Malta, Greece, and Ionian Islands, once a-fortnight, and from Malta to Egypt and India, every four weeks, (steam).

To Jamaica, St. Domingo, and Leeward Islands, once a-fortnight, carrying letters to La Guayra one fortnight, to Carthagena the other. To Mexico and Cuba, monthly.

To Halifax, North America, monthly. To Madeira, Brazil, and Buenos Ayres, monthly.

The mails are conveyed between the West India islands by steam-boats, on contract.

On the Falmouth station, there are thirty vessels employed in the packet service, six at the Dover station, and eight steam vessels from the Thames.

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[1] A consolidation of the general and twopenny post receiving-houses, within the three-mile circle, is understood to be now resolved upon.

[2] *Parliamentary Paper*, No. 442. About ninety years before this period, (the Earl of Leicester and Sir John Eyles being postmasters-general) the London *general* post establishment consisted of 157 persons. About the same time the Edinburgh establishment (Sir John Inglis being deputy postmaster-general) consisted of eleven persons, including three letter-carriers, and an officer designated "apprehender of private letter-carriers." *(Present State of Great Britain*, by Mr. Bolton, 1745.)

[3] Sub-offices differ from penny posts merely in having their letters charged according to *distance only*, as in principal offices. *Fifth clause* posts, (so called from the clause of the act 41st Geo. III., under which they are established,) are posts to villages, the inhabitants of which become bound for any deficiency in the expense of maintaining them.

Business and establishments.

For communication between Britain and Ireland, there are packets from Liverpool and Holyhead to Kingston, from Milford to Waterford, and from Port-Patrick to Donaghadee. There are also packets from Weymouth to Guernsey and Jersey, Liverpool to Isle of Man, Aberdeen to Shetland, &c.

Until about fifteen years ago, the post-office had the whole charge of procuring, fitting out, and maintaining the different mail packets. About that time the Falmouth packets were transferred to the Admiralty. A further transfer of most or all of the others was recommended by different commissions appointed to inquire into the management of the post-office, and carried into effect last year, (1837). The grounds of this recommendation were, that the duties required for the efficient and economical management of the packets, were such as the peculiar habits and qualifications of the heads of a civil department did not adequately fit them to perform. A great saving has accordingly been effected by the change of management. The packet communication with France is regulated by treaty made in 1833; and that with Belgium by a similar treaty made the following year.[1] France maintains her own packets for carriage of the French mails to Dover; but receives from L.10,000 to L.12,000 annually from Britain for transit postage of letters carried through her dominions to Italy, Turkey, Switzerland, Spain, &c., according to a scale fixed by the treaties of 1802 and 1836. Out of this, however, she has to pay to Austria the transit duty of letters passing through that country. Hamburgh and Holland pay nothing for having their correspondence conveyed by British packets, but charge no transit. Belgium also charges no transit against Britain, and moreover pays L.1000 yearly for packet conveyance, there being four weekly mails to that country, and only two to Hamburgh and Holland. From L.200 to L.300 a-year is paid by Rio Janeiro.

The mode in which letters are circulated, and the post revenues collected, is as follows:—Each of the three capitals, London, Edinburgh, and Dublin, sends a bag direct to, and receives one direct from, every office in its respective division of the kingdom. Every postmaster sends a bag to every office on the different lines of road leading from his own, as far as the first office (inclusive), at which the mail conveyance makes a stop. Into the bag for the most distant office, are put all the letters (tied up together indiscriminately) that are for places beyond it; and which, accordingly, are here sorted into the bags for each place, as far as that, inclusive, where the next stop takes place, and where the same process is repeated. Letters thus sent to another office to be sorted and forwarded are called *forward* letters. Such as are to go off at a cross line, are sent, as forward, to the office from which the cross line diverges. This is the general principle of the circulation. The moving post-office on the railway answers all the purpose that a sorting office interposed between every two stations on the line would do, at the same time saving the necessity of stoppage. Every office conveys its letters, as *forward*, into the moving one as it passes. In it, the mails for the station next occurring are immediately made up, ready against arrival there: the letters going to stations beyond being separated, so to speak, as forward on the *position* of the moving office, after passing that station. Letters are *taxed* (or marked with postage) as well as stamped, at the office where they are put in; and with every bag is sent a bill containing simply two *items*, namely, the amount of postage for letters in the bag, chargeable on the *sending* postmaster for *paid*, and on the *receiving*, for unpaid. The bill consequently does *not* include the *paid* postage on letters from offices *behind* the sending postmaster's, nor on *unpaid* letters going *beyond* the receiving postmaster's: the former having been already charged, the latter afterwards to be charged on other offices. Thus the postage on every letter whatever, paid or unpaid, is brought to the charge of one office or another. Both the items of every bill are entered in an account at each of the two offices to which its contents relate; the one account checking the other, and the bill remaining to settle differences if any; and when the accounts are summed, the charge against each postmaster is just his *sent paid*, and *received unpaid*. This charge he liquidates either by actual remittances, by allowances to his credit for his own salary and other payments, and by his dead-letter account. The last is vouched, first, by dead-letters actually returned; secondly, by receipts for overcharges; and thirdly, by claims for letters *re-sent* to other offices; which claims, as noted on a form prepared for that purpose and transmitted along with the re-sent letter, are certified by the receiving postmaster; and being forwarded to the inspector of dead-letters, serve to check the claimant's account.

Rates.

The country postmasters' remittances are made to the secretary, who transfers them over to the receiver-general, after furnishing a note of the amount to the accountant, who from thence credits the postmaster, and debits the receiver-general. The revenue collected at the general post-office is paid direct into the hands of the receiver-general by the persons actually collecting, who are merely the window clerks and the letter-carriers; the charge against each, certified by the parties as admitted, being furnished at once to the receiver-general and the accountant by the superintending officer. No account of the *paid* letters is sent from the general to the country offices; the check being there maintained between one department and another. Postmasters advancing the charge on a letter observed to be under-taxed, are required to put their initials to the alteration, which, if the letter is for their own delivery, is in effect sending out a receipt for the additional charge.

The deputy postmasters-general in the colonies are charged with the amount of letters sent them by each mail, in the same way as the country postmasters within the kingdom; the method of check and account between the internal colonial offices being also the same as between the different country offices at home.

Rates.

The present rates of inland postage in the United Kingdom are as follows:—

	Britain.	Ireland, (for same distance in *Irish* miles.)		
	d.	*d.*	*d.*	*d.*
For any distance not exceeding 8 miles,	2	0	2 and	3
Above 8, not exceeding 15 ...	4	0	0 ...	3
... 15, ... 20 ...	5	0	0 ...	4
... 20, ... 30 ...	6	0	4 and	5
... 30, ... 50 ...	7	5	6 and	7
... 50, ... 80 ...	8	7	8 and	9
... 80, ... 120 ...	9	0	9 and	10
... 120, ... 170 ...	10	0	11 and	12
... 170, ... 230 ...	11	0	12 and	13
... 230, ... 300 ...	12	0	13 and	14

And for every 100 miles above 300, (or fractional part of that distance,) one penny additional.

If the *amount* of all the rates in this scale is taken, and divided by the *number* of rates, it will yield an average of 9d. A similar process applied to the scale of 1710, gives 3½d. for the average. The increase in the intermediate period has been almost gradual, though the intervals between the alterations have been very different. There was no alteration from 1710 to 1765. Since that time, either in the British or Irish, there have been ten alterations. In 1800 the average was 5½d.; in 1810, 7½d.

The sea rates from Port-Patrick, Holyhead, or Milford

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[1] *Sixth Report of Commissioners of Post-Office Inquiry.*

Haven, and Liverpool, to Ireland, are respectively 4d., 2d., and 8d.; from Weymouth to Guernsey and Jersey, 3d.; and from Liverpool to the Isle of Man, 6d.

The packet postage from *London* to France is 10d.; to Switzerland, 1s. 2d.; Holland and Belgium, and Germany, *via* France, 1s. 4d.; Germany and north of Europe, (by Hamburgh,) 1s. 8d.; Spain, Italy, and Turkey, *via* France, 1s. 7d.; Spain, *via* Cadiz, 2s. 2d.: to which is to be added the inland rate to London, *less 2d.*, from any office in the country, where a letter may be posted. From *Falmouth* to Portugal is 1s. 7d.; Madeira, Azores, and Canaries, 1s. 8d.; Brazils, 2s. 7d.; West Indies and North America, 1s. 3d.; and inland postage to Falmouth, *less 1d.*; to Buenos Ayres, Chili, Peru, 2s. 5d.; St. Domingo, 1s. 3d.; Carthagena, La Guayra, Mexico, Honduras, Cuba, 2s. 1d.; and the full inland postage to Falmouth. To Gibraltar, Malta, Ionian Islands, Greece, Egypt, and India, (by steam from Falmouth,) a uniform rate of 2s. 6d. from all parts of the kingdom. To Cape of Good Hope, East Indies, New South Wales, and Van Diemen's Land, 2d. more than the inland postage.

Letters *from* India, Van Diemen's Land, Cape of Good Hope, &c., 4d. *a letter* above the inland postage; from other parts of the world by private ship, 8d. a *single* letter, and in proportion for double, &c. The charge on ship-letters *outwards*, has been already noticed.

All letters to places abroad must be paid at posting, except packet letters for the British colonies in America and the West Indies, or for France. Failing of this, the letters are opened at the dead-letter office, and returned to the writers.

Letters to and from soldiers and seamen in the service, pass through the whole British dominions for a postage of one penny, payable in advance.[1]

Letters under an ounce weight are charged single, double, or triple, according to the number of pieces of which they consist; triple being the highest rate below that weight. An ounce is charged four single postages, and every additional quarter of an ounce, a single postage more.

Exemptions.

Certain public officers, nearly a hundred in number, have the privilege of franking without any limitation either as to weight or number of letters. Every member of parliament can send ten and receive fifteen letters a-day, free; each letter not exceeding one ounce in weight, and being to and from a place within the United Kingdom. On occasion of passing the bill for the regulation of the post-office in 1657, "a proviso was tendered for freeing members of parliament and other officers of state from payment of any money for letters, which was laid aside without a question."[2] Freedom from postage, however, was claimed by the House of Commons in 1660, but the claim was afterwards dropped on an assurance from the crown that the privilege would be allowed. Accordingly, a warrant was always issued to the postmaster-general directing the allowance to the extent of two ounces in weight.[3] The privilege, however, was abused to an enormous extent, so much so that the servants of members sometimes procured a number of franks for the purpose of selling them. Occasionally, too, considerable frauds were practised by writing promissory notes or other instruments over the signature of a member given on a blank cover. Many curious devices were used by members in writing their signature to prevent this.[4] The estimated postage of franked letters in 1715 was L.23,600; in 1763 it had risen to L.170,700. Until that period, a letter passed free simply by the signature of a member. Even the requirement made by the act passed in 1763,[5] that the whole superscription should be in the member's hand-writing, was found an insufficient check to the abuse; and it was further required by the statute of 1784,[6] that the direction should bear the name of the post-town, and the day, (written in words at length) month, and year of posting. Letters can be franked from any post-town which the member has been within twenty miles of, on the day of, or day before date. They cannot be delivered but for full postage at a place where the member himself is not, (as to any agent or relation,) unless at his residence in London, or his proper house of parliament. Printed votes and proceedings in parliament pass free under certain regulations to and from members of parliament and some public officers. Petitions to parliament, not exceeding six ounces in weight, may be sent free to any member in covers open at the ends.

Revenue.

In 1653, the post-office revenue was farmed for L.10,000; in 1663 it yielded L.21,500; in 1685, when made over to James II. as part of his private income, it was estimated at L.65,000. The average of the nett revenue, during the eight years of King William's wars, is stated[7] at L.67,222; during four years of subsequent peace, at L.82,319; the average of the years 1707—10, at L.58,052; of 1711—14, at L.90,223. The gross in 1711,[8] was L.111,426. In 1722 the gross was L.201,804, nett L.98,010. From that period till after the middle of the century, the revenue, though of course, subject to occasional fluctuations, made on the whole but little advance, since we find that of the year 1754 to be only, gross, L.210,663, nett, L.97,365. Its progress for the remainder of the century, taken at intervals of ten years, (each ending 5th April), may be seen as follows:[9]

	Gross.	Nett.	Rate per cent. of Collection.
1764,	L.242,566	116,128	52
1774,	334,829	164,077	51
1784,	452,404	196,514	56
1794,	915,608	431,981	40
1800,	1,083,950	720,981	30

From the beginning of the present century the revenue continued increasing progressively until the year ending the 5th January 1816; the following year it was considerably lower, and never rose to such an amount again, until the corresponding year 1837, when it reached its highest. The following table exhibits the particulars; (the Marlborough grants, &c. are not included in the charges of collection.)

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[1] There are other descriptions of special, and modifications of general rates, which would require too much space to particularize. The system of rates is full of the most preposterous niceties and anomalies. It is but fair to state, however, that some attempts have lately been made to introduce greater uniformity, as in the ship-letter and Mediterranean rates.

[2] *Journals*, 9th June.

[3] Blackstone.

[4] See *Gentleman's Magazine*, 1784, vol. liv.; also vol. xxvii. p. 593.

[5] 4 Geo. III. c. 24.

[6] 24 Geo. III. c. 37.

[7] Chambers's *Historical View of the Domestic Economy of Britain*. The *gross*, on a medium of three years prior to 1698, is stated by D'Avenant at L.90,440.

[8] The revenue, as stated for the years previous to 1711, are believed to include the *Irish*. From that year to the end of the century, the account given relates to the *British* revenue solely; the Irish, for this period, not being stated in any of the documents from which the account is taken. In comparing different accounts of the post-office revenue, even including those found in parliamentary documents, the most puzzling discrepancies are to be met with. These, however, are not so much, if at all, to be ascribed to error, as to differences, not expressed in the subjects of the statements. Sometimes the Irish, or twopenny post revenue is included, sometimes not; the revenue for a year, ending 5th April or 5th January, is sometimes given as the revenue for that, sometimes for the preceding year; the *nett* sometimes means the remainder after deducting from the gross the simple charges of management, sometimes after farther deduction of returns, parliamentary grants, &c.

[9] *Second Report of Postage Com. Ap.* p. 176. The nett is after deduction of returns. In 1782, the expense of collection was 72 per cent.

General and Twopenny Post of United Kingdom.[1]

	Year ended	Gross.	Charges of collection.	Returns.	Nett.	Rate per cent. of collection.		
		£	£	£	£	£	s.	D.
	5th Jan. 1804	1,429,429	416,767	56,450	956,212	29	3	$1\frac{1}{2}$
	„ 1816	2,418,741	704,639	94,906	1,619,196	29	2	$7\frac{3}{4}$
	„ 1837	2,461,806	704,768	111,203	1,645,835	28	12	$6\frac{3}{4}$
Greatest *in the interval from* 1816-37..........	„ 1827	2,392,271	706,640	95,869	1,589,762	29	10	$9\frac{1}{4}$
Smallest..........................	„ 1822	2,122,965	645,241	84,259	1,393,465	30	7	$10\frac{1}{2}$
Greatest (absolute) amount of *charges of collection* from 1816-37..	„ 1827	stated	above.					
Smallest ditto................	„ 1820	2,191,562	586,193	82,729	1,522,640	26	14	$11\frac{1}{2}$
Greatest *returns*............	„ 1835	2,319,979	696,387	110,540	1,513,052	30	0	4
Smallest ditto................	„ 1823	2,128,926	620,977	79,597	1,428,352	29	3	$4\frac{1}{2}$
Greatest *nett*................	„ 1826	2,367,567	636,353	98,947	1,632,267	26	17	$6\frac{1}{2}$
Smallest ditto................	„ 1822	stated	above.					

The *gross Irish general* post revenue for the *year ending 5th January* 1800, was L.84,040; it increased progressing until 1816 when it reached L.225,000; it never attained so high again until 1829, from which it continued increasing till 1832, when it reached its highest, viz. L.256,976. In 1837 it was L.255,070. The lowest amount after 1816 was that of 1823, which was L.186,024. The highest *nett* in the whole period was in 1832, viz. L.154,322; the smallest after 1816, was 1821, viz. L.65,017. The highest rate per cent. of collection, January 1800, L.70, 9s. 2d., lowest, 1832, L.32, 11s. 9d.

The gross receipts of the London twopenny post in the year ending January 5, 1804, was L.60,069; 1837, L.120,801; *nett* for the same years, L.35,640 and L.73,334; rate per cent. of collection for the same years, L.40, 13s. $3\frac{3}{4}$d. and L.39, 5s. $10\frac{1}{4}$d.

It is related[2] that in the year 1698, Sir Robert Sinclair of Stevenson had a grant from King William of the whole revenue of the post-office of Scotland, together with a pension of L.300 to maintain the post. Even with this allowance, however, the undertaking was considered hazardous and the grant surrendered. At the union, the post-office revenue was farmed for L.1194. The nett revenue, on an average for three years preceding 1711, was estimated at only L.2000; in 1733 it was L.5399; in 1754, L.8927; in 1776, L.31,103. In the year ending 5th January 1801, the revenue was, gross, L.100,652, nett, L.83,755. It increased progressively till the corresponding year 1815, when the gross was L.203,366, nett, L.161,551. In 1822 the gross had sunk to L.179,404, whence again it took a start in the other direction, and in 1837 was L.220,759, nett, L.160,813. The expense of collection in the present century has varied from 14 to 28 per cent.[3]

The amount of postage charged on postmasters in the West Indies and British North America in the year ended 5th January 1838, was L.78,905, of which above L.18,000 was for unpaid letters from Britain. Of the first sum, there was for Canada, L.38,977, for Jamaica, L.18,274.

Laws.

The postmaster-general is not responsible, under any circumstances, for the safety of letters passing through the post-office, nor for the value they may inclose, if lost or stolen. This point was first settled in the case, Lane *v.* the Postmaster-General, in 1699, (reported in Raymond, vol. i. p. 646). Some doubts hanging over the principle of this decision, the point was again tried, before Lord Mansfield, in 1778, (Whitfield *v.* the Postmaster-General, Cowper's Reports, p. 754,) and judgment given for the defenders. The punishment of death for letter stealing was abolished in 1835,[4] and transportation substituted. Forging, or altering a frank is punishable with seven years' transportation. A newspaper with an enclosure, or any writing or marks, is subject to three times the postage of a packet of equal contents: which postage may be recovered from the sender,[5] or the postmaster-general may prosecute as for a misdemeanour. Masters, crews, or passengers of vessels from abroad, failing to deliver their letters at the first post-office, incur heavy fines. Penalties and postage debts not above L.20, are summarily recoverable. Letters once posted become the property of the person addressed, and cannot be again withdrawn. Other laws (those against illicit conveyance being frequently made public) are of less general concernment.

In the year ending October 1834, there were fifteen criminal prosecutions in England for post-office offences, and twelve convictions, some of them capital; and thirty-four prosecutions for penalties, in which the parties submitted.

The whole acts relating to the post-office have been consolidated into five statutes, viz. 1 Victoria, ch. 32—36.

Alleged defects, &c.

The British post-office has generally been allowed to be remarkable for the precision and regularity with which it circulates the correspondence passing through it, and the celerity with which the official business is conducted; and the prevalent opinion has until lately been, that the department, on the whole, has been skilfully and efficiently administered. Instances, however, both of defects and mismanagement, have, within these few years, been somewhat frequently brought forward, and perhaps with a degree of exaggeration answerable to the indifference with which they had in former periods been regarded. As respects, in the first place, the *constitution* of the department, the inexpediency has been maintained of having the supreme direction vested in a single person, generally a nobleman, removeable at every change of government, and who, by his education and habits, cannot be supposed peculiarly fitted to superintend an establishment, possessing fully more of a commercial than of a civil, or even fiscal character. The tendency, and even the actual effect of such a system has been alleged

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[1] *Appendix to First Report of Postage Committee*, 1838.

[2] *Old Statistical Account of Scotland*, vol. vi. p. 586.

[3] *Second Report of Postage Committee*, 1838.

[4] 5 and 6 William IV. c. 81.

[5] The postage of all returned letters is recoverable from the *sender*, (1 Vict. c. 34, § 2,) but the law has not hitherto been enforced.

Alleged defects, &c.

to be, that of removing the charge from the really responsible head, and throwing it upon a secondary officer. The abolition of the office of postmaster-general, and the substitution of a permanent board of three or more persons, has accordingly been recommended by successive commissions of inquiry; and a bill for giving effect to such recommendation has been twice sent up from the lower, to the upper house of parliament, but refused a second reading by the latter. As regards the *laws* of the post-office, the grand subject of complaint, and that on which perhaps the mind of the community is more made up than on any other, is the high rate of postage, both generally, and in particular cases, as for shorter distances, circuitous routes,[1] penny postage on general post letters, and the like. That there is a great fault in this respect, is argued from the fact of there being little or no increase on the annual revenue, for more than twenty years; and though this fact, to a certain extent, at least, admits of other explanations, it is undeniable that a large amount of correspondence is conveyed otherwise than by post, merely to avoid the expense of postage; and that the existing laws are insufficient, as would any laws be that could possibly be framed, to check such practice. The complaints against the *administration* of the post-office relate principally to the alleged want of sufficiently frequent and numerous communications on various lines of road, and the consequent delay of correspondence, of which the most important case is the want of day mails and Sunday mails[2] from London, there being at present but one day mail, and that but lately established. Without entering into a consideration of the justice of any of the complaints now enumerated, (the fact of their existence being all that it concerns the present purpose to notice), it may be remarked with regard to the *nature* of the particular class just adverted to, that they frequently resolve into questions between the interests of one portion of the community and those of another; or into similar questions between a portion and the whole; or between an advantage with a corresponding sacrifice, and the loss of such advantage; questions to which the administrators of the post-office, at least, profess and appear to have given full consideration, and, either in regard to what is done or what is contemplated, to have determined with a view to the best.

One cause of complaint of not unfrequent occurrence, namely, that regarding the losses that occur in the post-office, by the abstraction of letters containing value, may be said to have been of late in a great measure obviated by the establishment of a system of *money orders*, to be granted by one office, payable at another, to the amount of L.5, at an expense of from 6d. to 1s. 6d. Larger sums can, in general, be safely transmitted through banks.

Within these few years, a plan of singular boldness and ingenuity, and developed with the utmost perspicuity and fairness of intention, has been put forth by Mr. Rowland Hill; a plan which aims at the removal of several of the defects of the present post system, but the practicability of which is matter of much doubt and dispute. The main feature of this plan, as every body knows, consists in a proposal to reduce the postage of all letters under half an ounce weight, to a penny, to be collected by a stamp-duty on the paper of the letter or envelope. The great benefits of such a system as this are obvious, the objections are not less so. These (omitting minor articles) resolve chiefly into this dilemma; either the number of letters would not be sufficiently great to produce the required *gross* amount, or, if it were, they would be unmanageable without an additional expense that would as much diminish the *nett.* On Mr. Hill's part, the necessity of the alternative is denied. As respects the first branch of it, he calculates on as many letters as would be sufficient at once to keep up the revenue, and defray any additional expense, first, from the falling in of all the illicit and most of the franked correspondence; next, from the great number of letters that would be sent by persons who now cannot often, or at all, afford postage, and are restrained by fear or conscience from smuggling; and lastly from the variety of printed bills, lists, advertisements, &c., which may be legally sent otherwise than by post, but for which the post would be preferred at a low expense. On the other branch of the alternative he maintains, that, as regards the matters of receipt, despatch, and delivery, the post-office, by being freed from examining, taxing, and the *whole business of accounts*, would be relieved from a great part of the additional labour that would be imposed upon it by the increased number of letters; and, as to conveyance, that the estimated increase of chargeable letters, would add but by a very small proportion to the *weight* or *bulk* of the mails; the far greater part of which is made up of newspapers, parliamentary documents, and franks.[3]

French post-office.

The French post-office, after the modern system, had its

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[1] Since this was written, it has been announced that postage is in future to be charged only for the distance by the nearest carriage road without regard to the actual distance the letter may be conveyed.

[2] It is, perhaps, superfluous to observe, that the subject of Sunday mails and deliveries, involves considerations of a nature quite distinct from those on which questions, relating to post accommodation usually fall to be determined.

[3] That a system promising so great a reduction in the expense of correspondence, would meet with extensive favour and support, is what might be expected; and, consequently, in estimating the weight of the testimony in its behalf, which such support is calculated to yield, it is necessary to distinguish between a desire for its adoption, and a conviction of its practicability; so that we may not ascribe to the latter, what may be wholly due to the former. It is to be remembered, too, that what is called the *practicability* of the scheme, is a very vague expression. In the strictest sense, it must mean practicability, consistently with the maintenance of the present revenue from the post-office, or a revenue not materially smaller; in another sense, the practicability of the plan may mean that its adoption would occasion no deficiency, but what could, and ought to be, otherwise provided for. The supporters of the plan differ in the *sort* of practicability which they ascribe to it; but a conviction of its practicability generally, has been expressed by so many individuals and bodies of men, qualified by their knowledge and habits to judge of such a matter, and so little likely to think with indifference of an embarrassment of the public finances, that a strong presumption of the intrinsic merits of Mr. Hill's plan is unavoidable. The subject has been taken up in most of the principal cities of the empire, by constituted bodies, or associations formed for the specific purpose. Regular inquiries have been instituted by the circulation of minute queries, and otherwise, with the view of ascertaining how far the present system is sufficient as a means of accommodation; how far, as a source of revenue, the duties it imposes are liable to be evaded; and what increase of correspondence by post, or decrease of illicit conveyance, might be expected to take place, under such a reduction of postage as Mr. Hill proposes. Numerous petitions from the most influential and respectable quarters have been presented to parliament, in behalf of Mr. Hill's plan. A Committee of the House of Commons, appointed on the 23d of November 1837, to consider, generally, the subject of a reduction of postage, and especially the merits of Mr. Hill's proposal, has, in the course of two sessions, during which it has been sitting, examined a great number of witnesses, officers of the post-office, merchants, literary men, agents of trading companies, and philanthropic associations, clergymen, and others; all descriptions of persons, in short, the most likely to be able to shew the working of the present system, and to estimate the probable effects of the new. The Committee has, at the same time, collected a vast body of statistical evidence relating to the post establishment, in regard to every particular bearing on the subject of the investigation. The results of the inquiry have been communicated in two voluminous reports.

That the present high rates of postage have operated, in one way, to the repression of correspondence altogether, and in another, to the diversion, into illegal channels, of a vast portion of its existing amount,—a portion much more vast than had ever previously been suspected; that in the latter way, they beget a disregard to the law, and produce that deterioration of the moral feelings, which actions requiring concealment, tend to generate; that, in both ways, they embarrass the motions of trade, check the dissemination of knowledge, curb the

French post-office.

origin early in the 17th century. As in Britain, its revenues at first accrued to the postmaster, and were next for a time farmed. In 1791, the French post-office yielded a revenue of 11,000,000 of francs; about thirty years later, the revenue had become nearly double, and in 1836 it amounted to 37,405,516 francs; the number of letters for that year being 78,970,561. The French post establishment is under the direction of a council, consisting of a chief, and two or more members. The French differs from the British office, in charging postage by *weight*, a mode usual throughout the continent. The French office has been remarkable for the facilities it affords to the circulation of printed matter. All sorts of circulars, lists, advertisements, and the like, may first be stamped on payment of five centimes, and then transmitted by post for ten centimes more, in whole about 1½d. British money. The number of such circulars passing through the French post-office is immense. The business of the Parisian office even exceeds that of the London, there being from forty to fifty thousand letters, and 100,000 printed papers of different descriptions, dispatched from the former daily, Sundays not excepted. The French post towns amount in number to about 1460, but the post accommodation is carried to the utmost possible extent, letters being delivered not merely within the towns and villages, but throughout the country generally.[1] The same degree of dispatch in post business has not, however, been attained in France.

United States post-office.

The post-office of the United States is under the charge of the general government. For a long period it was a source of expense, and it is only during the last six or seven years that it has yielded a revenue, which, however, is now rapidly increasing. The following particulars regarding its present state, are from a report of the Postmaster-General of the United States to the President. On the first of July 1837, the post routes were about 141,242 miles in extent, and the annual transportation of the mails upon them was: on horses and in sulkeys 11,999,282 miles; in stages and coaches 18,804,800; and in steam-boats and

[1] The average of each letter is about fivepence. In Britain, it is probably double this, at least. The charges of collection in France are about 50 per cent., in Britain 28 per cent.

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exercise of the social affections, and confine the efforts of philanthropy; that the post-office, in short, is neither fully and effectually available for the purposes which it is the essential object of such an institution to serve, nor able to preserve the monopoly conferred upon it by law, from systematic and extensive violation; these are points which may fairly be considered as settled by the evidence given before the Committee.

The questions involved in the investigation, as far as it relates to the practicability of Mr. Hill's plan, have been partly of fact, partly of calculation, partly of conjecture and estimate. It being incumbent on Mr. Hill's part to make it appear that the increase of the number of letters would counterbalance the decrease on the postage of each, it became necessary to ascertain what is the actual number by which the present annual revenue is created, and annual expense incurred. This is a question of fact; how many letters at any definite reduced rate would produce the same gross revenue, is one of mere calculation; what increased number of letters might be consequent on such reduction, is one of conjecture. Even the first two descriptions of questions, however, have not been so easily determined as their nature would seem to promise. Actual returns beyond the suspicion of incompleteness or incorrectness are, under the circumstances of haste and perplexity, in which such returns can only be made, and the incapacity of some of those who have to make them, hardly to be expected; whilst, from the fluctuations in the amount of correspondence at different periods, a fair season for presenting an average is not easily fixed upon.* Even, however, after an agreement, actual or assumed, has been attained on this point, several of those differences on subjects of calculation (which, viewed in the abstract, might be supposed of impossible occurrence, but in point of fact, are so often found to occur in regard to the admissibility of *data* and the mode of applying them,) have arisen to complicate and embarrass the inquiry.

One cannot help observing that some of the calculations, the correctness of which has been made matter of dispute, refer to rather irrelevant points. Such, for instance, is that regarding the exact cost of the *conveyance* of letters, &c. in Britain. Mr. Hill's calculations on this point, are probably subservient to the single purpose of evincing the justice of a *uniform charge*, which is done by shewing that the cost of mere conveyance, as distinguished from other parts of the charge of postage, is so small, as to make mere distance an immaterial element in the adjustment of the rate. Without examining (and certainly without admitting) the correctness of Mr. Hill's statements on this subject,† it may be held as allowed, on all hands, that whatever considerations may exist, to justify, or even recommend, the regulation of postage according to distance, these considerations may fairly be made to yield to the advantage of *uniformity*, especially at a very low absolute rate. But conveyance being but a *part* of the expense of distributing correspondence,‡ the calculation now alluded to, goes to no farther end.

Equally irrelevant to the main question (except as facilitating a calculation of the increase of expense under the proposed system, if indeed they serve even for that) are all those *analyses* which Mr. Hill makes of the composition of the present post-office expenditure. It is obvious that, throughout the inquiry (so far as it relates merely to a point of *finance*, its sole relation as presently considered) the *nett* revenue now derived from the post-office, must be taken as a *standard*, by which, according as the revenue to be raised by Mr. Hill's system reaches or approximates to it, the merits of that system are to be tested. Consequently, in comparing Mr. Hill's plan with the present, we must take the expenditure of the post-office *as it is*, unless so far as a saving can be shewn to arise *specifically out of Mr. Hill's plan.* If any deduction, *otherwise*, is made from the charges of management, as applied to Mr. Hill's plan, the same deduction must be made from the present expenditure, thereby raising the *present nett*—that is, raising the standard that Mr. Hill is bound to reach, just in the same proportion that it raises his means of reaching it.§

The real question as to the increase of letters that would be necessary on Mr. Hill's plan, lies in the smallest possible compass. The *gross* revenue to be raised in a given year, after deducting L.71,755, arising from extraneous sources, supposed available under Mr. Hill's plan as well as the present, is L.2,390,515, or 573,723,600 pence. This revenue is at present raised‖ (taking Mr. Hill's own calculation) from fifty-seven millions of *general* post letters, eight millions of penny post letters, and thirteen millions of *twopenny* and *threepenny* post letters. On the *penny* letters, Mr. Hill calculates on no increase; the *twopenny* and *threepenny*, if reduced to a penny, he expects to increase threefold, making these three descriptions of letters amount to forty-seven millions. Forty-seven millions of pence, deducted from the 573,723,600, leave 526,723,600 to be raised from the *general* post letters, which Mr. Hill estimates (taking in the weights above the penny rate) to produce 1¼d. each. It requires 421,378,880 letters at 1½d. to produce this; and to give such a number, the fifty-seven millions (the present number) require to be multiplied by about 7½, that is, to be increased 7½ fold. Now this would only leave the present nett revenue, supposing the *expenses* to remain as at present. But Mr. Hill allows that a *sevenfold* increase of the number of letters would, or might, increase the expense of *internal* distribution by nearly half a million of pounds, (the difference between L.575,384,

* See Sir Edward Lees's evidence, Q. 9413.

† If postage is to be charged according to the actual cost of conveyance, as compared with the returns, then a letter for ten miles will often cost more than one for 100; if on an average of such cost as applied to the whole, then, of course, the postage will be uniform; but if the charge is to be fixed on the general principle, that the cost of establishing and maintaining a conveyance for a large distance, must exceed that for a small; and that conveyance for a large distance is worth a greater price to the *payer*, inasmuch, as generally it would increase the difficulty to him of getting his letter conveyed, (which seems the *actual* principle of the charge) then distance must be reckoned a fair element.

‡ In this particular, and otherwise, Mr. Hill's statements have been applied (though apparently not intended by him to serve such) to purposes of utter delusion and misrepresentation.

§ These considerations are not brought forward *as if in opposition to Mr. Hill*, (by whom, in his latter statement presented to the Committee, they are given full effect to, though apparently overlooked in his pamphlet) but in order that persons who desire to see the matter with their own eyes, may not be deterred by the apprehension of having to encounter a tedious or intricate calculation.

‖ This assumption appears incorrect, as supposing the year's revenue to be *wholly* raised from letters *posted in the United Kingdom*, without taking into account the postage of those *arriving* from abroad. And as, on the assumption in question, Mr. Hill multiplies the letters of one week by 53, instead of 52, (the postage of the week being but 1-53d of the year's revenue) a deduction of about a million of letters would fall to be made from his estimate.

United States post-office.

railroad cars 1,793,024. The number of post-offices on the 1st December 1837, was 12,089. The revenue of the department for the preceding year was D.4,137,056 . 59

The expenditure,..................................3,380,847 . 75

Excess of revenue..............................D.756,208 . 84

The average number of dead letters annually, is about 900,000. The number of letters delivered in the year, is estimated at 29,360,992. Free and dead letters about three millions more. The number of newspapers, pamphlets, &c. paying postage, is estimated at about 25 millions. Dead and free newspapers, four millions more.

The Americans charge in the same mode as the British, namely, by the pieces of which the letter consists. The rates are as follows : for a distance not exceeding

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the present, and 1,035,833 the *prospective* expense.) To balance this, he has the estimated additional rate on foreign and ship letters L.200,000,* (supposing a way shewn of raising this) thus leaving, after an increase of 7½-fold, a *deficit* of L.300,000.

Let the fairness of this calculation be tested, and then let it be reviewed in comparison with that by which Mr. Hill brings out a quite different result, that is to say, nearly *as favourable* a result from an increase of five-fold as has now been done from 7½.

After having on grounds, the correctness of which have been in part already questioned, (and, for the rest, are neither admitted nor denied), raised the number of letters for a year, from seventy-four to seventy-eight millions ; he next, on a ground which, on a moment's reflection he would probably give up as untenable,† raises them to eighty millions. These, at 1¼d. each, would produce L.416,666. Increased five-fold, they yield L.2,083,330, The cost on inland distribution he makes L.868,967, which, together with L.112,162, (other branches of expenditure) makes L.981,129. This deducted from the gross, leaves L.1,102,201 for the nett ; to which he adds the two items just mentioned of L.196,000 and L.48,000, thus making the total nett L.1,346,201, or only something more than L.300,000 of a deficit on a *five*-fold increase. Now all that is necessary for the purpose of explaining how this more favourable result is brought out, is to compare the produce of his *five*-fold, with that of his *one*-fold. The former will be found just five times the amount of the latter ; and as the *one*-fold includes all descriptions of letters, penny, twopenny, and threepenny, five times the produce of the one-fold, of course, suppose an equal increase on all.‡

Finding the average postage of a letter is merely another method of arriving at the same result. The average postage of a *general* post letter, appears from the returns to be above 10d. An eight-fold increase (at 1¼d. on average for each letter) would therefore produce the same amount on the present number at 10d. Other two-folds of an increase would produce L.475,000, to which the L.200,000 for foreign and ship letters being added, there would be L.675,000 for additional expenses. While it is admitted then to be a *vague* statement, (vague as respects the estimate of the increased expense, which can only be a guess), it is believed to be a *moderate* one, to say, that on ten-fold increase of general post letters, with a three-fold increase on the *twopenny* and *threepenny* post letters, would be necessary to uphold the present revenue.§

This, indeed, is a calculation, both the *data* and the conclusions of which, any plain man who pays twenty shillings to the post-office in a twelvemonth, may verify on five minutes' reflection. Let such a one consider, whether the average of his *general* post letters can be less than 10d., and then say, if the average cost were reduced to 1¼d., whether it could require less than ten letters for one, taking into consideration the increase of expense, to uphold the present revenue?

Passing now from matters of calculation, to those of conjecture and estimate, we encounter, as may be supposed, a much wider diversity of opinions. This head embraces that most essential question,—what precise increase of correspondence might be expected under such a reduction as recommended by Mr. Hill. That an increase would take place which, absolutely speaking, may be characterized as immense, may be held as at all hands acknowledged ; but in specifying the probable rate of such increase, in relation to that which would be necessary for the safety of the revenue, there is every possible variety of estimate,‖ ranging from, "very considerable" up to "beyond calculation," from four to a hundred fold ; of which extremes the *medium* may be given as "ten-fold," or "increase that would keep up the revenue." It is obvious, however, that evidence of this nature requires to be received with some degree of deduction. Besides being mostly *conjectural*, it may be said to be all *ex-parte*, brought forward *in support* of the scheme, the eligibility of which was the subject of investigation. There is no opposing party. Government is constrained, in such an inquiry, to be neutral. To the administrators of the post-office, interference would be an invidious office, seeing that even their evidence is apt to be viewed as that of interested, or at all events, prejudiced persons. The cross-examinations instituted by some of the members of the Committee, would be required even as a counterpoise to the effect of leading questions put (certainly without the slightest appearance of unfair intentions) by the others. When to this is added the significant fact, that few, indeed, of the witnesses ventured to state, that they would pay as much postage under the proposed reduction as at present, (while an increase of outlay is admitted to be inevitable on such reduction) and that the generality only hoped for a surplus revenue equal to the present, after the lapse of a considerable period ; when we advert to another important fact, that scarcely one of the witnesses professed to have examined Mr. Hill's calculations, but merely to have *assumed* their correctness ; when these considerations are taken into account, it is surely not too much to say, that the adoption of the plan in question would place the post-office revenue in very imminent hazard.

But although Mr. Hill's plan has been perilled by some of his supporters, if not by himself, on this issue, that it would, at least, maintain the present revenue, its proved insufficiency *on this issue*, is not, on a larger view of the question, to be viewed as conclusive against it. Even in a financial point of view, a defalcation in this source of revenue would probably be met by a proportionate growth in others. The increased facilities given to trade, would, in a variety of ways, tend to the creation of revenue. Even the increase on the paper duties might not be an inconsiderable item, though perhaps liable to be balanced by a corresponding decrease on those on advertisements. Viewing the advantage to commerce, literature, and morality, which would arise from a cheap system of postage, there are probably few persons conversant with subjects of social or political economy, who would advocate the employment of the post-office as a source of revenue, on any other grounds than, in the present circumstances of this country, the difficulty of finding another as a substitute.¶

Put off the supposition, however, that such an increase of correspondence would ensue, as that which has been mentioned as the average

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* Mr. Hill also claims, as a receipt to fall into him, L.48,000 for "payments by government offices not entitled to frank." But, it is presumed, the letters for which these payments were made on the year taken, were part of the 78,000,000 ; and, if so, query, farther, whether these ought not to be deducted from the number of increasable letters? The government officers would send no more letters at a penny than they do at present. In the uncertainty, however, as to the grounds of this claim, let it be allowed ; still the deficiency, after so great an increase, will remain a quarter of a million.

† The ground is, the high postage of ship and foreign letters which *came in* the week of the *return*, Q. 11032. But letters *arriving from abroad*, formed no part of the return, nor could their postage affect the question. It is but fair to say, however, that the suggestion on this point did not come originally from Mr. Hill.

‡ Is not this multiplying the penny letters in the same *ratio* with the others, as objected to by Lord Litchfield? It is true, that with the explanation that Mr. Hill would give it, namely, that by a *fivefold* increase, *he means* the average of a sixfold on the general post, and a threefold on the twopenny and threepenny, (the penny remaining the same) ; this would be merely a different mode of expressing the same thing. Practically, it is a deception ; because, any *increase* promised by Mr. Hill, being an increase *by virtue of reduced postage*, whenever he says that a fivefold increase would produce such and such a revenue, every body will understand him to mean, a fivefold increase of *reducible letters*, that is, (mainly) of *general post* letters. If Mr. Hill owns, as he would own that his statement, *in this meaning*, would be untrue, how can he complain of Lord Litchfield for supposing what would be necessary to make it true; namely, a fivefold multiplication of the *penny* letters, as well as of the others? In *substance*, then, there is an agreement as to the principle of the calculation; a difference as to the *data*—the number of letters from which a given revenue is *at present* drawn.

§ The average postage of a letter has been represented to be 6½d ; consequently, it is meant to be inferred, a sixfold increase, or little more, would produce the present revenue. But if this is the average *at all*, is it the average otherwise than by including the penny and twopenny letters? or would *these* increase sixfold? Do not the more unscrupulous supporters of Mr. Hill's plan, who blazon abroad partial statements of the kind, see that they prove too much? If 6½d. is the average of *increasable*, that is, of general post letters, (the sense intended to be conveyed) what becomes of the outcry about the exorbitant rate of postage? Tell a man, that for 6½d., at an average, he may have a letter conveyed, with the utmost possible speed, and with all but infallible certainty, to any part of the known world, and will he sympathise in the complaint of excessive charge? Mr. Hill's plan may safely be allowed to rest on its merits; let it be allowed to rest there, without the employment of deception and misrepresentation.

‖ The importance of keeping these two points distinct in the mind, is shewn from this, that Lord Ashburton is made, in the Appendix to the Report, to give evidence of the probability of a "great increase," while his Lordship explicitly states his belief, that the adoption of Mr. Hill's plan would be equivalent to a surrender of the whole post-office revenue.

¶ Might such a mode as this be suggested :—Let a bill be brought into Parliament, to grant her Majesty a certain revenue from *postage*, to be raised after the manner described by Mr. Hill ; but containing provisions, that any deficiency of such revenue is to be supplied from other *defined* sources. Let these sources be named by the Chancellor of the Exchequer, or offered by the supporters of Mr. Hill's scheme, (to which the latter could not object, as on their principles the provisions would be inoperative for want of occasion ;) but, at all events, agreed upon as an essential part of the bill.

Postulate
‖
Potash.

30 miles,		6 cents.
above 30 and not exceeding	80,	10
80	150,	12½
150	400,	18¾
400		25

Potatoes.

Ship letters at the port of arrival, 6 cents; 2 cents more than the inland postage, if carried inland. Newspapers 1 cent, or 1½. Magazines and pamphlets from 1½ cent to 6 cents per sheet, according to mode of publication and distance.[1]

POSTULATE, in mathematics, is described to be such an easy and self-evident supposition, that it needs no explication or illustration to render it intelligible.

POTAMON, or POTAMO, was a philosopher of Alexandria. He steered a middle course between the scepticism of the Pyrrhonists and the presumption of the Dogmatists; but attached himself to none of the schools of philosophy of his time. He was the first projector of the Eclectic sect; for though the mode of philosophising had been pretty common before, he was the first who attempted to institute a new sect on this principle. Diogenes Laertius relates, that not long before he wrote his *Lives of the Philosophers*, an Eclectic sect, ἐκλεκτική τις ἀιρεσις, had been introduced by Potamo of Alexandria, who selected tenets from every former sect. He then proceeds to quote a few particulars of his system from his Eclectic Institutes, respecting the principles of reasoning, and certain general topics of philosophical inquiry; but from these nothing further can be learned than that Potamo endeavoured to reconcile the precepts of Plato with those of other masters.

POTASH, the lixivious ashes of certain vegetables, used in making glass, soap, and other articles. See GLASS, SOAP, and CHEMISTRY. Potash was formerly considered as a simple substance; but it appears, from the discoveries of Sir H. Davy, to be a compound of a peculiar metallic substance and oxygen.

POTATOES, of the order *solaneæ*. See BOTANY. It seems to be the prevalent opinion that potatoes were first introduced into Europe from America, by Sir Walter Raleigh, about 1586. Gerard, an old English botanist, mentions that he had reared seedlings of the potatoe in 1590, and that it grew as well in his garden as in its native soil, Virginia. Gerard gave to the potatoe the botanical name of *solanum tuberosum*,—a name adopted by Linnæus, and which it still retains. Previously to 1684, its cultivation in England was confined to the gardens of a few of the nobility and gentry. It was then first planted in the open fields in Lancashire, a county in which it is now very extensively cultivated. In an account of the household expenses of Queen Anne, wife of James I., who died in 1618, and which is supposed to have been compiled in 1613, the price of potatoes is stated at 1s. a pound.

[1] A *cent*, or hundredth part of a dollar, is about a halfpenny.

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of the estimates on this point, the question has arisen, to what extent a corresponding increase of the post establishment must take place, both as regards the *space* in which the duties are to be performed, and the number of persons required for such performances.* The chief difficulty apprehended, is that which would be experienced in the *dispatch* of the mails from London, and other large offices, under the circumstances of the closeness of the hour of receipt to that of dispatch, to which the public are accustomed, and the great proportion of letters that are put in at the very latest hour.† On these points, the officers of the post-office, who can alone, or who can best form an opinion, while they concur in stating that a large additional expense would certainly be incurred, profess not to be able to form, or, in point of fact, not to have formed, any definite idea of its extent. The sums put to this amount in the foregoing calculations, may be considered as stated in mere conjecture; nor is it very easy to offer anything on the subject further than to observe, that any saving of time or labour, in regard to the business of dispatch, effected by Mr. Hill's plan, applies only to the taxing; partly, if at all, to the examination, and to the telling up: the duty occupying the longest time, (that of sorting) together with the stamping, being increased in full proportion to the increase of letters.

Of the minor difficulties attending Mr. Hill's plan, that which regards the mode of collecting the postage on *foreign* letters, is the most considerable. Mr. Hill seems latterly to think, that, as regards these, it might be necessary to take payment on delivery. But it seems, by no means clear, that Mr. Hill's first suggestion on that point, (namely, that of charging twopence in advance outwards, and nothing inwards) is liable to any great objection *peculiar to this part of his plan*; the persons who *send* letters abroad, being generally the same who *receive* from abroad. The inconvenience of having letters above weight, returned (after opening) from the dead letter office, cannot be allowed to stand in the way of an extensive arrangement otherwise beneficial. If parties would neither be at the pains to weigh their letters, *nor use a stamp of a penny higher price*, when in doubt, they might very fairly be left to take the consequence.

But after considering all the defects and difficulties of Mr. Hill's plan, the question recurs, if we do not adopt it, what *else* is to be done? That a *great* reduction of postage must be made, seems to be universally admitted; but what *other* scheme of reduction has been proposed, or who is ready to propose one? If we are to reduce *at all*, there seems much reason to question, whether any reduction short of that proposed by Mr. Hill, will be to good purpose. The Committee have recommended a penny rate for distances not exceeding fifteen miles, and twopence for larger distances. But there are not wanting good grounds for maintaining that the penny rate might fetch a greater revenue than the twopenny one.

Speaking loosely, it may be reckoned that, at a uniform penny postage, a fourfold increase on the general post letters, and a threefold on the twopenny and threepenny, would more than cover the charges of management. That an increase to this extent would ensue, may be held for certain; that it would ensue to double or treble this extent is, if improbable, not beyond the bounds of possibility. So that, at the worst, perhaps, the utmost evil that would arise from the adoption of Mr. Hill's plan, would be the payment of a million and-a-half of taxes in one way, instead of in another, while the vast advantage of a low rate of postage would be so much clear gain obtained. And this leads to a consideration of what, in a question of political economy, ought to be reckoned the *proper measure* of the advantage of Mr. Hill's plan. Suppose a person to pay L.1 a-year in postage, and L.5 in other taxes; suppose that in another year he pays only 5s. for postage, and L.5, 15s. in other taxes, it is evident that, *ceteris paribus*, matters will remain the same, both as regards the state and the individual, that is, if the *number of letters* which the individual gets conveyed *remains the same*. But if, on the latter supposition, he gets twenty-five letters conveyed, while on the former he only got twenty, the conveyance of the five letters additional is a clear advantage gained. The true measure then of the benefits of Mr. Hill's plan, is not the amount of surplus revenue it creates, as relative to the present, but the *number of letters conveyed, on that plan, as relative to the expense of conveyance*. If Mr. Hill, by adding twenty-five *per cent*. to the cost of conveyance, can add 100 per cent. to the number of letters conveyed, this is clear benefit. And as there can be no real advantage from the adoption of his plan that does not resolve into this principle, so (speaking on the abstract) any alleged disadvantage, not resolving into the same principle, may be regarded as only apparent.

* As regards increase of expense for *conveyance*, there does not seem so much ground for apprehension.

† Various suggestions might be offered for lessening this difficulty. For a time, at least, the system of receiving a *fee* with late letters might be extended. This would be no nullification of the boon of a cheap postage; for it would be the fairest and most convenient way of throwing the expense on those who most created it, and who could best find their account in increasing it. Or London might be split down into separate post towns, with separate bags from each, (an inconvenience that would be gradually diminishing, as railways, with *moving* offices, were established.) Or three or four different kinds of stamped covers might be sold, distinguishing by *colour*, and marked respectively, *late, later, latest*, and charged 3d., 6d., or 1s. each, to be received up to certain hours. A clerk, at the receiving box, could, with great quickness, throw out *in transition* all of the *wrong* colour for the *hour*, to wait next dispatch; or, as often as the sorting boxes are filled, their contents might be transferred to the bags.

Potatoes were not introduced into Ireland until 1610, when a small parcel was sent by Sir Walter Raleigh to be planted on his estate in the vicinity of Youghall. There is no other instance of the cultivation of an exotic having been so rapidly extended in so short a period as has elapsed since potatoes were introduced into Ireland.

Potatoes were not raised in Scotland, except in gardens, till 1728, when they were planted in the open fields by Thomas Prentice, day-labourer at Kilsyth. Prentice died at Edinburgh so late as 1792.

It has been estimated that one acre of land will produce three times, or at least twice, as much food when growing potatoes, as when employed in the culture of wheat; consequently, where the inhabitants live upon potatoes, the population will be twice or thrice as dense as where they are fed entirely on corn. While, however, the use of the potato as a principal article of food renders population comparatively dense, it tends also to render the people habitually poor, and to multiply the chances of famine. For the cultivation of the potato see AGRICULTURE. For the political views see M‘Culloch's *Commercial Dictionary*, and his notes to Smith's *Wealth of Nations*.

POTENTIA, POWER, that whereby a thing is capable either of acting or being acted upon.

POTENTIAL, in the schools, is used to denote and distinguish a kind of qualities which are supposed to exist in the body *in potentia* only; that is, to be capable in some measure of affecting and impressing on us the ideas of such qualities, though not actually inherent in themselves. In this sense we say, potential heat, potential cold, &c.

POTENTIAL, in *Grammar*, an epithet applied to one of the moods of verbs. The potential is the same in form with the subjunctive, and is, according to Ruddiman, implied in that mood, for which reason it is rejected by that grammarian; but others consider that it differs from the subjunctive by always implying in it either *possum*, *volo*, or *debeo*. It is also called the *permissive mood*, because it often implies a permission or concession to do a thing.

POTIPHAR, or PUTIPHAR, an officer of the court of Pharaoh, king of Egypt, and general of his troops, according to our translation, Le Clerc, and the version of the vulgate; but according to the Hebrew and Septuagint, the chief of his butchers or cooks. The Hebrew text, the Septuagint, and vulgate, call him Eunuch. But it is probable it in this place means only an officer of the king's court, for he was certainly married and had children. We have no other account of him but what appears in Scripture.

POTOMAC, a large river of North America, which forms through its whole course the boundary between the states of Maryland and Virginia. It rises in the Alleghany Mountains, and flowing in a north-easterly direction towards Pennsylvania, it forms a junction with the Shenandoah at Harper's Ferry, and then makes its celebrated passage through South Mountain. At its embouchure it is seven miles and a half in breadth; and at Alexandria, 290 miles from the ocean, it is one mile and a quarter in breadth. Tide-water reaches about 300 miles from the Atlantic; and for nearly that distance the Potomac is navigable for the largest vessels. The river is seven fathoms deep at its mouth, five at St George's Island, three at Swan's Point, and thence to Alexandria of the same depth. The length of its course, the curvatures included, is considerably above 300 miles.

POTOSI is the name of a department, a province, and a city of Bolivia, in South America. This part of the republic has been celebrated from the earliest times for its metallic wealth. The Cerro de Potosi, where the argentiferous mines are situated, is a conical hill, 16,037 feet in height, and about three leagues in circumference at the base. It bears marks of a volcanic origin, and its sides are marked with spots of various hues, such as dark green, orange, gray, and red. In this mountain no less than above 5000 mine mouths or levels have been opened, but very few of the mines are now worked. A tradition exists that Diego Hualca, an Indian peasant, accidentally discovered these mines whilst hunting the wild goat. In pursuing his game, he arrived at a steep declivity, and, to prevent himself from falling, he seized hold of a shrub, which, yielding to his weight, was torn from the ground, and disclosed to his eyes a large mass of silver, part of which adhered to the roots of the plant. A slave to whom he intrusted the secret of his good fortune betrayed him, and the mine was opened by the Spaniards on the 21st of April 1545. The surrounding country is also metalliferous. Silver of great fineness abounds in a hill called Guayna-Potosi (Young Potosi), close to the Cerro; but from the number of springs which occur not far from the surface, it has been found impossible to work it. The ore is pulverised in mills, driven by streamlets conducted from lakes or pools in the mountains, from one to ten miles distance from the city of Potosi. In connexion with the mines, General Miller relates the following circumstance. "A singular custom, which probably originated in the indulgence of early mine-owners, still prevails. Between Saturday night and Monday morning, the Cerro literally becomes the property of such persons as choose to work upon their own account. During that time, the boldest master would not venture to visit his own mines. They who thus take possession are called caxchas, and generally sell the produce of Sunday to their own masters. Independently of the ore thus abstracted, the caxchas did considerable mischief, by neglecting the proper precautions as they excavated. If they met with a more than usually rich vein in the course of the week, it was passed over, and cunningly reserved for the following Sunday. Very strong measures were therefore taken to abolish the custom; but every effort proved unsuccessful. The caxchas defended their privilege by force of arms, and by hurling down large stones upon their assailants." These mines are still considered the richest in South America, but great ignorance of mining operations is displayed in working them. In an agricultural point of view this province is unimportant; its riches consist in its mineral wealth.

The city of Potosi, the capital of the department, is situated on the south side of the mountain, above 13,000 feet above the level of the sea, in lat. 19° 34′ south, and long. 67° 22′ west from Greenwich. Upon the discovery of the mines, it was named an *asiento* or mine-station; but in process of time it was raised to the rank of a town, and made the capital of an intendencia. In 1611 it contained 150,000 inhabitants, according to a census taken by order of government officials. On this point General Miller judiciously observes, "This number must at that time have consisted principally of *mitayos* of every tribe existing between Potosi and Cuzco, a distance of nearly 300 leagues. Those unhappy beings were generally accompanied in their labours by their wives and families, who came rather to share in the hopeless sufferings of their husbands and fathers, than to settle in the arid hills of Potosi. It is not therefore surprising that its population should have been, by the abolition of the *mita*, and by the shocks which wealthy establishments received during the revolution, reduced to only 8000 in the year 1825."

POTSDAM, one of the provinces into which the kingdom of Prussia is divided. It is bounded on the north by the duchies of Mecklenburg-Schwerin and Mecklenburg-Strelitz, on the north-east by Pomerania, on the east by Frankfort, on the south by Saxony, on the south-west by the duchy of Anhalt-Dessau, on the west by Prussian Saxony, and on the north-west by the kingdom of Hanover. It extends over 8272 square miles, and comprehends 67 cities, or places once fortified, 16 market-towns, and 1319 villages, besides scattered houses, and distinct agricultural establishments. It is divided into thirteen circles. The population, which in 1817 consisted of 696,878 individuals, had increased in 1826 to 812,138, and has gone on augmenting up to the present time. With the exception of about 3000 Catholics, and about 2000 Jews, the whole of the inhabitants profess the Protestant religion. The land is generally level, and though tolerably cultivated, is by no means productive, though there are some local exceptions. It is provided with great natural means of access to the sea by the navigable river Havel, which falls into the Elbe, and which affords a communication between the different portions of the province. The capital of this province is the city of the same name, the first in exterior beauty in the Prussian dominions. It is situated twenty-one miles from Berlin, on an island about eighteen miles in circumference, formed by some lakes and canals, and by the river Nuthe, which here joins the Havel. Potsdam contains seven Protestant and one Catholic church, and a synagogue for the Jews. The inhabitants are about 26,000, the dwellings 1640. The civil population does not exceed 16,000 persons. The others are either military, or those employed in the fabrication of arms. The muskets for the troops are made at Spandau, but are fitted with locks and finished at Potsdam. There are manufactories carried on of silk and cotton, of leather, of cloth, of snuff, of musical and mathematical instruments, and some large breweries and distilleries.

POTTEN, a market-town of Bedfordshire, in the hundred of Biggleswade, forty-nine miles from London. It is well built now, having been burned down in 1785, after which for some time the inhabitants lived under tents. It is in a fertile district, and has a good market on Saturday. The population amounted in 1801 to 1103, in 1811 to 1154, in 1821 to 1498, and in 1831 to 1768.

POTTER, Christopher, a learned English divine, was born in 1591, and bred at Oxford. In 1633, he published his *Answer to a late Popish Plot*, entitled *Charity Mistaken*, which he wrote by special order of Charles I., whose chaplain he was. In 1634, he was promoted to the deanery of Worcester; and, in 1640, was constituted vice-chancellor of the university of Oxford, in the execution of which office he met with some trouble from the members of the Long Parliament. Upon the breaking out of the civil wars, he sent all his plate to the king, declaring that he would rather, like Diogenes, drink in the hollow of his hand, than that his majesty should want; and he afterwards suffered much for the royal cause. In consideration of this he was nominated to the deancry of Durham in 1646, but was prevented from being installed by his death, which happened about two months thereafter.

Potter, John, D.D., Archbishop of Canterbury, was the son of a linen-draper at Wakefield in Yorkshire, where he was born about the year 1674. He studied at University College, Oxford; and at the age of nineteen he published, *Variantes Lectiones et Notæ ad Plutarchi librum ad audiendis poetis; et ad Basilii Magni orationem ad juvenes, quomodo cum fractu legere possint Græcorum libros*, 1693, 8vo. In 1697, came out his edition of *Lycophron*, in folio, which is reckoned the best of that obscure writer; and soon after, he published his antiquities of Greece, in two vols. 8vo. These works established his literary reputation, and engaged him in a correspondence with Grævius and other learned foreigners. In 1706, he was made chaplain to the queen; in 1715, bishop of Oxford; and in 1737, he succeeded Archbishop Wake in the see of Canterbury, which high station he supported with much dignity until his death in 1747. He was a learned and exemplary churchman; but not of an amiable disposition, being too strongly tinctured with the pride of office. Nor is it to his credit that he disinherited his eldest son for marrying below his rank in life. His theological works, containing sermons, charges, discourses on church government, and divinity lectures, were printed at Oxford in 3 vols. 8vo, 1753.

POTTERY and Stone-ware. Under this name may be classed all those wares, from the common butter-pot mentioned by Dr Plot, to the finer kinds of earthen-ware, which, in contradistinction to porcelain, possess neither transparency nor any degree of vitrification, except on the surface after being glazed.

The most famous manufacture for this common ware, as Dr Plot states in his History of Staffordshire (1686), was at Burslem, in that county, now one of the principal towns, forming a part of that extensive and populous district called the Staffordshire potteries, in which it is calculated that no less than 30,000 persons, or one half the population, are directly employed in the manufacture of porcelain and earthen-ware. It is proved, however, that the manufacture of common wares had existed long before Dr Plot's time; but of its first introduction no tradition remains.

These common wares were made of the clays found in the district, and were of a red body covered with a glazing of lead ore, with a portion of manganese added to make a black when that colour was wanted.

About the year 1690, two ingenious artisans from Germany, of the name of Eller, settled near Burslem, and carried on a small trade for a little time. They brought into this country the method of glazing stone-ware, by casting salt into the kiln while it is hot, and some other improvements of less importance; but finding they could not keep their secrets to themselves, they left the place rather in disgust. From this time various kinds of stone-ware, glazed by the fumes of salt in the manner above mentioned, were added to the wares before made. The white kind, which afterwards became, and for many succeeding years continued, the staple branch of pottery, is said to have owed its origin to the following accident. A potter, Mr Astbury, travelling to London, perceived something amiss with one of his horse's eyes; an hostler at Dunstable said he could soon cure him, and for that purpose put a common black flint-stone into the fire. The potter observing it, when taken out, to be of a fine white, immediately conceived the idea of improving his ware by the addition of this material to the whitest clay he could procure. Accordingly he sent home a quantity of flint-stones of that country, where they are plentiful among the chalk, and, by mixing them with tobacco-pipe clay, produced a white stone-ware much superior to any that had been seen before.

Some of the other potters soon discovered the source of this superiority, and did not fail to follow his example. For a long time they pounded the flint-stones in private rooms by manual labour in mortars; but many of the poor workmen suffered severely from the dust of the flint getting into their lungs, and producing dreadful coughs, consumptions, and other pulmonary disorders. These disasters, and the increased demand for the flint-powder, induced them to try to grind it by mills of various constructions; and this method, being found both effectual and safe, has continued in practice ever since. With these improvements, in the beginning of the present century, various articles were produced for tea and coffee equipages. Soon after, attempts were made to furnish the dinner-table also; and before the middle of the century, utensils for the table were manufactured in quantity as well for exportation as home consumption.

But the salt glaze, the only one then in use for this purpose, is in its own nature so imperfect, and the potters, from an injudicious competition among themselves for cheapness rather than excellence, had been so inattentive to elegance of form and neatness of workmanship, that this ware was rejected from the tables of persons of rank; and about the year 1760, a white ware, much more beautiful and better glazed than ours, began to be imported in considerable quantities from France.

The inundation of a foreign manufacture, so much superior to any of our own, must have had very bad effects upon the potteries of this kingdom, if a new one, still more to the public taste, had not appeared soon after. In the year 1763, Mr Josiah Wedgwood, who had already introduced several improvements into this art, invented a species of earthen-ware for the table, quite new in its appearance, covered with a rich and brilliant glaze, bearing sudden alternations of heat and cold, manufactured with ease and expedition, and consequently cheap, and having every requisite for the purpose intended. To this new manufacture the queen was pleased to give her name and patronage, commanding it to be called *Queen's ware*, and honouring the inventor by appointing him her majesty's potter.

The common clays of the district are now mostly used for making the saggers or cases in which the finer wares are fired, for bricks to construct the ovens and kilns, and for some kinds of inferior wares, while the clays for the improved article are brought from Devonshire and Dorsetshire by sea to Liverpool, and by the canal to the potteries. The flint-stone is obtained mostly from London, so that it would appear the cheapness of coals has been the principal reason for the establishment of extensive potteries in this inland district, notwithstanding the heavy charges of transport on the raw materials to the seat of manufacture, and, so far as the export trade is concerned, again on the manufactured articles to the shipping ports.

Before the introduction of steam power to machinery purposes, the flint-stones were ground by water-mills at a considerable distance from the manufactories; but many of the manufacturers have now erected steam-engines of great power, for the purposes of grinding flint, and other materials used in the different processes of the manufacture.

The article of *queen's ware*, before mentioned, was composed of the Devonshire and Dorsetshire clays, mixed with a proportion of ground flint, covered with a fine soft glazing, composed of siliceous earths and carbonate or oxide of lead. This glazing, covering a very porous body, made of the above clays and a portion of flint-stone, was liable to crack or craze, and become discoloured in the using, causing a prejudice against it, under an erroneous idea that, by its coming in contact with acids and salts, the glaze had been decomposed, that the lead it contained was poisonous; and a premium was accordingly offered by the Society of Arts for the discovery of a glaze without lead, which was only cancelled on the books of the society a few years ago. It appears singular that it did not immediately occur to scientific men, that all the chemical vessels made of glass contain as large a portion of lead in their composition as there is in the glaze on queen's ware, and that the vitrification is as complete in the one case as the other. The fact is, that, through the cracks in the glazing, it was the earth composing the body of the ware which the acids and salts acted upon, leaving a coloured deposit, visible through the extreme thin lamina of glazing which covers it.

This defect in the glazing arises from several causes; the want of a corresponding contraction of the body and the glaze, from too sudden a cooling of the oven, and other mismanagement of the workmen.

Since the introduction, however, of a better clay from the mines in Cornwall (about 1777), together with a stone containing a notable quantity of feldspar, the potter has been enabled to bring his earthen-ware to a very great degree of perfection; the defect in glazing above noticed has been greatly diminished on the queen's ware, and other glazes introduced, in appearance possessing much of the texture and whiteness of porcelain, though still deficient in the solidity and compactness of the old white stone-ware which it had superseded.

About the year 1805 an article was produced called *Ironstone-ware*, in which, however, not a particle of iron stone was introduced, it being a compound principally of the Cornish materials above mentioned.

This ware has nearly all the properties of the Japan porcelain; it possesses great hardness and density; is sonorous, but is deficient in whiteness and transparency, although the vitrification is as complete as in that of the Japan. It continues to be made in great quantities, and being more durable, is perhaps, though higher in price, as economical as earthen-ware. It is a cheap substitute for porcelain, but its nature does not admit of those fine paintings and splendid decorations which are applied with so much success on that more elegant production.

Manipulation.

From the common earthen-ware to the finest porcelain, the manipulations are nearly similar. The materials being finely ground and levigated, are mixed together in their proper proportions in a liquid state, and this mixture being put into broad shallow pans or kilns, is subjected to a heat sufficient to evaporate the extra water until the clay is of a proper consistency for use, and it is then prepared by beating with wooden and iron paddles until it becomes one ductile homogeneous mass, fit for the operation of the workman. The operations of throwing on the wheel, turning in the lathe, and moulding, are similar to those already described in the article on porcelain.

Throwing.

The potter's wheel consists of a triangular bench, whereon the workman sits, having before him a small horizontal circular block on which he places the portion of clay made into a ball, according to the size of the piece of ware wanted to be made, and with his hands fashions it into the shape wanted; the inner surface being smoothed by a piece of slate, iron, or earthen-ware, cut to the form required. This workman has two assistants; one employed to prepare the balls of clay, and remove the piece when formed; the other to turn a larger vertical wheel, which gives motion to the horizontal block, or whirler, as it is called, before mentioned as being before the workman. The ware is then taken into a stove and dried sufficiently hard to be put upon the lathe and undergo the operation of turning or smoothing the outer surface.

Turning, &c.

This lathe is of the like construction as the common lathe used in wood turning, and needs no description here.

The ware is then given to another workman, who puts on the handles and feet, or such ornaments as may have to be fixed on the body of the ware; and after being thoroughly dried, it is ready for the first or biscuit firing.

It must be observed, that only articles of a circular form can be produced on the wheel or from the lathe. All others, as well as the feet and handles and ornaments, are made by different workmen, from moulds of gypsum or of baked ware. An earthen-ware called *dipped ware* is made of different colours, some of which are very striking, by being dipped into a slip or wash of the same clay, or of other clays coloured by metallic oxyds finely ground and mixed up with the wash. This operation is performed at the lathe, before the ware has had time to get dry or hard.

Firing and baking.

The ware being made dry, is placed in saggers (cases), which are piled on each other until the oven is filled up nearly to the top of the dome. Fire is then applied in mouths round the outside of the oven, having flues round the inside, and under the bottom of the oven, communicating with the mouths. The fire is applied very gradually, the operation requiring from forty-eight to fifty hours. As a test to show when the necessary degree of heat is obtained, small round caps made of common brick-clay are put into a sagger, opposite a small opening in the oven, which the fireman draws out from time to time, judging, from the degree of colour the test or trial had acquired, which was produced by the oxyd of iron contained in the clay, how to regulate his further operations.

Glazing.

The operation of glazing is similar to that detailed in the article on porcelain, but is performed with much less difficulty, and with a greater degree of certainty, on a porous than on a vitrified surface. After the ware is glazed (a considerable portion of which is first painted, and printed on the body, a biscuit), the ware is then again placed into the saggers or cases, and placed as before to undergo the second firing. In this second firing for the glazing, a much lower degree of heat is applied than for the biscuit-ware, and the operation is performed in fifteen or eighteen hours, according to the size of the oven. The painting or enamelling, and the printing on earthen-ware, are done in the same manner as that described on porcelain, which need not here be repeated.

The extent to which the manufacture of pottery wares is now carried on in this country, in which porcelain may be included, together with its usefulness and excellence, has rendered it a subject of great national importance. The raw materials are of home production, and of little intrinsic value, the transport of which affords to the coasting trade a freightage of from 40,000 to 50,000 tons annually. The manufactured articles are wholly produced by manual labour, which is not likely to be superseded by machinery, while the export of the bulky article of earthen-ware to all parts of the world gives employment, to an immense extent, to the shipping of this and other countries. Nor is this interesting manufacture without some claim in furthering the progress of the fine arts, by the cultivation of painters, engravers, and modellers, many of whom have displayed talents of a superior order in their respective lines. In flower-painting, the specimens exhibited in the work of English artists cannot be excelled. In figure-painting, owing to the want of schools for design, the porcelain painters of this country have not made much progress; but in flower-painting, and in decoration generally, our British artists cannot be surpassed.

There are some considerable manufactories of pottery ware in the north of England, and one or two in Yorkshire; but the principal site of both pottery and porcelain wares is in the newly created borough of Stoke-upon-Trent, which contains a population of nearly 60,000 persons, engaged either directly or indirectly in these manufactures. On the passing of the reform bill, this borough was considered of sufficient importance to have its great interests represented by two members in parliament. (B. A.)

POULTON, a market-town in the county of Lancaster, and hundred of Amounderness, 235 miles from London. It is on the sea-shore, near the mouth of the river Wye, and communicates by a canal with most of the rivers of the county. It has a market on Monday. The population of the town was, in 1801, 769; in 1810, 926; in 1821, 1011; and in 1831, 1025; but the whole parish contains five townships, and at the last census 4080 inhabitants.

POULTRY, all kinds of domestic fowls brought up in yards, as cocks, hens, and the like. See Agriculture.

POUND, a standard weight, for the proportion and subdivisions of which, see the article Weights and Measures.

Pound also denotes a money of account, so called because the ancient pound of silver weighed a pound troy.

POUNDAGE, a subsidy of twelve pence in the pound, granted to the crown on all goods and merchandises exported or imported; and if by aliens, one penny more.

POUSSIN, Nicholas, an eminent French painter, born in 1594, at Andel, a little city in Normandy, where his father was of noble extraction, but born to a small estate. Being invited to Paris by Louis XIII., who assigned him a pension and lodgings in the Tuilleries, he painted for Prince Justiniani an historical picture representing Herod's cruelty; an admirable composition, in which he gave such expression to every character, as could not fail to strike the beholder with terror and pity. He then laboured for several years on the celebrated pictures of the seven sacraments of the Catholic church. But none of Poussin's designs have been more generally admired than that of the death of Germanicus, which would have gained him immortal honour if he had never painted another picture. He began the labours of Hercules in the gallery of the Louvre; but the faction of Vouet's school railing at him and his performances, put him so out of humour with his own country, that he returned to Rome, where he died in 1665. He never went beyond easel-pieces, for which he had a perpetual demand; and his method was to fix the price he expected on the back of the canvass, which was readily paid.

Poussin, *Gaspar*. This painter, whose real name was *Dughet*, was born at Paris in 1600, and was induced to travel to Rome, not only from a love of the art of painting, but also to visit his sister, who was married to Nicholas Poussin. Sandrat says that Gaspar was employed at first only to prepare the pallet, pencils, and colours for Nicholas; but by the precepts and example of that excellent master, he gradually rose to the highest reputation, and is undoubtedly one of the best landscape painters that ever appeared. Whilst he continued at Rome he dropped his own name, and assumed that of his brother-in-law and benefactor, by which only he is now known. He died in 1662.

POUTEOU, or Pootoo, a small island off the coast of China, a little to the east of Tehnsan. It is represented as a beautiful spot, containing numerous temples.

POVERTY Bay, on the east coast of New Holland, in the South Pacific Ocean, discovered by Captain Cook in 1769. Long. 181. 36. W. Lat. 38. 42. S.

POWALLY, a town of Hindustan, in the province of Tinnevelly, twenty miles south-west from Madura. Long. 77. 59. E. Lat. 9. 39. N.

POWANGHUR, a celebrated hill-fort of Hindustan, province of Gujerat. It rises nearly perpendicular to the immense height of six hundred yards, and is inaccessible except on the north side, which is fortified with fine walls. A small rock rises on the summit, on which stands a Hindu temple. It was taken by the British, after a very slight resistance, in 1803. Long. 73. 39. E. Lat. 22. 31. N.

PRACELS, a range of small islands and rocks in the Chinese Sea, about sixty miles to the east of Cochin-China. They are of dangerous navigation, from the currents that run between them. Length, 300 miles; breadth, 60; from long. 110. to 111. E. and lat. 11. 40. to 16. 10. N.

PRÆMUNIRE, in *English Law*, a writ of citation.

PRÆNESTE, in *Ancient Geography*, a town of Latium, to the south-east of Rome, towards the territory of the Æqui. It is a place of great strength, and famous for the temple and oracle of Fortune, called *Sortes Prænestinæ*.

PRAGMATIC SANCTION, in the civil law, is defined by Hottoman to be a rescript or answer of the sovereign, delivered by advice of his council, to some college, order, or body of people, upon consulting him on some case of their community. The like answer given to any particular person is called simply rescript.

The term pragmatic sanction is chiefly applied to a settlement of Charles VI. emperor of Germany, who, in the year 1722, having no sons, settled his hereditary dominions on his eldest daughter, the archduchess Maria Theresa, which was confirmed by the diet of the empire, and guaranteed by Great Britain, France, the States-General, and most of the powers in Europe.

PRAGUE, a city, the capital of the Austrian kingdom of Bohemia. It is nearly in the centre of the kingdom, on the river Moldau, which runs to the Elbe on its way to the ocean, and divides the city into two parts. There is over the river one of the finest ancient bridges in Europe, 1800 feet in length, consisting of sixteen arches, and adorned with twenty-eight statues of saints and martyrs.

The city is built on seven hills, and the streets are consequently irregular; the houses are very antique and large, and the compass of the whole is said to be nine miles. It contains numerous public buildings, amongst others the metropolitan cathedral, dedicated to St. Beit, with twelve highly-decorated side chapels, besides which, are no less than forty-six other Catholic churches, and several monasteries and nunneries. The palace of the ancient kings of Bohemia has been converted into a citadel; but a more modern one, now used as a Stadthouse, is of vast extent, containing 150 apartments, with a hall near equal in size to that of Westminster. There is a university, one of the oldest in Germany, in which degrees are obtained in the four faculties of law, medicine, theology, and philosophy. It has connected with it a library of 100,000 volumes; a botanic garden, an astronomical observatory, and collections of natural history. There are forty-four professors, and the students, which were in 1816, only 8798, had increased, and in 1823, were 1348. This seminary may be considered the birthplace of the reformation of religion, as John Huss and Jerome exercised in it the right of free inquiry, and became victims to it nearly one hundred years before the appearance of Luther. There are also several societies for the promotion of learning, of the sciences, and of the fine arts. The institutions for the maintenance of the poor, for affording medical aid, and for other benevolent purposes, are numerous and well conducted. The inhabitants, like those of all Europe, have greatly increased since the treaty of Vienna in 1815. In that year they were 67,730 Christians, and 6,783 Jews; in 1817, they were 79,606, from which, by regular increase, they had grown up, in 1827, to 107,325.

The chief trade is that which arises from its central position, and from its being the seat of the local government; but there are manufactures of gold, silver, jewellery, and other luxuries, as well as others, for internal consumption, of silk, cotton, linen, and woollen goods, and for cutlery and haberdashery wares; there are also large breweries and distilleries. The city is fortified; but, from being commanded by hills, is scarcely defensible; but it has been the theatre of many bloody actions. A battle was fought in 1620 on the white plains a few miles from the city, between the Elector Palatine and the Austrians, when the success of the latter caused the independence of Bohemia to expire. It was besieged by the French in 1751, and by the Prussians, who bombarded it in 1757; but in both cases the resistance was attended with success. Lat. 50. 5. 33. Long. 14. 49. 40.

PRAAM, a kind of lighter used in Holland and the ports of the Baltic sea, to carry the cargo of a merchant-ship alongside, in order to lade or to bring it to shore to be lodged in the storehouses after being discharged out of the vessel.

PRATINAS, a Greek poet contemporary with Æschylus, and born at Phlius. He was the first amongst the Greeks who composed satires, which were represented as farces. Of these, thirty-two were acted, as also eighteen of his tragedies, one of which only obtained the poetical prize. Some of his verses are extant, quoted by Athenæus.

PRATO, a city of the duchy of Tuscany, in Italy, the capital of a district called a vicarate, of the same name, in the circle of Florence. It stands on the river Bisenzeo. It is surrounded with walls and ditches. It contains some handsome plazas, a theatre, a cathedral, twelve parish and seventeen monastic churches, four hospitals, and 10,000 inhabitants, who make linen and woollen cloths, paper, copper ware, and other articles, and draw from quarries some good millstone.

PRATT, CHARLES, Earl of Camden, was the third son of Sir John Pratt, knight, chief-justice of the Court of King's-Bench under George I. by his second wife Elizabeth, daughter of the Reverend Hugh Wilson, canon of Bangor, and was born in 1713, the year before his father was called to the honour of the bench. He received the first rudiments of his education at Eton, and afterwards removed to King's College, Cambridge. Of his early life at both places little is known, other than that at college he was found to be remarkably diligent and studious, and particularly so in the history and constitution of this country. By some he was thought to be a little too tenacious of the rights and privileges of the college he belonged to; but perhaps it was to this early tendency that we are indebted for those noble struggles in defence of liberty, which, whether in or out of office, he displayed throughout the whole course of his political life. After remaining the usual time at college, and taking his master's degree, in 1739 he entered himself a student of the Inner Temple, and was in due time admitted by the honourable society as a barrister-at-law. And here a circumstance developes itself in the history of this great man, which shows how much chance governs in the affairs of this world, and that the most considerable talent and indisputable integrity will sometimes require the introduction of this mistress of the ceremonies, in order to obtain that which they ought to possess from their own intrinsic qualifications.

Mr. Pratt, after being called to the bar, notwithstanding his family introduction, and his own personal character, was very near nine years in the profession, without ever getting in any degree forward. Whether this arose from a natural timidity of constitution, ill-luck, or perhaps a mixture of despondence growing out of the two circumstances, it is now difficult to tell. But the fact was so; and he was so dispirited by it, that he had some thoughts of relinquishing the profession of the law, and retiring to his college, where, in rotation, he might be sure of a church living, that would give him a small but honourable independence. With these melancholy ideas he went as usual the western circuit, to make one more experiment, and then to take his final determination. Mr. Henley, afterwards Lord Northington, and chancellor of England, was in the same circuit. He was Mr. Pratt's most intimate friend; and he now availed himself of that friendship, and told him his situation, and his intentions of retiring to the university and going into the church. He opposed his intention with strong raillery, and got him engaged in a cause along with himself; and Mr. Henley being ill, Mr. Pratt took the lead, and displayed a professional knowledge and elocution that excited the admiration of his brother barristers as much as that of the whole court. He gained his cause; and besides, he acquired the reputation of an eloquent, profound, and constitutional lawyer. It was this circumstance, together with the continued good offices of his friend Henley, which led to his future greatness; for with all his abilities and all his knowledge, he might otherwise in all probability have passed his life in obscurity, and gone down to the grave unnoticed and unknown.

He now became one of the most successful pleaders at the bar, and honours and emoluments flowed thick upon him. He was chosen to represent the borough of Downton, Wiltshire, after the general election in 1759; recorder of Bath 1759; the same year he was appointed attorney-general; and in January 1762 he was called to the degree of serjeant at law, appointed chief-justice of the common pleas, and knighted. His lordship presided in that court with a dignity, weight, and impartiality, never exceeded by any of his predecessors; and when John Wilkes was seized and committed to the Tower on an illegal general warrant, his lordship, with the intrepidity of a British magistrate, and the becoming fortitude of an Englishman, granted him an *habeas corpus*, and on his being brought before the court of common pleas, discharged him from his confinement in the Tower, 6th May 1763, in a speech which did him honour. His wise and spirited behaviour on this remarkable occasion, was so acceptable to the nation, that the city of London presented him with the freedom of their corporation in a gold box.

On the 16th of July 1765 he was created a peer of Great

Britain, by the style and title of Lord Camden, Baron Camden, in the county of Kent; and, on the 30th July 1766, on the resignation of Robert Earl of Northington, he was appointed lord high chancellor of Great Britain. In this capacity he, in a speech of two hours, declared, upon the first decision of the suit against the messengers who arrested Mr. Wilkes, that it was the unanimous opinion of the whole court, that general warrants, except in cases of high treason, were illegal, oppressive, and unwarrantable. He conducted himself in this high office so as to obtain the love and esteem of all parties; but when the taxation of America was in agitation, having declared himself against it, and strongly opposed it, he was removed from his station in 1770.

Upon the fall of Lord North he was again taken into the administration, and on the 27th of March 1782, appointed president of the council; an office which he resigned in March 1783. On the 13th of May 1786, he was created Viscount Bayham of Bayham Abbey, Kent, and Earl Camden. He died on the 18th of April 1794 at his house in Hill Street, Berkeley Square, being at that time president of his Majesty's most honourable privy council. He married Elizabeth, daughter and co-heir of Mr. Nicholas Jeffery, son and heir of Sir Jeffery Jefferys of Brecknock Priory, knight, who died in December 1779, and by whom he had issue John Jefferys Pratt, born 1759, and several daughters.

PRASLIN, an island in the eastern seas, one of the group called the Sechettis. It contains an excellent harbour, well sheltered by small islands from every wind. The interior is lofty, and covered with trees. Long. 55. 47. E. Lat. 4. 19. S.

PRATUS ISLES, a cluster of islands, shoals, and large rocks, in the Chinese sea, about 300 miles S.S.E. of Canton. The principal island, called Prata, is surrounded by a very extensive shoal of uncertain extent. They are six leagues in extent from north to south, and stretch three or four leagues to the east. Long. 116. 45. E. Lat. 23. 50. N.

PRAXAGORAS, a native of Athens, who, at nineteen years of age composed the History of the Kings of Athens, in two books; and at twenty-two wrote the Life of Constantine the Great, in which, though a pagan, he speaks very advantageously of that prince. He also wrote the History of Alexander the Great. Praxagoras lived under Constantine, about the year 345.

PRAXITELES, a very famous Greek sculptor, who lived 330 years before Christ, during the reign of Alexander the Great. All the ancient writers mention his statues with high commendation, especially a Venus executed by him for the city of Cnidus, which was so admirable a piece, that Nicomedes offered to release the inhabitants from their tribute as the purchase of it; but they refused to part with it. The inhabitants of the isle of Cos requested of Praxiteles a statue of Venus; and in consequence of this application the artist gave them their choice of two, one of them representing the goddess entirely naked, and the other covered with drapery. Both of these were of exquisite workmanship. Although the former was esteemed the most beautiful, nevertheless the inhabitants of Cos had the wisdom to give the preference to the latter, from a conviction that no motive whatever could justify their introducing into their city any indecent statues or paintings, which are so likely to inflame the passions of young people, and lead them to immorality and vice.

PRAYER, a solemn address to God, which, when it is of any considerable length, consists of *adoration*, *confession*, *supplication*, *intercession*, and *thanksgiving*.

By *adoration* we express our sense of God's infinite perfections, his power, wisdom, goodness, and mercy; and acknowledge that our constant dependence is upon Him by whom the universe was created and has been hitherto preserved. By *confession* is meant our acknowledgment of our manifold transgressions of the divine laws, and our consequent unworthiness of all the good things which we enjoy at present, or expect to be conferred upon us hereafter. In *supplication* we entreat our omnipotent Creator and merciful Judge, not to deal with us after our iniquities, but to pardon our transgressions, and by his grace to enable us to live henceforth righteously, soberly, and godly, in this present world; and by Christians this intreaty is always made in the name and through the mediation of Jesus Christ, because to them it is known that there is none other name under heaven given unto men whereby they may be saved. To these supplications for mercy, we may likewise add our prayers for the necessaries of life, because if we seek *first* the kingdom of God, and his righteousness, we are assured that such things shall be added unto us. *Intercession* signifies those petitions which we offer up for others, for friends, for enemies, for all men, especially for our lawful governors, whether supreme or subordinate. And *thanksgiving* is the expression of our gratitude to God, the giver of every good and perfect gift, for all the benefits enjoyed by us and others, for the means of grace, and for the hope of glory. Such are the component parts of a regular and solemn prayer, adapted either for the church or for the closet. But an ejaculation to God, conceived on any emergency, is likewise a prayer, whether it be uttered by the voice, or suffered to remain a mere affection of the mind; because the being to whom it is addressed discerneth the thoughts of the heart.

That prayer is a duty which all men ought to perform with humility and reverence, has been generally acknowledged as well by the untaught barbarian as by the enlightened Christian; and yet to this duty objections have been made by which the understanding has been bewildered in sophistry and affronted with jargon. "If God be independent, omnipotent, and possessed of every other perfection, what pleasure, it has been asked, can he take in our acknowledgment of these perfections? If he knows all things past, present, and future, where is the propriety of our confessing our sins unto him? If he is a benevolent and merciful Being, he will pardon our sins, and grant us what is needful for us without our supplications and entreaties; and if he be likewise possessed of infinite wisdom, it is certain that no importunities of ours will prevail upon him to grant us what is improper, or for our sakes to change the equal and steady laws by which the world is governed.

Shall burning Ætna, if a sage requires
Forget to thunder, and recal her fires?
On air or sea new motions be imprest,
O blameless Bethel, to relieve thy breast?
When the loose mountain trembles from on high,
Shall gravitation cease, if you go by?
Or some old temple, nodding to its fall,
For Chartres' head reserve the hanging wall?

Such are the most plausible objections which are usually made to the practice of prayer; and though they have been set off with all the art of the metaphysical wrangler, and embellished with all the graces of the poetry of Pope, they appear to us such gross sophisms as can operate only on a very unthinking head, or on a very corrupt heart. For if God certainly exists, and there is not a mathematical theorem capable of more rigid demonstration, it is obvious that no man can think of such a Being without having his mind strongly impressed with the conviction of his own constant dependence upon him; nor can he "contemplate the heavens, the work of God's hands, the moon and the stars which he has ordained," without forming the most sublime conceptions that he can of the Divine power, wisdom, and goodness. But such conviction, and such conceptions, whether clothed in words or not, are to all intents and purposes what is meant by adoration; and are as well known to the Deity whilst they remain the silent affections of the heart, as after they are spoken in the beginning of a prayer. Our adoration, therefore, is not expressed for the purpose of giving information to God, who understands our thoughts afar off; but merely, when the prayer is private, because we cannot think any more than speak without words, and because the very *sound* of words that are well chosen affects the heart, and helps to fix our attention. And as the Being who sees at once the past, present, and to come, and to whom a thousand years are but as one day, stands not in need of our information; so neither was it ever supposed by a man of rational piety, that he takes pleasure on his *own* account in hearing his perfections enumerated by creatures of yesterday; for being independent, he has no passions to be gratified, and being self-sufficient, he was as happy when existing alone as at that moment "when the morning stars sang together, and all the sons of God shouted for joy." Adoration is therefore proper only as it tends to preserve in our minds just notions of the Creator and Governor of the world, and of our own constant dependence upon him; and if such notions be useful to ourselves, who have a part to act in the scale of existence, upon which our happiness depends, a proposition which no theist will controvert, adoration must be acceptable to that benevolent God, who, when creating the world, could have no other end in view than to propagate happiness.

By the same mode of reasoning, it will be easy to show the duty of *confession* and *supplication*. We are not required to confess our sins unto God, because he is ignorant of them; for he is ignorant of nothing. If he were, no reason could be assigned for our divulging to our judge actions deserving of punishment. Neither are we required to cry for mercy, in order to move him in whom there is no variableness, neither shadow of turning. The Being that made the world, governs it by laws that are inflexible, because they are the best; and to suppose that he can be induced by prayers, oblations, or sacrifices, to vary this plan of government, is an impious thought, which degrades the Deity to a level with man. One of these inflexible laws is the connection established between certain dispositions of mind and human happiness. We are enjoined to pursue a particular course of conduct under the denomination of virtue, not because our virtuous actions can in any degree be of advantage to him by whom we are created, but because they necessarily generate in our own minds those dispositions which are essential to our ultimate happiness. A man of a malignant, arrogant, or sensual disposition, would have no enjoyment in that heaven, where all are actuated by a spirit of love and purity; and it is doubtless for this reason amongst others, that the Christian religion prohibits malice, arrogance, and sensuality, among her votaries, and requires the cultivation of the opposite virtues. But a person who has deviated far from his duty cannot think of returning, unless he be previously convinced that he has gone astray. Such conviction, whenever he obtains it, will necessarily impress upon his mind a sense of his own danger, and fill his heart with sorrow and remorse for having transgressed the laws established by the most benevolent of all Beings for the propagation of universal felicity This conviction of error, this sense of danger, and this compunction for having transgressed, are all perceived by the Deity as soon as they take place in the mind of the sinner; and he is required to *confess* his sins, only because the act of confession tends to imprint more deeply on his mind his own unworthiness, and the necessity of returning immediately into the paths of that virtue of which all the ways are pleasantness, and all the paths are peace.

In the objection, it is taken for granted, that if God be a benevolent and merciful Being, he will pardon our sins, and grant us what is needful for us, whether we supplicate him or not; but this is a gross and palpable mistake, arising from the objector's ignorance of the end of virtue and the nature of man. Until a man be sensible of his sins and his danger, he is, for the reason already assigned, incapable of pardon, because his disposition is incompatible with the happiness of the blessed. But whenever he acquires this conviction, it is impossible for him not to form a mental wish that he may be pardoned; and this wish being perceptible to the all-seeing eye of his Judge, forms the sum and substance of a supplication for mercy. If he clothe it in words, it is only for a reason similar to that which makes him adore his Creator and confess his sins in words, that just notions may be more deeply imprinted on his own mind. The same reasoning holds good with respect to those prayers which we put up for temporal blessings, for protection and support in our journey through life. We are told by high authority, that "the Lord is nigh unto all them that call upon him, to all that call upon him in truth." This, however, is not because he is attracted or delighted by their prayers and entreaties, but because those prayers and entreaties fit such as offer them for receiving those benefits which he is at all times ready to pour upon all mankind. In his essence God is equally present with the righteous and with the wicked, with those who pray, and with those who pray not; for "the eyes of the Lord are in every place, beholding the evil and the good." But as the atmosphere equally surrounds every person upon this globe, and yet in its state of greatest purity does not affect the asthmatic as it affects those who are whole; so the Divine presence, though essentially the same everywhere, yet does not protect the impious as it protects the devout, because the impious are not in a state capable of the Divine protection. The end for which God requires the exercise of prayer as a duty, is not his benefit, but ours; because it is a mean to generate in the petitioner such a disposition of mind as must render him a special object of that love and that providential care which extend over the whole creation.

That part of the objection which results from the consideration of the fixed laws of nature, and which the poet has so finely illustrated, presents, it must be confessed, considerable difficulties; but none which to us appear insurmountable. If, indeed, we suppose that in the original constitution of things, when the laws of nature were established, a determinate duration was given to the top of the mountain and the nodding temple, without any regard to foreseen consequences, it would undoubtedly be absurd and perhaps impious to expect the law of gravitation to be suspended by the prayers of a good man, who should happen to be passing at the instant decreed for the fall of these objects. But of such a constitution there is so far from being evidence, that it appears not to be consistent with the wisdom and goodness of the Author of nature. This world was undoubtedly formed for the habitation of man and of other animals. If so, we must necessarily suppose, that in the establishing of the laws of nature, God adjusted them in such a manner as he saw would best serve the accommodation of those sentient beings for whose accommodation alone they were to be established. Let it then be admitted, that all the human beings who were ever to exist upon this globe, with all their thoughts, words, and actions, were at that important moment present to the divine intellect, and it will surely not be impossible to conceive that in consequence of the foreseen danger and prayers of a good man, the determinate duration of the mountain and the tower might be either lengthened or shortened to let him escape. This idea of providence, and of the efficacy of prayer, is thus illustrated by Mr. Wollaston. "Suppose M (some man) certainly to *foreknow*, by some means or other, that, when he should come to be upon his death-bed, L would *petition* for some *particular legacy*, in a manner so earnest and humble, and with such a good disposition, as would render it proper to grant his request; and upon this, M makes his *last will*, by which he devises to L that which was to be asked, and then locks up the *will*; and all this many years before the death of M, and whilst L had yet no expectation or thought of any such thing. When the time comes, the *petition* is made and *granted;* not by making any *new* will, but by the old one already made, and without alteration; which legacy had, notwithstanding that, never been left, had the petition never been preferred. The grant may be called the effect of a future act, and depends as much upon it as if it had been made after the act. So, if it had been foreseen, that L would not *so much as ask*, and he had been therefore left out of the will, this *præterition* would have been caused by his carriage, though much later than the date of the will. In all this nothing is hard to be admitted, if M be allowed to foreknow the case. And thus the *prayers* which good men offer to the *all-knowing* God, and the *neglect of prayers* by others, may find fitting effects *already* forecasted in the course of nature."

This solution of the difficulty presents indeed to the mind a prodigious scheme, in which all things to come are, as it were, comprehended under one view, and estimated and compared together. But when it is considered what a mass of wonders the universe is in other respects; what an incomprehensibly great and perfect being God is; that he cannot be ignorant of any thing, no not of the future wants and deportments of particular men; and that all things which derive their existence from him must be consistent with one another, it must surely be confessed that such an adjustment of physical causes to moral volitions is within the compass of infinite power and perfect wisdom.

To that part of a prayer which we have termed intercession, it has been objected, that " to intercede for others is to presume that we possess an interest with the Deity upon which their happiness and even the prosperity of whole communities depends." In answer to this objection, it has been observed by an ingenious and useful writer (Mr. Paley), that " how unequal soever our knowledge of the Divine economy may be to a complete solution of this difficulty, which may require a comprehension of the entire plan, and of all the ends of God's moral government, to explain it satisfactorily, we can yet understand one thing concerning it, that it is, after all, nothing more than the making of one man the instrument of happiness and misery to another; which is perfectly of a piece with the course and order that obtain, and which we must believe were intended to obtain, in human affairs. Why may we not be assisted by the *prayers* of other men, as well as we are beholden for our *support to their labour?* Why may not our happiness be made in some cases to depend upon the intercession as it certainly does in many upon the good offices of our neighbours? The happiness and misery of great numbers we see oftentimes at the disposal of one man's choice, or liable to be much affected by his conduct; what greater difficulty is there in supposing, that the prayers of an individual may avert a calamity from multitudes, or be accepted to the benefit of whole communities."

These observations may perhaps be sufficient to remove the force of the objection, but much more may be said for the practice of mutual intercession. If it be one man's duty to intercede for another, it is the duty of that other to intercede for him; and if we set aside the particular relations which arise from blood, and from particular stations in society, mutual intercession must be equally the duty of all mankind. But there is nothing (we speak from our own experience, and appeal to the experience of our readers), which has so powerful a tendency to generate in the heart of any person good-will towards another, as the constant practice of praying to God for his happiness. Let a man regularly pray for his enemy with all that seriousness which devotion requires, and he will not long harbour resentment against him. Let him pray for his friend with that ardour which friendship naturally inspires, and he will perceive his attachment to grow daily and daily stronger. If, then, universal benevolence, or charity, be a disposition which we ought to cultivate in ourselves, mutual intercession is undeniably a duty, because nothing contributes so effectually to the acquisition of that spirit which an apostle terms the end of the commandment.

When it is said, that by interceding for kings, and all in authority, we seem to consider the prosperity of communities as depending upon our interest with God, the objector mistakes the nature and end of these intercessions. In the prosperity of any community consists great part of the happiness of its individual members; but that prosperity depends much upon the conduct of its governors. When, therefore, individuals intercede for their governors, the ultimate object of their prayers must be conceived to be their own good.

Having evinced the duty of adoration, confession, supplication, and intercession, we need not surely waste our readers' time with a formal and laboured vindication of thanksgiving. Gratitude for benefits received is so universally acknowledged to be a virtue, and ingratitude is so detestable a vice, that no man who lays claim to a moral character will dare to affirm that we ought not to have a just sense of the goodness of God. (H.H.H.H)

PREADAMITE, a denomination given to the inhabitants of the earth, conceived, by some people, to have lived before Adam.

Isaac de la Pereyra, in 1655, published a book to evince the reality of Preadamites, by which he gained a considerable number of proselytes to the opinion; but the answer of Desmarets, professor of theology at Gröningen, published the year following, put a stop to its progress, though Pereyra made a reply.

PREBEND, the maintenance a prebendary receives out of the estate of a cathedral or collegiate church. Prebends are distinguished into simple and dignitary. A simple prebend has no more than the revenue for its support; but a prebend with dignity has always a jurisdiction annexed to it.

PREBENDARY, an ecclesiastic who enjoys a prebend. The difference between a prebendary and a canon is, that the former receives his prebend in consideration of his officiating in the church, but the latter merely by his being received into the cathedral or college.

PRECEDENCE, a place of honour to which a person is entitled. This is either of courtesy or of right. The former is that which is due to age, estate, or the like, and is regulated by custom and civility; the latter is settled by authority, and when broken in upon, gives an action at law.

In Great Britain, the order of precedency is as follows: The king, the princes of the blood, the archbishop of Canterbury, the lord high chancellor, the archbishop of York, the lord treasurer of England, the lord president of the council, the lord privy seal, dukes, the eldest sons of dukes of the blood royal, marquises, dukes' eldest sons, earls, marquises' eldest sons, dukes' younger sons, viscounts, earls' eldest sons, marquises' younger sons, bishops, barons, speaker of the house of commons, lord commissioner of the great seal, viscounts' eldest sons, earls' younger sons, barons' eldest sons, privy counsellors not peers, chancellor of the exchequer, chancellor of the duchy, knights of the Garter not peers, lord chief justice of the king's bench, master of the rolls, lord chief justice of the common pleas, lord chief baron of the exchequer, puisne judges and barons, knights banneret if made in the field, masters in chancery, viscounts' younger sons, barons' younger sons, baronets, knight banneret, knights of the Bath, knights batchelors, baronets' eldest sons, knights' eldest sons, baronets' younger sons, knights' younger sons, field and flag officers, doctors graduate, serjeants at law, esquires, gentlemen bearing coat armour, yeomen, tradesmen, artificers, labourers. It is to be observed, the ladies, except those of archbishops, bishops, and judges, take place according to the degree of quality of their husbands; and unmarried ladies take place according to that of their fathers.

PRECESSION OF THE EQUINOXES.

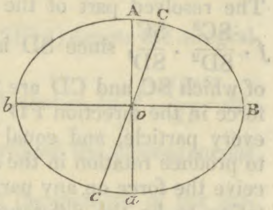
In the article **Astronomy** (vol. vi. p. 767), the phenomenon of the annual precession of the equinoxes has been described, and its physical cause stated to be the attraction of the sun and moon upon the protuberant mass of matter accumulated about the earth's equator, combined with the diurnal rotation. We shall here discuss the subject more particularly, and shew in what manner the different forces which tend to displace the plane of the earth's equator give rise to the phenomenon in question, and how their effects are computed from the fundamental principles of dynamics. The general problem, which is that of determining the perturbations of the earth's axis of rotation, embraces the *Nutation* of the axis, as well as the precessional motion of the equinoctial points, and is one of the most important and interesting in physical astronomy.

If the earth were a perfect sphere, the attraction of the sun or moon would have no tendency to communicate to it any motion about its centre of gravity. In this case, all the particles being symmetrically disposed with reference to every plane passing through its centre, the forces acting on opposite sides of any plane passing through its centre and the centre of the attracting body, would exactly balance each other, and consequently would have no tendency to produce a rotatory motion. But by reason of the spheroidal form of the earth, and of the intensity of the force of attraction varying with the distance, the action of a distant body which is not situated either in the plane of the equator, or in the prolongation of the axis of rotation, produces an unequal effect on the opposite sides of every plane passing through the earth's centre, (excepting the meridian in which the body is situated), and tends to produce a rotatory motion about that diameter of the equator which is perpendicular to the line which joins the centre of the earth with the centre of the attracting body. Hence the sun exerts a force, which at every instant has a tendency to bring the plane of the earth's equator towards the plane of the ecliptic; and if the earth had no motion of rotation about its axis, the two planes would at length be brought to coincide. In consequence, however, of the rotatory motion, the inclination of the two planes, as we shall shew, undergoes no permanent alteration; but a motion is given to the earth's axis, such that the pole of the equator constantly revolves about the pole of the ecliptic in the direction opposite to that of the diurnal rotation, and the intersection of the equator and ecliptic, following the motion of the pole, is carried backwards along the ecliptic. The moon produces a similar effect in reference to the plane of the lunar orbit; and the motion produced by the combined action of the sun and moon, which is the phenomenon observed, is the *luni solar* precession of the equinoxes.

As the efficacy of the disturbing force to turn the earth about an axis varies with the distance of the attracting body from the plane of the equator, the precessional motion of the equinoxes is not uniform. The efficacy of the sun's force continues to increase, while the sun passes from either equinox to the solstice, and to diminish while it passes from the solstice to the equinox. The period of the inequality is consequently half a-year. The period in which the action of the moon passes through all its degrees of intensity is about nine years, being that in which the nodes of the lunar orbit accomplish half a revolution on the ecliptic. The apparent effect of this irregular action, is an alternate increase and diminution of the declinations of the fixed stars, most sensible for those nearest the pole, which is characteristically called the *nutation* of the earth's axis. The solar nutation, however, is so small as to be insensible to observation; the lunar nutation is sufficiently sensible, amounting to about 18″ between the extreme positions of the pole.

Before proceeding with the investigation of the problem, it will be convenient to premise the two following elementary theorems respecting the composition of rotatory motion, referring the reader for their demonstration to the article **Rotation**.

Theorem 1. If a rigid body revolving about an axis A*a*, which passes through its centre of gravity O, with an angular velocity $=v$, receive an impulse which alone would cause it to revolve about an axis B*b*, also passing through its centre of gravity, with a velocity $=\phi$, the body will now revolve about a third axis C*c*, passing through its centre of gravity, and lying in the plane of the two axes A*a* and B*b*, and so situated that the sine of its inclination to the axis A*a* will be to the sine of its inclination to the axis B*b*, as the velocity about B*b* to the velocity about A*a*; that is, the new axis will divide the angle AOB, so that sin AOC : sin BOC : : $\varphi : v$.



In order to determine whether the pole C of the new axis lies between A and B, or between A and *b*, it is only necessary to consider that the new axis must evidently be that line in the body in which every point is at rest in respect of both motions. If, therefore, we suppose the original motion about A*a*, to be in the direction which would raise the point B above the plane of the paper, and to depress *b* below it, and the new impulse to be given in the direction which would depress the point A below the plane of the paper, and raise *a* above it, then C will lie between A and B; but if the new impulse tends to raise A above the plane of the paper, then C will lie between A and *b*.

Corollary 1. If the two axes A*a* and B*b* are at right angles, then sin BOC = cos AOC, and we have $\frac{\sin \mathrm{AOC}}{\cos \mathrm{AOC}} = \frac{\varphi}{v}$, that is, $\tan \mathrm{AOC} = \frac{\varphi}{v}$.

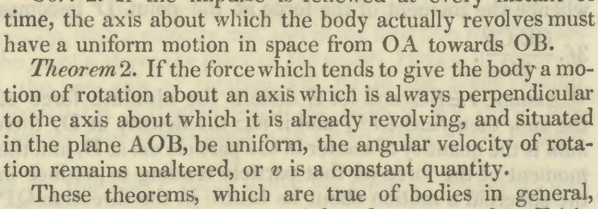
Cor. 2. If the impulse is renewed at every instant of time, the axis about which the body actually revolves must have a uniform motion in space from OA towards OB.

Theorem 2. If the force which tends to give the body a motion of rotation about an axis which is always perpendicular to the axis about which it is already revolving, and situated in the plane AOB, be uniform, the angular velocity of rotation remains unaltered, or v is a constant quantity.

These theorems, which are true of bodies in general, whatever be their figure, were first demonstrated by Frisi.

Proposition 1. To determine the efficacy of the sun's attraction to turn the spheroid about its centre, the earth being supposed homogeneous.

Let P*p* be the axis of rotation, Q*q* the projection of the equator, S the sun, C the centre of the spheroid, and D



Precession of the Equinoxes.

the projection of a point in the interior of the spheroid on the plane PQ*pq*. Join SC, SD, DC; and draw CG perpendicular to SC, and DE, DF respectively perpendicular to SC, CG.

Let f represent the force of the sun's attraction on a particle at the centre C, and f' the force of its attraction on a particle at D, then the attraction being inversely as the square of the distance, we have $f'=f\cdot\frac{\mathrm{SC}^2}{\mathrm{SD}^2}$. Now the force f', which acts on D in the direction SD, may be resolved into two; one in the direction CD, which has no tendency to turn the spheroid about its centre, and the other in the direction FD parallel to SC, which tends to turn the spheroid in the direction PQ about an axis passing through C, and perpendicular to the plane PQ*pq*. The resolved part of the force f', in the direction FD is $f\cdot\frac{\mathrm{SC}^2}{\mathrm{SD}^2}\cdot\frac{\mathrm{SC}}{\mathrm{SD}}$, since SD is the diagonal of a parallelogram of which SC and CD are the sides. Now, if the resolved force in the direction FD parallel to SC were the same on every particle, and equal to f, it would have no tendency to produce rotation in the spheroid; we may therefore conceive the force on any particle which tends to produce rotation to be the difference between the part of the force acting on that particle in the direction parallel to SC, and the force f acting on the particle at C. Hence the force on D tending to impress a rotatory motion on the spheroid is $f\cdot\left(\frac{\mathrm{SC}^2}{\mathrm{SD}^2}\cdot\frac{\mathrm{SC}}{\mathrm{SD}}-1\right)=f\cdot\frac{\mathrm{SC}^3-\mathrm{SD}^3}{\mathrm{SD}^3}=f\cdot\frac{(\mathrm{SC}-\mathrm{SD})\,(\mathrm{SC}^2+\mathrm{SC}\cdot\mathrm{SD}+\mathrm{SD}^2)}{\mathrm{SD}^3}$. Now by reason of the great distance of the sun in comparison of the radius of the earth, SD is very nearly parallel to SC, and equal to SC—CE. Substituting therefore SC—CE for SD, and neglecting terms divided by SC^2 which are so small as to be altogether insensible, the factor $\frac{\mathrm{SC}^2+\mathrm{SC}\cdot\mathrm{SD}+\mathrm{SD}^2}{\mathrm{SD}^3}$ becomes $\frac{3}{\mathrm{SD}}$, and consequently the above expression is reduced to $3f\cdot\frac{\mathrm{CE}}{\mathrm{SD}}$, or to $3f\cdot\frac{\mathrm{CE}}{\mathrm{SC}}$, since the difference between $1\div\mathrm{SD}$ and $1\div\mathrm{SC}$ is a quantity divided by SC^2, and therefore insensible. This is the part of the force on D which tends to turn the spheroid about the diameter of the equator which is perpendicular to Q*q*; and by the principles of mechanics, its efficacy in communicating a rotatory motion to the spheroid is proportional to the distance of its line of direction from the axis, that is, proportional to CF; whence the moment of the force at the point D becomes $3f\cdot\frac{\mathrm{CE}\cdot\mathrm{CF}}{\mathrm{SC}}$.

Assume $r=\mathrm{SC}$, and let S denote the absolute force of the sun, then $f=\mathrm{S}\div r^2$; and if $k=$ the density at D, then kdm is the quantity of matter in the particle dm at D, and the moment of the force on that particle tending to produce in the spheroid a motion about its centre in the direction QP (which is the general direction of the motion produced by the forces on all the particles) is $-\frac{3\mathrm{S}}{r^3}\cdot\mathrm{CE.CF}.\ k.dm$, the integral of which must be taken for the whole spheroid.

Draw DM parallel to P*p*, and MN perpendicular to DF, meeting SC in O, and make

$$\mathrm{CM}=\mathrm{X},\ \mathrm{DM}=y,\ \mathrm{SCP}=\theta,$$

(θ being the complement of the sun's declination) then $\mathrm{CE}=\mathrm{DN}+\mathrm{NF}=y\cos\theta+x\sin\theta$, and $\mathrm{CF}=\mathrm{MN}-\mathrm{MO}=y\sin\theta-x\cos\theta$, whence the moment of the force impressed on D becomes

$$\frac{3}{r^3}\,kdm\left\{(x^2-y^2)\sin\theta\cos\theta+xy\,(\cos^2\theta-\sin^2\theta)\right\}.$$

In order to find the integrals $\int kx^2dm$, $\int ky^2dm$, $\int kxydm$ for every particle in the spheroid, let z be the co-ordinate perpendicular to the plane of the figure, and conceive the whole spheroid to be divided into an infinite number of thin slices parallel to the plane of yz, the thickness of each slice being dx; suppose, again, each slice to be divided into an infinity of parallelepipeds, parallel to the axis z, and terminated by the surface of the spheroid, the breadth of each being dy; and, lastly, let each parallelepiped be divided into an infinite number of lengths, each $=dz$. The element of the volume, dm, then becomes $dxdydz$; and consequently the sum of kx^2dm in respect of every particle is expressed by the triple integral $\int\int\int kx^2dxdydz$.

Precession of the Equinoxes.

Assuming x^2, dx and dy to be constant, and integrating with respect to z, we obtain $kx^2dxdyz+$const. Let $a=$ the semi-diameter of the equator, $b=$ the polar semi-axis, and the equation of the spheroid is $\frac{x^2}{a^2}+\frac{y^2}{b^2}+\frac{z^2}{a^2}=1$, from which the limits of z must be found. This equation gives for a point at the surface, $z=\pm a\sqrt{1-\frac{x^2}{a^2}-\frac{y^2}{b^2}}$, and between those values of z the definite integral becomes

$$2\,kax^2dxdy\sqrt{1-\frac{x^2}{a^2}-\frac{y^2}{b^2}}.$$

This expresses the sum of kx^2dm for the parallelepiped corresponding to a given value of x.

If we next suppose x^2 and dx to be constant, and integrate this expression with respect to y, we shall have the sum of kx^2dm for the slice, the distance of which from the plane yz is x. Make $1-\frac{x^2}{a^2}=\frac{u^2}{b^2}$, or $u^2=b^2-\frac{b^2x^2}{a^2}$, and the expression becomes $\frac{2kax^2dx}{b}\sqrt{u^2-y^2}.\,dy$. In integrating this expression, the limits of y, in respect of any given value of x, are obtained from the equation of the section of the ellipsoid in the plane xy, namely $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$. This equation gives $y^2=b^2-\frac{b^2x^2}{a^2}$; whence, at the limits $y^2=u^2$, and therefore $y=\pm u$. Now, by a known formula, the integral $\int\sqrt{u^2-y^2}.dy$ from $y=-u$ to $y=+u$ is $\frac{1}{2}\pi u^2$ (π being the ratio of the circumference to the diameter); therefore the integral of x^2dm for the slice corresponding to a given value of x is $\frac{\pi kau^2x^2dx}{b}$; which, on substituting for u^2, its value $b^2-\frac{b^2}{a^2}x^2$, becomes

$$\pi k\frac{b}{a}(a^2x^2-x^4)dx.$$

We have lastly to integrate this expression from $x=-a$ to $x=+a$. The integral between those limits is $\frac{2\pi kb}{a}\left(\frac{a^5}{3}-\frac{a^5}{5}\right)$; whence we have ultimately, in respect of the whole spheroid,

$$\int\int\int kx^2dxdydz=\tfrac{4}{15}\pi ka^4b.$$

On going through the same process for y^2dm, or $y^2dxdydz$, and observing that the integral $\int y^2\sqrt{u^2-y^2}.dy$ from $y=-u$ to $y=+u$ is $\frac{1}{8}\pi u^4$, there results for the whole spheroid

$$\int\int\int ky^2dxdydz=\tfrac{4}{15}\pi ka^2b^3.$$

With respect to the remaining integral $\int xydm$, it is easy to see that its value in respect of the whole spheroid must be 0, for on integrating $kxydxdydx$ with respect to x, there results $\frac{1}{2}kx^2ydydz$, which vanishes on giving x all values between $-t$ and $+t$, t being any definite quantity.

From these values of $\int x^2dm$, $\int y^2dm$, $\int xydm$, we obtain the following expression for the moment of all the forces impressed on the spheroid,

$$\frac{3S}{r^3}\cdot\frac{4\pi}{15}ka^2b(a^2-b^2)\sin\theta\cos\theta.$$

Prop. 2. To determine the efficacy of the sun's attraction to turn the spheroid about its centre, the earth being supposed heterogeneous.

Conceive the spheroid to be composed of infinitely thin concentric layers, bounded by spheroidal surfaces, and suppose the ellipticity and density to be different for each layer, but both to be functions of the distance from the centre of the spheroid. Let α and β be respectively the equatorial and polar semi-diameters of the layer which contains a particle dm, $e=$ its ellipticity, and k its density. In order to find the moment of all the forces impressed on the spheroid, we must first find an expression in terms of β, for their moment on the elementary layer containing dm, and then integrate this expression from $\beta=0$ to $\beta=b$. Now, suppose all the matter of the spheroid exterior to the layer in question to be removed, and suppose also for a moment the matter in the interior of the spheroidal surface passing through dm to be all of the same density, k, then the moment of the impressed forces on the spheroid whose surface passes through dm, is by the last proposition

$$\frac{3S}{r^3}\cdot\frac{4\pi}{15}k\alpha^2\beta(\alpha^2-\beta^2)\sin\theta\cos\theta.$$

The variable part of this expression is $k\alpha^2\beta(\alpha^2-\beta^2)$. Now, since $\alpha=\beta(1+e)$, we have, on neglecting terms multiplied by e^2, which, by reason of the smallness of the earth's ellipticity are altogether insensible, $\alpha^2=\beta^2+2\beta^2e$ and $\alpha^2-\beta^2=2\beta^2e$, whence $k\alpha^2\beta(\alpha^2-\beta^2)=2k\beta^5e$. Suppose now the semi-axis β to receive an infinitely small increment, and to become $\beta+d\beta$; then since k and e are both functions of β, the expression $2k\beta^5e$ will become $2k\beta^5e+\frac{2d(k\beta^5e)}{d\beta}d\beta$. This is the variable part of the moment of the forces on the spheroid whose semiaxis is $\beta+d\beta$; consequently, in respect of the spheroidal layer which remains on subtracting the spheroid whose semiaxis is β, it becomes $\frac{2d(k\beta^5e)}{d\beta}d\beta$. Let the integral of this expression between the limits $\beta=0$ and $\beta=b$ be denoted by $2\,F(\beta)$; then the moment of all the forces impressed on the spheroid supposed heterogeneous is

$$\frac{3S}{r^3}\cdot\frac{8\pi}{15}F(\beta)\sin\theta\cos\theta.$$

Prop. 3. To determine the angular velocity φ generated by the sun's force, and the position of the equator after the infinitely small time dt.

By dynamics, the angular velocity of rotation is equal to the moment of the impressed forces divided by the moment of inertia of the mass to be moved. Now, the moment of inertia of a body, with respect to a given axis of rotation, is the sum of the products obtained by multiplying each particle of the body into the square of its distance from the axis; that is, in respect of the axis z, about which the impressed forces tend to turn the spheroid, the moment of inertia is $\int(x^2+y^2)dm$, supposing the spheroid homogeneous, and the density $k=1$. But it has been shewn that in this case $\int x^2dm=\frac{4}{15}\pi a^4b$, and $\int y^2dm=\frac{4}{15}\pi a^2b^3$; therefore the moment of inertia of the spheroid is $\frac{4}{15}\pi a^2b(a^2+b^2)$. And by prop. 1, the moment of the impressed forces is $\frac{3S}{r^3}\cdot\frac{4}{15}\pi a^2b(a^2-b^2)\sin\theta\cos\theta$, therefore

$$\varphi=\frac{3S}{r^3}\cdot\frac{a^2-b^2}{a^2+b^2}\sin\theta\cos\theta.$$

In the case of the heterogeneous spheroid the moment of inertia is thus found. As before, let α and β be the equatorial and polar semiaxes of the spheroidal surface passing through the particle dm, then if the matter within this surface be supposed of uniform density $=k$, the moment of inertia of this spheroid, by what is already shewn, is $\frac{4}{15}\pi k\alpha^2\beta(\alpha^2+\beta^2)$. But $\alpha^2+\beta^2=2\beta^2+2\beta e$, and $\alpha^2\beta=\beta^3+2\beta^3e$, therefore $\alpha^2\beta(\alpha^2+\beta^2)=2\beta^5+6\beta^5e$; and since e is a very small quantity, the second term of this expression is very small, and may be neglected in comparison of the first; therefore $k\alpha^2\beta(\alpha^2+\beta^2)=2k\beta^5$. For the spheroid whose semiaxis is $\beta+d\beta$, this quantity becomes $2k\beta^5+\frac{2d(k\beta^5)}{d\beta}d\beta$, and therefore in respect of the elementary spheroidal layer the semiaxes of whose interior and exterior surfaces are β and $\beta+d\beta$, it is $\frac{2d(k\beta^5)}{d\beta}d\beta$. Let $2F'(\beta)$ denote the integral of this quantity from $\beta=0$ to $\beta=b$, that is, let $\int\frac{d(k\beta^5)}{d\beta}d\beta=2F'(\beta)$, and the moment of inertia of the heterogeneous spheroid becomes $\frac{8\pi}{15}F'(\beta)$. But the moment of the impressed forces is by prop. 2, $\frac{3S}{r^3}\cdot\frac{8\pi}{15}F(\beta)\sin\theta\cos\theta$, therefore in the case of the heterogeneous spheroid,

$$\phi=\frac{3S}{r^3}\cdot\frac{F(\beta)}{F'(\beta)}\sin\theta\cos\theta.$$

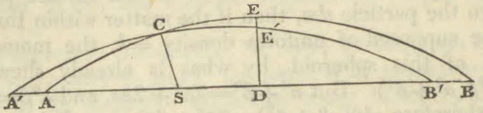
Let us assume $K=\frac{a^2-b^2}{a^2+b^2}$ in the case of the homogeneous spheroid, and $K=\frac{F(\beta)}{F'(\beta)}$ in the case of the heterogeneous spheroid, and we have for both cases

$$\phi=\frac{3S.K}{r^3}\sin\theta\cos\theta.$$

Now to find the place of the pole, and the position of the equator after the small interval of time dt, we must apply the first of the two theorems above premised. If the earth had no diurnal rotation, the sun's force would cause it to revolve about an axis passing through C perpendicular to the meridian P Qpq, or perpendicular to the plane of the paper, so as to bring the point Q nearer to the line SC, with a velocity $=\phi$. But the earth is already revolving about the axis Pp, with a velocity $=v$, and in the direction which raises the point q above the plane of the paper. Hence, by theorem 1, the new axis of rotation will be in the plane passing through Pp, perpendicular to the plane of the paper, and after the time dt will make with Pp an angle whose tangent $=\frac{\phi}{v}$, the pole P rising above the plane of the paper; and the new equator will intersect the former in the line Qq, and make with it an angle whose tangent is also $\frac{\phi}{v}$. The effect of the compound motion is thus to twist as it were the equator about the line Qq as an axis, or about that diameter of the equator which lies in the same meridian with the sun, instead of twisting it about the diameter perpendicular to that meridian, as would be the case if the earth had no diurnal motion.

Prop. 4. To find the amount of the solar precession after any given time.

Let AB be the intersection of the plane of the ecliptic, with the surface of sphere whose centre is at the centre of the earth; let ACB be the equator, and S the projection of the sun's place in the ecliptic. Now, the plane of the



equator being always perpendicular to the axis of rotation, when the axis changes its position the equator will also change its position, and the new equator will intersect the former in an angle equal to the deviation of the axis. Let A'CB' be the new position of the equator, after the infinitely small time dt, intersecting the former in C, then the angle ACA' is the measure of the momentary deviation of the axis, and AA', which is the amount of variation in the place of the node, is the precession in the time dt.

From the properties of spherical triangles we have sin SAC : sin ACA' :: sin A'C : sin AA'. But because ACA' is a very small angle, and AA' a very small arc, the arcs may be taken instead of the sines; whence, since A'C = AC, the proportion gives $\mathrm{AA'} = \mathrm{ACA'}\,\dfrac{\sin \mathrm{AC}}{\sin \mathrm{SAC}}$.

But by the last proposition $\tan \mathrm{ACA'} = \dfrac{\phi}{v} = \dfrac{3\mathrm{S.K}}{vr^3} \sin\theta \cos\theta$, therefore, as the small arc may be substituted for its tangent,

$$\mathrm{AA'} = \frac{3\mathrm{S.K}}{vr^3}\,\frac{\sin \mathrm{AC}}{\sin \mathrm{SAC}} \sin\theta \cos\theta.$$

It will now be convenient to express this value of AA' in terms of the sun's longitude and the obliquity of the ecliptic. Since the equator, as was shewn in the last proposition, is twisted about the diameter which is in the same meridian with the sun, it follows that the line joining S and C is a part of the meridian; whence ACS is a right angle, and SC (the sun's declination) $= 90° - \theta$. Let $l = \mathrm{AS}$, (the sun's longitude), and $\mathrm{I} = \mathrm{SAC}$, (the obliquity of the ecliptic), then, in the right angled spherical triangle SAC, we have $\cos \mathrm{SC} \,.\, \cos \mathrm{AC} = \cos \mathrm{AS}$, or $\sin\theta \cos \mathrm{AC} = \cos l$; and $\sin \mathrm{SC} = \sin \mathrm{SAC} \sin \mathrm{AS}$, or $\cos\theta = \sin \mathrm{I} \sin l$, therefore $\sin\theta\cos\theta = \dfrac{\sin \mathrm{I} \sin l \cos l}{\cos \mathrm{AC}}$. Again, in the same triangle we have $\tan \mathrm{AC} = \cos \mathrm{SAC} \tan \mathrm{AS}$, whence $\sin \mathrm{AC} = \cos \mathrm{AC} \cos \mathrm{I} \tan l$, and (dividing by $\sin \mathrm{SAC} = \sin \mathrm{I}$) $\dfrac{\sin \mathrm{AC}}{\sin \mathrm{SAC}} = \dfrac{\cos \mathrm{AC} \cos \mathrm{I} \sin l}{\sin \mathrm{I} \cos l}$. Substituting these values of $\sin\theta\cos\theta$ and $\dfrac{\sin \mathrm{AC}}{\cos \mathrm{AC}}$ in the above value of AA', we get

$$\mathrm{AA'} = \frac{3\mathrm{S.K}}{vr^3} \cos \mathrm{I} \sin^2 l.$$

This is the solar precession in the element of time dt; consequently for a given time T we have

$$\text{solar precession} = \frac{3\mathrm{S.K} \cos \mathrm{I}}{v} \int \frac{\sin^2 l}{r^3}\, dt,$$

the integral being taken from $t = 0$ to $t = \mathrm{T}$.

To prepare this expression for integration, r^3 and dt must be expressed in terms of l and known quantities. Let a = semiaxis major of the earth's orbit, ϵ = its eccentricity, T = a sidereal year, then r being the radius vector, and dl the angle described in the time dt, $\frac{1}{2}r^2 dl$ is the space passed over by the radius vector in the element of the time, and by Kepler's law of the equable description of areas, we have $dt : \mathrm{T} :: \frac{1}{2}r^2 dl :$ area of orbit.

Now the area of the orbit is $\pi a^2 \sqrt{1-\epsilon^2}$, therefore this proportion gives $dt = \dfrac{\mathrm{T}r^2 dl}{2\pi a^2 \sqrt{1-\epsilon^2}}$. But it is shewn in the article ASTRONOMY, part iii. art. 10, that $\mathrm{T} = 2\pi\sqrt{a} \div \sqrt{\mathrm{F}}$, where F is the attracting force at the mean distance a. But we have assumed S to denote the sun's force at the unit of distance; therefore, the forces being inversely as the squares of the distances, $\mathrm{F} = \mathrm{S} \div a^2$, whence $\mathrm{T} = \dfrac{2\pi a^{\frac{3}{2}}}{\sqrt{\mathrm{S}}}$. From this formula we get $\mathrm{S} = \dfrac{4\pi^2 a^3}{\mathrm{T}^2}$, and therefore $\dfrac{\mathrm{S}.dt}{r^3} = \dfrac{2\pi a\, dl}{\mathrm{T}r\sqrt{1-\epsilon^2}}$. Again, assuming λ = longitude of sun's perigee, the polar equation of the ellipse gives $r = \dfrac{a(1-\epsilon^2)}{1+\epsilon \cos(l-\lambda)}$; whence $\dfrac{\mathrm{S}.dt}{r^3} = \dfrac{2\pi\{1+\epsilon\cos(l-\lambda)\}\, dl}{\mathrm{T}(1-\epsilon^2)^{\frac{3}{2}}}$, and the above expression becomes

$$\text{solar precession} = \frac{6\pi \mathrm{K} \cos \mathrm{I}}{\mathrm{T}v(1-\epsilon^2)^{\frac{3}{2}}} \int \sin^2 l\{1+\epsilon\cos(\lambda - l\}\, dl.$$

The expression under the sign of integration consists of two parts, of which the first $\int \sin^2 l\, dl = \frac{1}{2}(\mathrm{C} + l - \cos l \sin l)$. (See FLUXIONS, art. 153.) The second part, namely $\int \epsilon \sin^2 l \cos(l-\lambda)\, dl$, when integrated becomes $\epsilon \sin(l-\lambda) - \dfrac{\epsilon}{2} \sin(l+\lambda) - \dfrac{\epsilon}{6} \sin(3l-\lambda)$, but by reason of the smallness of ϵ these terms are insensible, and are therefore neglected. Rejecting also the terms in the divisor of the coefficient which are multiplied by ϵ^2, and observing that $\cos l \sin l = \frac{1}{2} \sin 2l$, we obtain, finally,

$$\text{solar precession} = \frac{3\pi \mathrm{K} \cos \mathrm{I}}{\mathrm{T}v}(\mathrm{C} + l - \tfrac{1}{2}\sin 2l).$$

The first term of this expression, which depends on $\mathrm{C} + l$, or on the sun's longitude, is the constant or uniform precession. Its amount in one year is found by supposing l to be increased by 2π, and is consequently $\dfrac{6\pi^2 \mathrm{K} \cos \mathrm{I}}{\mathrm{T}v}$. The second is periodic, and being proportional to twice the sine of the sun's longitude, it runs through its changes in half a-year. It is usually regarded as a part of solar nutation, and called *the solar equation of the equinoxes in longitude.*

Prop. 5. To find the diminution of the obliquity of the ecliptic produced by the sun's attraction.

Referring to the last diagram, make AE = EB = 90°, and let ED be perpendicular to AB the ecliptic, and meet A'CB' in E', then EE' is the small change in the inclination in the time dt. In the triangle ECE', we have $\sin \mathrm{EE'} = \sin \mathrm{CE} \sin \mathrm{ECE'}$. But EE' being very small, the arc may be taken for the sine, and therefore $\mathrm{EE'} = \sin \mathrm{CE} \sin \mathrm{ECE'}$. Now $\sin \mathrm{CE} = \cos \mathrm{AC} = \dfrac{\cos l}{\sin\theta}$; and it has been already seen that $\sin \mathrm{ECE'} = \mathrm{ACA'} = \dfrac{\phi}{v} = \dfrac{3\mathrm{S.K}}{r^3 v} \sin\theta\cos\theta$; therefore $\mathrm{EE'} = \dfrac{3\mathrm{S.K}}{r^3 v} \cos\theta \cos l$, or since $\cos\theta = \sin \mathrm{I} \sin l$, $\mathrm{EE'} = \dfrac{3\mathrm{S.K}}{r^3 v} \sin \mathrm{I} \sin l \cos l$. Multiplying by dt, and making the same substitutions as in the last proposition, we have

$$\int \mathrm{EE'}\, dt = \frac{6\pi \mathrm{K}}{\mathrm{T}v(1-\epsilon^2)^{\frac{3}{2}}} \sin \mathrm{I} \int \sin l \cos l\{1 + e\cos(l-\lambda)\}\, dl,$$

whence neglecting as before terms multiplied by ϵ, and integrating, there results

$$\int EE'dt = -\frac{3\pi K}{2Tv}\sin I\cos 2l,$$

for the solar nutation in obliquity. This expression, depending on twice the cosine of the sun's longitude, runs through all its changes in half a year; but its greatest value amounts to scarcely half a second, and is consequently altogether insensible to observation.

Prop. 6. To investigate the precessional motion of the equinoxes produced by the moon. Let

M = moon's mass,
E = earth's mass,
I' = inclination of moon's orbit to the equator,
l' = moon's distance from the intersection of her orbit with the equator,
r' = radius vector of the moon's orbit,
a' = semitransverse axis of moon's orbit,
ϵ' = eccentricity of the lunar orbit,
T' = sidereal time of revolution,

then, by following exactly the same reasoning as was pursued in *prop.* 4, there results for the retrograde motion of the points in which the plane of the lunar orbit intersects the plane of the equator (corresponding to the solar precession in *prop.* 4.), the expression

$$\frac{3M.K\cos I'}{v}\int\frac{\sin^2 l'}{r'^3}dt.$$

Now, we have $dt = \dfrac{T'r'^2dl'}{2\pi a'^2\sqrt{1-\epsilon'^2}}$, and $r' = \dfrac{a'(1-\epsilon'^2)}{1+\epsilon'\cos(\lambda'-l')}$ therefore $\dfrac{dt}{r'^3} = \dfrac{T'\{1+\epsilon'\cos(\lambda'-l')\}dl'}{2\pi a'^3 1-\epsilon'^2)^{\frac{3}{2}}}$. But in the present case $T' = \dfrac{2\pi a'^{\frac{3}{2}}}{\sqrt{(E+M)}}$ (for the mass of the moon cannot be neglected in comparison of that of the earth, as the mass of the earth is neglected in comparison of that of the sun), hence $\dfrac{1}{a'^3} = \dfrac{4\pi^2}{T'^2(E+M)}$. The above expression therefore becomes

$$\frac{6\pi M.K\cos I'}{T'v(E+M)(1-\epsilon'^2)^{\frac{3}{2}}}\int\sin^2 l'\{1+\epsilon'\cos(x-l')dl',\},$$

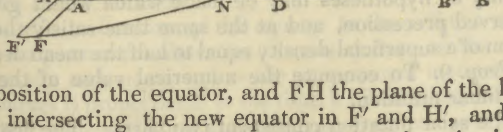
the integral of which (rejecting, as before, terms multiplied by ϵ') gives

$$\frac{3\pi M.K\cos I'}{T'v(E+M)}(C+l'-\tfrac{1}{2}\sin 2l').$$

for the regression of the equator on the plane of the lunar orbit. Suppose l' to be increased by 2π, or a whole circumference, the regression caused by the moon's action in a sidereal revolution becomes $\dfrac{6\pi^2M.K\cos I'}{T'v(E+M)}$.

It is now necessary to reduce this retrograde motion to the plane of the ecliptic.

Let AB be the ecliptic, ACB the equator, A′CB′ the new position of the equator, and FH the plane of the lunar orbit intersecting the new equator in F′ and H′, and the ecliptic in N. The mean effect of the moon's action in the course of a month, if the earth had no motion of rotation, would be to bring the equator nearer the plane of the lunar orbit, causing it to revolve about the line of its intersection with the lunar orbit; therefore by *Theorem* I., the momentary axis of rotation lies in the plane passing through that line and the pole of the equator, and the equator is consequently twisted about the equatorial diameter which is perpendicular to the intersection of the equator and lunar orbit. Hence, FC = CH and F′C = CH′; and since FC + CH = 180°, therefore FC and F′C are quadrantal arcs, and the two triangles CFF and CHH′ are in all respects equal. Now



$$\sin FC : CF'F :: \sin FF' :: ACA',$$

that is, $\quad 1 : \sin I' :: FF' :: ACA',$

and $\quad \sin CA'A : \sin AC :: \sin ACA' :: \sin AA',$

that is, $\quad \sin I : \cos AF :: ACA' :: AA',$

therefore,

$$\sin I : \sin I'\cos AF :: FF' : AA',$$

and consequently,

$$AA' = \frac{F'F\sin I'\cos AF}{\sin I}.$$

But AA′ represents the velocity along the ecliptic, and FF′ the velocity along the plane of the moon's orbit, and we have seen that the motion along this plane is $\dfrac{6\pi^2K.M\cos I'}{T'v(E+M)}$, in the time T′, or a sidereal revolution. Dividing this by T′, we get the mean velocity in the plane of the orbit in the unit of time; whence $FF' = \dfrac{6\pi^2K.M\cos I'}{T'^2v(E+M)}$. For the sake of brevity let $Q = \dfrac{\pi^2K.M}{T'^2v(E+M)}$, then $FF' = Q\cos I'$, and we have

$$AA' = \frac{Q\cos I'\sin I'\cos AF}{\sin I}.$$

We must now express $\cos I'\sin I'\cos AF$, in terms of the obliquity and inclination of the lunar orbit to the ecliptic. Let i = ANF = inclination of moon's orbit to the ecliptic, n = NA, the longitude of the node; then in the triangle ANF, we have by spherical trigonometry,

$$\cos ANF = \cos NAF\cos NFA + \sin NAF\sin NFA\cos AF,$$

that is, since NAF = I, NFA = I′,

$$\cos i = \cos I\cos I' + \sin I\sin I'\cos AF,$$

In like manner, in the same triangle,

$$\cos I' = \cos I\cos i + \sin I\sin i\cos n.$$

From these two equations we obtain this other,

$$\begin{aligned}\cos I'\sin I'\cos AF = {} & \cos I\sin I\cos^2 i \\ & -(\cos^2 I-\sin^2 I)\cos i\sin i\cos n \\ & -\cos I\sin I\sin^2 i\cos^2 n,\end{aligned}$$

which, on substituting in it $\cos 2I$ for $\cos^2 I-\sin^2 I$, $\frac{1}{2}\sin 2i$ for $\cos i\sin i$, and $\frac{1}{2}+\frac{1}{2}\cos 2n$ for $\cos^2 n$, becomes

$$\begin{aligned}\cos I'\sin I'\cos AF = {} & \cos I\sin I(\cos^2 i-\tfrac{1}{2}\sin^2 i) \\ & -\tfrac{1}{2}\cos 2I\sin 2i\cos n \\ & -\tfrac{1}{2}\cos I\sin I\sin^2 i\cos 2n.\end{aligned}$$

Assuming i (the inclination of the moon's orbit) to be constant, which may be done in the present case without sensible error, the only variable in this expression is n, (the longitude of the node), which, on the supposition of i constant, is proportional to the time. Let τ denote the time of a revolution of the node, then for any time t, we have $n = \dfrac{2\pi t}{\tau}$. On making this substitution in the last equation, we obtain by means of it

$$\begin{aligned}AA' = Q\Big\{ & \cos I(\cos^2 i-\tfrac{1}{2}\sin^2 i) \\ & -\frac{\frac{1}{2}\cos 2I}{\sin I}\sin 2i\cos\frac{2\pi t}{\tau} \\ & -\tfrac{1}{2}\cos I\sin^2 i\cos\frac{4\pi t}{\tau}\Big\}\end{aligned}$$

Now, if we assume y = the regression of the equinoctial points on the ecliptic caused by the lunar action, and suppose y a function of t, then $AA' = \frac{\dot{d}y}{dt}$, and the amount of this regression in a given time $= \int \frac{dy}{dt}\,dt$. Multiplying therefore the right hand side of the last equation by dt, and integrating, $\left(\text{observing that} \int \cos\frac{2\pi t}{\tau}\,dt = \frac{\tau}{2\pi}\sin\frac{2\pi t}{\tau},\right.$ and $\left.\int \cos\frac{4\pi t}{\tau}\,dt = \frac{\tau}{4\pi}\sin\frac{4\pi t}{\tau}\right)$, we obtain, finally, for the regression of the equinoctial points, or the precessional motion of the equinoxes, produced by the moon in the time t,

$$Q\left\{\cos I(\cos^2 i - \tfrac{1}{2}\sin^2 i)t \right.$$
$$- \frac{\tau}{4\pi}\,\frac{\cos 2I \sin 2i}{\sin I}\sin\frac{2\pi t}{\tau}$$
$$\left. - \frac{\tau}{8\pi}\cos I \sin^2 i \sin\frac{4\pi t}{\tau}\right\} + \text{const.}$$

The first term of this expression increases uniformly with the time, and is called the *lunar precession*. The second term, being multiplied by $\sin\frac{2\pi t}{\tau}$, is periodic, and depends on the mean longitude of the moon's ascending node. It is called the *lunar equation of the equinoxes in longitude.* The third term is also periodic, but its numerical value is so small as to be insensible, and it is therefore omitted in the calculation. The lunar precession in a sidereal year is found by substituting T for t in the first term, and we have, therefore,

$$\text{lunar annual precession} = Q\cos I(\cos^2 i - \tfrac{1}{2}\sin^2 i)T.$$

Prop. 7. To find the diminution in the inclination of the equator to the ecliptic produced by the moon's action.

Let AB be bisected in D, and let DE be an arc perpendicular to AB, and meeting A′B′ in E′; then the alteration of obliquity produced by the moon in the time dt is represented by EE′. Now in the triangle CFF′ we have

$$\sin CF' : \sin CFF' :: \sin FF' : \sin FCF',$$

that is, $\quad 1 : \sin I' :: FF' : FCF';$

and in the triangle CEE′,

$$\text{Sin } CE'E : \sin CE :: \sin ECE' : \sin EE'$$

that is, by reason of CE=AF (since FC=AE=90°) and ECE′=FCF′

$$1 : \sin AF :: FCF' : EE';$$

whence $EE' = FF' \sin I' \sin AF$. Now it was shewn in the last proposition that $FF' = Q\cos I'$, therefore

$$EE' = Q\cos I' \sin I' \sin AF.$$

To refer this to the ecliptic we have in the triangle NAF,

$$\sin NFA : \sin ANF :: \sin AN : \sin AF$$

which gives the equation

$$\sin I' \sin AF = \sin i \sin n;$$

and, as before we have

$$\cos I' = \cos I \cos i + \sin I \sin i \cos n;$$

whence multiplying the two equations together, and substituting $\frac{1}{2}\sin 2i$ for $\cos i \sin i$, and $\frac{1}{2}\sin 2n$ for $\cos n \sin n$, we get

$$\cos I' \sin I' \sin AF = \tfrac{1}{2}\cos I \sin 2i \sin n + \tfrac{1}{2}\sin I \sin^2 i \sin 2n,$$

and, consequently, writing for n its value $\frac{2\pi t}{\tau}$,

$$EE' = Q\left\{\tfrac{1}{2}\cos I \sin 2i \sin\frac{2\pi t}{\tau} + \tfrac{1}{2}\sin I \sin^2 i \sin\frac{4\pi t}{\tau}\right\}.$$

Multiplying this by dt and integrating, we obtain for the diminution of the inclination, or *lunar nutation in obliquity*

$$-Q\left(\frac{\tau}{4\pi}\cos I \sin 2i \cos\frac{2\pi t}{\tau} + \frac{\tau}{8\pi}\sin I \sin^2 i \cos\frac{4\pi t}{\tau}\right).$$

Both terms of this expression are periodic; but the second is omitted in the calculation, as being too small to be sensible. Hence we have

$$\text{lunar nutation in obliquity} = -Q.\frac{\tau}{4\pi}\cos I \sin 2i \cos\frac{2\pi t}{\tau}.$$

Prop. 8. To compute the numerical value of the annual precession.

By prop. 4. the solar precession in one year $= \frac{6\pi^2 K \cos I}{Tv}$.

Now Tv is the angle which any point of the earth describes about its axis of rotation in a sidereal year, or 366·26 days, and consequently $= 2\pi \times 366{\cdot}26$. The solar precession therefore becomes $\frac{3\pi K \cos(23°\ 28')}{366{\cdot}26}$ expressed in parts o the radius. To reduce it to seconds, we have, assuming radius $= 1$, $\pi = 180° = 180 \times 60 \times 60 = 648000$ seconds. Substituting this for π, and computing the above expression by the logarithmic tables we get

$$\text{solar annual precession} = K \times 4869''.$$

By prop. 6, the lunar precession in a sidereal year (on substituting for Q its value) is $\frac{6\pi^2 K.M}{T'^2 v(E+M)}\cos I(\cos^2 i - \frac{1}{2}\sin^2 i)T$. But T′$v$ is the angle described by the diurnal rotation of the earth in one sidereal revolution of the moon, or 27·32 days (ASTRONOMY, vol. iii. p. 792), and therefore $= 2\pi \times 27{\cdot}32$. We have also (p. 791), $i = 5°\ 8'\ 47{\cdot}9''$, and, as before, T=366·26 days. Now assuming the moon's mass =1-70th of the earth's mass, $M \div (E+M) = \frac{1}{71}$. By the substitution of these numbers, the lunar annual precession becomes

$$\frac{3\pi.K \times 366{\cdot}26 \times \cos(23°\ 28') \times \{1 - \frac{3}{2}\sin^2(5°\ 8'\ 50'')\}}{27{\cdot}32 \times 27{\cdot}32 \times 71},$$

the calculation of which, reduced to seconds as before, gives

$$\text{lunar annual precession} = K \times 12176''.$$

Adding this to the solar annual precession, we obtain the effect produced by the joint action of the sun and moon, or

$$\text{luni-solar annual precession} = K \times 17045''.$$

It is now necessary to assign a value to the quantity K which depends on the law of the density of the earth. Supposing the earth homogeneous, we have $K = \frac{a^2 - b^2}{a^2 + b^2} = \frac{e}{1-e}$, e being the elipticity $= \frac{1}{301}$, (FIGURE OF THE EARTH, vol. ix. p. 563), whence $K = \frac{1}{300}$. This value of K gives

$$\text{luni-solar annual precession} = \frac{17045''}{300} = 56''{\cdot}82.$$

The observed quantity is only 50″·4; the difference being occasioned chiefly by the erroneous assumption of the homogeneity of the earth. If the earth be denser towards the centre, (and it is known to be so from other phenomena), the momentum of the protuberant parts will not be so great as if it were equally dense with the interior parts, and the precession will be less. From Cavendish's experiment, and experiments on the attraction of mountains, it has been ascertained that the mean density of the whole earth is about five times greater than that of water, and twice as great as that of the solid substances composing its exterior crust. But we are entirely ignorant of the law according to which the density varies from the surface towards the centre, and an infinity of hypotheses may be made which would give the observed precession, and at the same time satisfy the condition of a superficial density equal to half the mean density.

Prop. 9. To compute the numerical value of the solar and lunar nutation.

The solar nutation consists of two parts. The first is the solar equation of the equinoxes in longitude, or the second term of the expression for the solar precession in prop. 4, its value is $\frac{3\pi K}{Tv}\cos I \times \frac{1}{2}\sin 2l$. Substituting $2\pi \times 366{\cdot}26$ for Tv, and multiplying by $\frac{180 \times 60 \times 60}{\pi}$ to reduce to seconds, the computation gives

$$\text{1st part of solar nutation} = K \times 387''{\cdot}5 \times \sin 2l.$$

The second part is the nutation in obliquity, found by prop. 5, the value of which is $\frac{3\pi K}{Tv}\sin I \times \frac{1}{2}\cos 2l$. This being computed in the same manner as the last gives

$$\text{2d part of solar nutation} = K \times 168''{\cdot}3 \times \cos 2l.$$

Assuming the earth to be homogeneous, and consequently $K = \frac{1}{300}$, we have for the sum of the two parts

$$\text{solar nutation} = 1''{\cdot}29 \sin 2l + 0''{\cdot}56 \cos 2l,$$

both terms being so small as to be insensible to observation.

The lunar nutation is also composed of two parts; the first being the lunar equation of the equinoxes in longitude, or the second term of the expression in prop. 6; and the second the nutation in obliquity found in prop. 7. By prop. 6, the first of these parts is

$$\frac{3\pi K \,.\, M \,.\, \tau}{2T'^2 v(E+M)} \cdot \frac{\cos 2I \sin 2i}{\sin I} \sin \frac{2\pi t}{\tau},$$

which, since $\tau = 18{\cdot}6 \times 366{\cdot}26$ days, becomes, on substituting for the different quantities their numerical values, and reducing to seconds,

$$K \times \frac{3 \times 64800 \times 18{\cdot}6 \times 366{\cdot}26 \times \cos(46^0\, 56) \sin(10^\circ\, 17'\, 36)}{2\pi \times (27{\cdot}32)^2 \times 2 \times 71 \sin(23^\circ{\cdot}28)} \sin \frac{2\pi t}{\tau},$$

whence there is found from computation,

$$\text{lunar nutation in longitude} = K \times 6093'' \times \sin \frac{2\pi t}{\tau}.$$

By prop. 7. the lunar nutation in obliquity becomes, on substituting for Q its value, and neglecting the sign,

$$\frac{3\pi K \,.\, M \,.\, \tau}{2T'^2 v(E+M)} \,.\, \cos I \times \sin 2i \times \cos \frac{2\pi t}{\tau}.$$

Comparing the coefficient of $\cos \frac{2\pi t}{\tau}$ in this expression with that of $\sin \frac{2\pi t}{\tau}$ in the above, it is obvious that the latter is found by multiplying the former by $\frac{\cos I \sin I}{\cos 2I} = \frac{\sin 2I}{2 \cos 2I} = \frac{1}{2}\tan 2I = \frac{1}{2}\tan(46^\circ\, 56')$. The multiplication gives

$$\text{lunar nutation in obliquity} = K \times 3260'' \cos \frac{2\pi t}{\tau}.$$

Assuming that the earth is homogeneous, and consequently $K = \frac{1}{300}$, these two parts added together give

$$\text{lunar nutation} = 20''{\cdot}31 \sin \frac{2\pi t}{\tau} + 10''{\cdot}88 \cos \frac{2\pi t}{\tau}.$$

The observed values of the coefficients are $18''{\cdot}36$ and $9''{\cdot}239$, the differences between the observed and computed values, as in the case of the precession, arising from the assumption of the uniform density of the earth.

Prop. 10. To determine the motion of the pole of the earth's axis of rotation.

As the inclination of the equator to the ecliptic undergoes no permanent alteration in consequence of the action of the sun and moon, and as the precessional motion of the equinoxes is proportional to the time, it follows that, abstracting the effects of lunar and solar nutation, the pole of the equator must describe a circle about the pole of the ecliptic, the plane of which is parallel to the ecliptic, and of which the radius is equal to the sine of the obliquity, or = sin (23° 28′). The mean velocity corresponding to the regression of the equinoctial points, is $50''.4$ in a year, and consequently the period of a revolution is about 25900 years. Now in order to take account of the lunar nutation (the solar, as has already been remarked, is scarcely sensible), it is only necessary to remark that the absolute velocity of the pole in its small circle, is to the velocity with which the equinoctial points regress in the ecliptic, as the radius of the small circle to the radius of the ecliptic, or as sin I : 1. Hence the motion of the pole in the plane of the small circle, is obtained by multiplying the expression in prop. 6, by sin I; and therefore the correction to be applied to the uniform motion of the pole, is the second term of that expression, multiplied by sin I, or sin I × lunar equation of the equinoxes in longitude. But by prop. 9, this term $= K \times 6093'' \sin \frac{2\pi t}{\tau}$, therefore the corresponding motion of the pole =

$$K \times 6093'' \sin(23^\circ\, 28') \,.\, \sin \frac{2\pi t}{\tau} = K \times 2427'' \sin \frac{2\pi t}{\tau}.$$

With respect to the second part of the nutation, it is obvious that any change of obliquity produces an equal change in the place of the pole on the meridian, and therefore, by the last proposition, the motion of the pole in this direction is $K \times 3260'' \cos \frac{2\pi t}{\tau}$. Now let $K \times 2427'' = a$, and $K \times 3260'' = b$, and let the motion of the pole in the two directions be respectively denoted by x and y, we have then $x = a \sin \frac{2\pi t}{\tau}$, $y = b \cos \frac{2\pi t}{\tau}$; and consequently the equation

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1;$$

which is the equation to an ellipse, and shews that the pole describes a small ellipse about its mean place in the course of a revolution of the nodes, as was discovered by Bradley from observation.

Prop. 11. From the observed values of the precession and nutation, to determine the ratio of the moon's mass to the mass of the earth.

The quantities most accurately determined from observation, from which the moon's mass can be found, are the whole annual precession $p\ (=50''{\cdot}4)$, and the coefficient of the lunar nutation in obliquity $q\ (=9''{\cdot}239)$. Let $s =$ the solar annual precession, and $m =$ the lunar annual precession, then $s = p - m$. Now, by prop. 7, $q = Q\frac{\tau}{4\pi}\cos I \sin 2i$, and, by prop. 6, $m = Q \cos I(\cos^2 i - \frac{1}{2}\sin^2 i)T$, whence by eliminating Q cos I, we get

$$m = \frac{q \,.\, 4\pi \,.\, T(\cos^2 i - \frac{1}{2}\sin^2 i)}{\tau \sin 2i},$$

and on computing m from the values of T, τ and i above given, we find $m = q \times 3''{\cdot}735 = 34''{\cdot}51$; therefore, also, $s = p - m = 15''{\cdot}89$.

Again, from prop. 4, we have $s = \frac{6\pi^2 \,.\, K \cos I}{Tv}$, and from prop. 6, (on substituting for Q its value), $m = \frac{6\pi^2 \,.\, K \,.\, M \cos I}{T'^2 v(E+M)}(\cos^2 i - \frac{1}{2}\sin^2 i)T$; whence

$$\frac{s}{m} = \frac{T'^2}{T^2(\cos^2 i - \frac{1}{2}\sin^2 i)} \cdot \frac{E+M}{M}.$$

By computing the coefficient of $(E+M) \div M$, and by means of the values s and m now found, this equation gives

$$\frac{E+M}{M} = 81{\cdot}755,$$

whence it follows that the mass of the moon is to the mass of the earth in the ratio of 1 to 80·755.

The phenomena of the precession and nutation, and those of the tides, are the only astronomical facts which enable us to determine the moon's mass. From a long series of observations on the tides at the harbour of Brest, Laplace found the ratio of the masses of the moon and earth to be 1 : 75·77.

The regression of the equinoctial points amongst the fixed stars, and consequent precession of the equinoxes, being a motion which, though extremely slow amounting only to a degree in about seventy-two years, increases constantly with the time, was detected at an early period in the history of astronomy, and its rate was determined with considerable accuracy by Hipparchus. Its physical cause was of course not suspected until after the discovery of gravitation; but Newton himself, by a process of reasoning, which, although not quite accurate, affords one of the most remarkable instances of his extraordinary sagacity, (*Principia*, lib. iii. prop. 39), shewed it to be a necessary consequence of the flattened form of the earth. D'Alembert was the first who gave a general and accurate solution of the problem, in his *Recherches sur la Précession des Equinoxes* (1749); and Euler also treated the subject in the *Berlin Memoirs* for the same year. Various solutions of the problem have since been given, amongst which may be mentioned those of Sylvabella and Walmesley in the *Philosophical Transactions* (vols. xlviii. and xlix); that of Simson (*Miscellaneous Tracts*, 1757); that of Frisi in his *Theoria Geometrica Diurni Motûs* (*Opera*, tom. iii.); that of Lagrange in his *Memoir on the Libration of the Moon*, which obtained the prize of the Academy of Sciences of Paris for 1769; that of Landen (*Mathematical Memoirs*, 1780); and that of Vince (*Philosophical Transactions*, 1787.) Of these solutions, that of Frisi deserves to be noticed as perhaps the most perspicuous and elegant. An excellent elementary demonstration is given by Mr. Airy, the present astronomer royal, in his *Mathematical Tracts*, (1826 and 1831) of which we have freely availed ourselves in the present article; but for a complete investigation of the question in all its generality, we must refer the reader to the *Mécanique Céleste*, and still more particularly to a Memoir of Poisson, *Sur le Mouvement de la Terre autour de son Centre de Gravité*, in the *Mémoires de l'Académie Royale des Sciences*, tome vii. 1829.

The nutation, as has already been remarked, (see also ASTRONOMY, vol. iii. p. 768), was detected by Bradley, from a comparison of observations which were undertaken with a view to determine the parallax of the fixed stars. Bradley assigned to the coefficient or constant of nutation the value 9″, which till a late period was adopted by most astronomers. Laplace computed its value from theory to be 9″.63; but as this result could only be obtained by having recourse to hypotheses respecting the ellipticity and density of the earth, and also the mass of the moon, which may possibly differ considerably from the truth, it cannot be regarded as of much weight. There are, however, three other determinations of the constant (besides that of Bradley), from observation, which may be supposed to give its value with all the precision that is capable of being attained. The first is that of Von Lindenau, from about 800 observations of Polaris made between the years 1750 and 1815, and consequently including three revolutions of the moon's node; as well as from those made by Bradley, Maskelyne, Bessel, Carlini, Piazzi, and Von Lindenau himself. From these observations he found the value of the constant of nutation to be 8″·97718. The second determination is that of Dr. Brinkley (*Philosophical Transactions*, 1821) deduced from his own observations with the Dublin Mural Circle; and the value which he found was 9″·25. The third determination, and that which has the greatest probability in its favour, is a very recent one by Dr. Robinson of Armagh, undertaken at the instance of the British Association. It is deduced from 11,000 observations made at Greenwich with the mural circle, between the years 1812 and 1834, and embraces more than a complete revolution of the node. The result gives the constant of nutation =9″·23913. (See the *Monthly Notices* of the Royal Astronomical Society for May 1838). S.

PRECORDIA, in *Anatomy*, a general name for the parts situated about the heart, in the forepart of the thorax; as the diaphragm, pericardium, and even the heart itself, with the spleen, lungs, &c.

PREDECESSOR, properly signifies a person who has preceded or gone before another in the same office or employment; in which sense it is distinguished from ancestor.

PREDESTINATION, the supposed decree of God by which he has from all eternity unchangeably appointed whatsoever comes to pass; and has more especially fore-ordained certain individuals of the human race to everlasting happiness, and passed by the rest, fore-ordaining them to everlasting misery. The former of these are called the elect, and the latter are called the reprobate.

This doctrine is the subject of one of the most perplexing controversies that has occurred amongst mankind. But it is not altogether peculiar to the Christian faith. The opinion, that whatever occurs in the world at large, or in the lot of private individuals, is the result of a previous and unalterable arrangement by that Supreme Power which presides over nature, has always been a favourite opinion amongst the vulgar, and has also been believed by many speculative men. Thus, in that beautiful scene in the sixth book of the Iliad, Hector, taking leave of his wife and child, speaks thus:

> Andromache, my soul's far better part,
> Why with untimely sorrows heaves thy heart?
> No hostile hand can antedate my doom,
> Till fate condemns me to the silent tomb.
> Fix'd is the term to all the race of earth,
> And such the hard condition of our birth.
> No force can then resist, no flight can save;
> All sink alike, the fearful and the brave.

The ancient Stoics, Zeno and Chrysippus, whom the Jewish Essenes seem to have followed, asserted the existence of a Deity, who, acting wisely, but necessarily, contrived the general system of the universe; from which, by a series of causes, whatever is now done in it unavoidably results. This series, or concatenation of causes, they held to be necessary in every part; and thought God himself as so much the servant of necessity, and of his own decrees, that he could not have made the smallest object in the world otherwise than it now is, much less was he able to alter any thing.

According to the words of Seneca, *Eadem necessitas et Deos alligat. Irrevocabilis divina pariter atque humana cursus vehit. Ille ipse omnium conditor ac rector scripsit quidem fata sed sequitur. Semper paret, semel jussit.* "The same chain of necessity constrains both gods and men. Its unalterable course regulates divine as well as human things. Even he who wrote the Fates, the Maker and Governor of all things, submits to them. He did but once command, but he always obeys." The stoical fate, however, differs from the Christian predestination in several points. They regarded the divine nature and will as a necessary part of a necessary chain of causes; whereas the Christians consider the Deity as the lord and ruler of the Universe, omnipotent and free, appointing all things according to his pleasure. Being doubtful of the immortality of the soul, the Stoics could have no idea of the doctrine of election and reprobation; nor did they ever doubt their own freedom of will, or power of doing good as well as evil, as we shall presently see the Christian predestinarians have done.

Mahommed introduced into his Koran the doctrine of an absolute predestination of the course of human affairs. He represented life and death, prosperity and adversity, with every event that befalls a man in this world, as the result of a previous determination of the one God who rules over all; and he found this opinion the best engine for inspiring his followers with that contempt of danger, which, united to fanatical zeal, has extended the empire of their faith over the fairest portion of the habitable globe.

The controversy concerning predestination first made its appearance in the Christian church about the beginning of the fifth century. Pelagius a British, and Cœlestius an Irish monk, both lived at Rome during that period, and possessed great celebrity on account of their piety and learning. They taught that the opinion is false, which asserts, that human nature is necessarily corrupted by a depravity derived from our first parents. They contended, that men are born at present in a state as pure as that in which Adam was originally created; and that they are not less qualified than he was for fulfiling all righteousness, and for reaching the most sublime eminence of piety and virtue. They maintained that the external grace of God, which is given unto all, and attends the preaching of the gospel, is necessary to call forth the attention and the exertions of men; but that we do not want the assistance of any internal grace to purify the heart, and to give it the first impulse towards what is good. Having fled into Africa on account of the Goths, who at that time (A. D. 410,) invaded Italy, Cœlestius remained at Carthage as a presbyter; but Pelagius went into the East, where he settled, and prospered under the patronage of John bishop of Jerusalem, to whom his sentiments were agreeable. On the contrary, the celebrated Augustin, bishop of Hippo, strenuously asserted the depravity of human nature since the fall of the first man; the necessity of a special interposition of divine grace to enable us to do any one good action; and consequently, that none could obtain salvation excepting those whom God has thought fit to elect, and upon whom he bestows this grace. The dispute was carried on with great zeal. Zozimus, bishop of Rome, decided at first in favour of Pelagius and Cœlestius, whose followers were called *Pelagians;* but he afterwards altered his opinion, and by the activity of Augustin, the council of Ephesus was called, at which the opinion of his antagonists was formally condemned.

In the course of the same century, these opinions assumed a variety of forms and modifications. One party, called *Predestinarians,* carried Augustin's doctrine fully farther than he himself had ventured to do in express words; and asserted, that God had not only predestinated the wicked to punishment, but that he had also decreed that they should commit those very sins on account of which they are hereafter to be punished. Another party moderated the doctrine of Pelagius, and were called *Semipelagians.* Their peculiar opinion is expressed in a different manner by different writers; but all the accounts sufficiently agree. Thus, some represent them as maintaining that inward grace is not necessary to the first beginning of repentance, but only to our progress in virtue. Others say, that they acknowledged the power of grace, but said that faith depends upon ourselves, and good works upon God; and it is agreed upon all hands, that these Semipelagians held that predestination is made upon the foresight of good works. The assistance of St. Augustin, though then far advanced in life, was called in to combat these tenets, and he wrote several treatises upon the subject. In all these he strenuously maintained, that the predestination of the elect was independent of any foresight of their good works, but was according to the good pleasure of God only; and that perseverance comes from God, and not from man. Thereafter the doctrine of St. Augustin, as he is often called, became general. He was the oracle of the schoolmen. They never ventured to differ from him in sentiment; they only pretended to dispute about the true sense of his writings.

Almost the whole of the earliest reformers maintained these opinions of St. Augustin. They assumed, under Luther, a more regular and systematic form than they had ever formerly exhibited. But as the Lutherans afterwards abandoned them, they are now known by the name of *Calvinistic Doctrines,* from John Calvin of Geneva. This reformer asserted, that the everlasting condition of mankind in a future world was determined from all eternity by the unchangeable decree of the Deity, arising from his sole good pleasure or free will. Being a man of great ability, industry, and eloquence, Geneva, where he taught, and which was a free state, soon became the resort of all the men of letters belonging to the reformed churches, and was a kind of seminary from which missionaries issued to propagate the Protestant doctrine throughout Europe. Their success was such, that, excepting a small part of Germany, the principles of all the reformed churches are professedly Calvinistic or Predestinarian.

The opponents of the doctrine of predestination amongst the Protestants usually receive the appellation of *Arminians* or *Remonstrants.* They derive the first of these appelations from James Arminius, who, in 1602, was appointed[1] professor of theology at Leyden. He was violently opposed by Gomer his colleague, and died in 1609. After his death, the controversy was conducted with great eagerness on both sides. The Calvinists, however, gradually prevailed. A synod was called at Dort, in 1618, to which the most celebrated divines of different countries were invited. There, in a great measure, by the authority and influence of Maurice prince of Orange, the Arminians were condemned as heretics; for by this time ambitious and powerful men found themselves politically interested in this religious contest. The Arminians presented to this synod a remonstrance, containing a statement of their faith upon the subjects in dispute; and from this they derived the appellation of *Remonstrants.* This statement contained the five following articles. 1. That God from all eternity predestinated those to everlasting salvation whom he foresaw would believe in Christ unto the end of their lives, and predestinated obstinate unbelievers to everlasting punishment. 2. Jesus Christ died for the whole human race, and for every individual of it, but believers alone reap the benefit of his death. 3. No man can produce faith in his mind by his own free-will, but it is necessary that man, who is by nature wicked and unfit for acting or thinking aright, should be regenerated by the grace of the Holy Spirit, imparted by God for Christ's sake. 4. This divine grace constitutes the source, the progress, and the fulfilment, of all that is good in man, but it is not irresistible in its operation. 5. Believers, by the assistance of the Holy Spirit, are abundantly fitted for every good work; but whether it is possible for those who have once been truly such to fall away, and to perish finally, is not clear, and must be better inquired into by searching the Scriptures.

In opposition to these, a counter remonstrance was presented, containing the opinions of the Calvinists, which was approved of by the synod. The substance of it was afterwards adopted, and in nearly the same expressions, into the Confession of Faith compiled by the assembly of divines which met at Westminster, in 1643, and which every clergyman and probationer for the ministry in Scotland is at present required to subscribe previous to his admission. To give as clear and fair an idea as possible to the Calvinistic doctrine upon this head, we transcribe the following passage from that Confession: "God from all eternity did, by the most wise and holy counsel of his own will, freely and unchangeably ordain whatsoever comes to pass; yet so, as thereby neither is God the author of sin, nor is violence offered to the will of the creatures, nor is the liberty or contingencies of second causes taken away, but rather established. Although God knows whatsoever may or can come to pass upon all supposed conditions; yet hath he not decreed any thing because he foresaw it as future, or that which would come to pass upon such conditions. By the decree of God, for the manifestation of his glory, some men and angels are predestinated unto everlasting life, and others are fore-ordained to everlasting death. These angels and men, thus predestinated and fore-ordained, are particularly and unchangeably designed; and their number is so certain and definite, that it cannot be either increased or diminished. Those of mankind that are predestinated unto life, God, before the foundation of the world was laid, according to his eternal and immutable purpose, and the secret counsel and good pleasure of his will, hath chosen, in Christ, unto everlasting glory, out of his mere free grace and love, without any foresight of faith, or good works, or perseverance in either of them, or any other thing in the creature, as conditions or causes moving him thereunto; and all to the praise of his glorious grace. As God hath appointed the elect unto glory, so hath he, by the eternal and most free purpose of his will, fore-ordained all the means thereunto. Wherefore, they who are elected, being fallen in Adam, are redeemed by Christ, are effectually called unto faith in Christ, by his spirit working in due season; are justified, adopted, sanctified, and kept, by his power through faith unto salvation. Neither are any other redeemed by Christ effectually called, justified, adopted, sanctified, and saved, but the elect only. The rest of mankind, God was pleased, according to the unsearchable counsel of his own will, whereby he extendeth or withholdeth mercy as he pleaseth for the glory of his sovereign power over his creatures, to pass by, and to ordain them to dishonour and wrath for their sin, to the praise of his glorious justice."

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[1] *Relatio Historica de Origine et Progressu Controversiarum de Prædestinatione* Philippi à Limborch.

There are two kinds of Calvinists or Predestinarians, viz. the *Supralapsarians*, who maintained that God did originally and expressly decree the fall of Adam, as a foundation for the display of his justice and mercy; whilst they who maintain that God only *permitted* the fall of Adam, are called *Sublapsarians*, their system of decrees concerning election and reprobation, being as it were, subsequent to that event. But, as Dr. Priestley justly remarks, if we admit the divine prescience, there is not, in fact, any difference between the two schemes; and accordingly that distinction is now seldom mentioned.

Nor was the church of Rome less agitated by the contest about predestination than were the first Protestants. The council of Trent was much perplexed how to settle the matter without giving offence to the Dominicans, who were much attached to the doctrine of St. Augustin, and possessed great influence in the council. After much dispute, the main object came to be, how to contrive such a decree as might give offence to nobody, although it should decide nothing. Upon the whole, however, they seem to have favoured the Semipelagian scheme. Amongst other things, it was determined, that good works are of themselves meritorious to eternal life; but it is added, by way of softening, that it is through the goodness of God, that he makes his own gifts to be merits in us. Catarin revived at that council an opinion of some of the schoolmen, that God chose a small number of persons, such as the blessed virgin, the apostles, and others, whom he was determined to save without any foresight of their good works; and that he also wills that all the rest should be saved, providing for them all necessary means, but they are at liberty to use them or not. This is called the *Baxterian* scheme in England, from one of its promoters there. But at all events, the council of Trent seems to have been extremely anxious that any opinions entertained amongst them concerning predestination might have as little influence as possible upon practical morality. "Let no man," say they, "whilst he remains in this mortal state presume that he is among the number of the elect, and that therefore he cannot sin, or sin without repentance; for it cannot be known who are elected without a special revelation from God." (Sect. 6. c. 13.)

The Jesuits at first followed the opinion of St. Augustin; but they afterwards forsook it. Molina, one of their order, was the author of what is called the *middle scheme*, or the doctrine of *a grace sufficient for all men*, but subject to the freedom of the human will. Jansenius, a doctor of Louvain, opposed the Jesuits with great vigour, and supported the doctrine of St. Augustin. He wrote in a very artful manner, declaring that he did not presume to state his own sentiments upon the subject. He pretended only to explain and publish the sentiments of that great father of the church St. Augustin. But the Jesuits, in consequence of that inviolable submission to the authority of the pope, which they always maintained, had sufficient interest at Rome to procure the opinion of Jansenius to be condemned there; with this addition subjoined, however, that nothing was thereby intended to be done in prejudice of the doctrine of St. Augustin. This produced an absurd dispute about the pope's infallibility in matters of fact. The Jansenists affirmed, that the pope had made a mistake in condemning the opinions of Jansenius as different from those of St. Augustin; whereas in truth they are the same, and the one cannot be condemned without the other. But the Jesuits affirmed, that the pope is no less infallible in points of fact than he is in questions of faith; and he having decided, that the opinions of Jansenius are different from those of St. Augustin, every good Catholic is bound to believe accordingly that they are different. Some of the very ablest supporters of predestination have appeared amongst the Jansenists, and particularly amongst the gentlemen of Port-Royal.

With regard to Great Britain, the earliest English reformers were in general Sublapsarians, although some of them were Supralapsarians. But the rigid Predestinarians have been gradually declining in number in that church, although they still subscribe the thirty-nine articles of their faith, which are unquestionably Calvinistic. The celebrated Scotch reformer John Knox having been educated at Geneva, established in this country the doctrine of predestination in its strictest form; and it has probably been adhered to with more strictness in Scotland than in any other country of Europe.

PREDETERMINATION, in *Philosophy* and *Theology*, is that concurrence of God which makes men act, and determines them in all their actions, both good and evil, and is called by the schoolmen *physical predetermination* or *premotion*.

PREDICABLE, amongst logicians, denotes a general quality which may be predicated or asserted of several things.

PREDICAMENT, amongst logicians, is the same thing with category.

PREDICATE, in *Logic*, is that which, in a proposition, is affirmed or denied of the subject. In these propositions, *snow is white, and ink is not white;* whiteness is the predicate which is affirmed of snow, and denied of ink.

PREETZ, a town of the Danish dimensions, in Holstein, situated on a lake connected with the Baltic sea. It has a very extensive and rich monastic institution, with some valuable estates belonging to it, though many have been secularised. It is, however, the richest Protestant institution remaining of that kind. The town, with the cloister, contains 400 houses, and 3060 inhabitants.

PRE-EXISTENCE, a priority of being, or the being of one thing before another. Thus a cause, if not in time, is yet in nature pre-existent to its effect. Thus God is pre-existent to the universe, and a human father is pre-existent to his son. The Peripatetics, though they maintained the eternity of the world, were likewise dogmatical in their opinion, that the universe was formed, actuated, and governed, by a sovereign intelligence.

The pre-existence of the human soul to its corporeal vehicle had been from time immemorial a prevailing opinion amongst the Asiatic sages, and from them was perhaps transferred by Pythagoras to the philosophy of the Greeks; but his metempsychosis, or transmigration of souls, is too trivial either to be seriously proposed or refuted. Nevertheless, from the sentiments of Socrates concerning the immortality of the soul, delivered in his last interview with his friends, it is obvious that the tenet of pre-existence was a doctrine of the Platonic school. If at any period of life, say these philosophers, you should examine a boy, of how many ideas, of what a number of principles, of what an extent of knowledge will you find him possessed? These without doubt could neither be self-derived nor recently acquired. With what avidity and promptitude does he attain the knowledge of arts and of sciences, which appear entirely new to him? These rapid and successful advances in knowledge can only be the effects of reminiscence, or of a fainter and more indistinct species of recollection. But in all the other operations of memory, we find retrospective impressions attending almost every object or idea which emerges to her view; nor does she ever suggest any thought, or word, or action, without informing us, in a manner equally clear and evident, that those impressions had been made upon our senses, mind, or intellect, on some former occasion. Whoever contemplates her progress, will easily discover, that association is her most faithful and most efficacious auxiliary; and that by joining impression with impression, idea with idea, circumstance with circumstance, in the order of time, of place, of similarity or dissimilarity, she is enabled to accumulate her treasures and enlarge her province even to an indefinite extent. But when intuitive principles, or simple conclusions, are elicited from the puerile understanding by a train of easy questions properly arranged, where is the retrospective act of the memory, by which the boy recognises those truths as having formerly been perceived in his mind? Where are the crowds of the concomitant, antecedent, or subsequent ideas, with which those recollections ought naturally to have been attended? In a word, where is the sense of personal identity, which seems to be absolutely inseparable from every act of memory? This hypothesis, therefore, will not support the notion of pre-existence. After the Christian religion had been considerably diffused, and warmly combated by its philosophical antagonists, the same doctrine was resumed and taught at Alexandria, by Platonic proselytes, not only as a constituent topic of their master's philosophy, but as an answer to those formidable objections which had been deduced from the doctrine of original sin, and from the vices which stain, as well as from the calamities which disturb, human life. Hence they strenuously asserted, that all the human race were either introduced to being prior to Adam, or pre-existent in his person; that they were not, therefore, represented by our first parents, but actually concurred in their crime, and participated in their ruin.

The followers of Origen, and such as entertained the notion of pre-adamites, might argue from the doctrine of pre-existence with some degree of plausibility. For the human beings introduced by them to the theatre of probation had already attained the capacity or dignity of moral agents; as their crime therefore was voluntary, their punishment might be just. But those who believe the whole human race created in Adam to be only pre-existent in their germs or stamina, were even deprived of this miserable subterfuge; for in these "homunculi" we can neither suppose the moral nor rational constitution unfolded. Since, therefore, their degeneracy was not spontaneous, neither could their sufferings be equitable. Should it be said that the evil of original sin was penal, as it extended to our first parents alone, and merely consequential as felt by their posterity, it will be admitted that the distinction between penal and consequential evil may be intelligible in human affairs, where other laws, assortments, and combinations than those which are simply and purely moral, take place. But that a moral government, at one of the most cardinal periods of its administration, should admit gratuitous or consequential evil, seems to us irreconcilable with the attributes and conduct of a wise and just legislator. Consequential evil, taken as such, is misery sustained without demerit, and cannot result from the procedure of wisdom, benignity, and justice, but must flow from necessity, from ignorance, from cruelty, or from caprice, as its only possible sources. But even upon the supposition of those who pretend that man was mature in all his faculties before the commission of original sin, the objections against it will still remain in full force; for it is admitted by all except the Samian sage, that the consciousness of personal identity which was felt in pre-existence, is obliterated in a subsequent state of being.

Now it may be demanded, whether agents thus resuscitated for punishment have not the same right to murmur and complain as if they had been perfectly innocent, and only created for that dreadful catastrophe? It is upon this principle alone that the effects of punishment can be either exemplary or disciplinary; for how is it possible, that the punishment of beings unconscious of a crime should ever be reconciled either to the justice or beneficence of that intention with which their sufferings are inflicted? Or how can others be supposed to become wise and virtuous by the example of those who are neither acquainted with the origin nor the tendency of their miseries, but have every reason to think themselves afflicted merely for the sake of afflicting? To us it seems clear, that the nature and *rationale* of original sin lie inscrutably veiled and hidden in the bosom of Providence; nor can we, without unpardonable presumption and arrogance, form the most simple conclusion, or attempt the minutest discovery, either different from or extraneous to the clear and obvious sense of revelation. This sense indeed may with propriety be extracted from the whole, or from one passage collated with another; but independently of it, as reason has no premises, she can form no deductions. The boldness and temerity of philosophy, not satisfied with contemplating pre-existence as merely relative to human nature, has dared to try how far it was compatible with the three Persons of the sacred Trinity. The Arians, who allowed the subordinate divinity of our Saviour, believed him pre-existent to all time, and before all worlds; but the Socinians, who esteemed his nature as well as his person merely human, insisted, that before his incarnation he was only pre-existent in the divine idea, not in nature or person. But when it is considered, that children do not begin to deduce instructions from nature and experience, at a period so late as we are apt to imagine; when it is admitted, that their progress, though insensible, may be much more rapid than we apprehend; when the opportunities of sense, the ardour of curiosity, the avidity of memory, and the activity of understanding, are remarked; we need not have recourse to a pre-existent state for our account of the knowledge which young minds discover. It may likewise be added, that moral agents can only be improved and cultivated by moral discipline. Such effects therefore of any state, whether happy or miserable, as are merely mechanical, may be noxious or salutary to the patient, but can never enter into any moral economy as parts of its own administration. Pre-existence, therefore, whether rewarded or punished, without the continued impression of personal identity, affords no solution of original sin.

PREFACE, something introductory to a book, to inform the reader of the design and method observed therein, and generally whatever is necessary to the understanding of a work.

PREFECT, in ancient Rome, one of the chief magistrates who governed in the absence of the kings, consuls, and emperors.

This power was greatest under the emperors. The chief care of the prefect was the government of the city; as taking cognizance of all crimes committed therein or within a hundred miles thereof. He judged capitally and finally, and even presided in the senate. He had also the superintendence of provisions, building, and navigation.

PREJUDICE, or PREJUDGMENT, from *præ* and *judicium*, means a judgment formed beforehand, without examination; the preposition *præ* expressing an anticipation, not so much of time as of knowledge and due attention; and hence the schoolmen have called it *anticipation* and a *preconceived opinion*. See METAPHYSICS.

PRELATE, an ecclesiastic raised to some eminent and superior dignity in the church; as bishops, archbishops, and patriarchs.

PRELIMINARY, in general, denotes something to be examined and determined before an affair can be treated of on its own merits.

PRELUDE, in *Music*, is usually a flourish or irregular air, which a musician plays off hand, to try if his instrument be in tune, and to lead him into the piece to be played.

PREMISES, in *Logic*, an appellation given to the two first propositions of a syllogism.

PREMIUM, or PRÆMIUM, properly signifies a reward or recompense; but it is chiefly used in a mercantile sense for the sum of money given to an insurer, whether of ships, houses, lives, or other subjects.

PREMONSTRANTES, or PRÆMONSTRANTENSES, a religious order of regular canons instituted in 1120, by St. Norbert, and thence called *Norbertines*. The first monastery of this order was built by Norbert in the Isle of France, three leagues to the west of Laon, which he called *Præmonstratum;* and hence the order itself derived its name, though as to the occasion of the denomination, the writers of the order are divided. At first the religious of this order were so very poor, that they had only a single ass, which served to carry the wood they cut down every morning, and was sent to Laon for the bread they purchased. But they soon received so many donations, and built so many monasteries, that in thirty years after the foundation of the order, they had above one hundred abbeys in France and Germany; and in process of time the order so increased, that it had monasteries in all parts of Christendom, amounting to one thousand abbeys, three hundred provostships, a vast number of priories, and five hundred nunneries. But they are now greatly diminished. The rule they followed was that of St. Augustin, with some slight alterations, and an addition of certain severe laws, the authority of which did not long survive their founder. The order was approved by Honorius II. in 1126, and again by several succeeding popes. At first the abstinence from flesh was rigidly observed. In 1245 Innocent IV. complained to a general chapter of its being neglected. In 1288, their general, William, procured leave of Pope Nicholas IV. for those of the order to eat flesh upon journeys. In 1460, Pius II. granted them a general permission to eat meat, excepting from Septuagesima to Easter. The dress of the religious of this order was white, with a scapulary before the cassock.

The Præmonstrantenses, or monks of Premontre, vulgarly called *white canons*, came first into England in the year 1146. Their first monastery, called *New-house*, was erected in Lincolnshire, by Peter de Saulia, and dedicated to St. Martial. In the reign of Edward I. this order had twenty-seven monasteries in England.

PRENOMEN, PRÆNOMEN, amongst the ancient Romans, a name prefixed to the family name, and answering to our Christian name; such as Caius, Lucius, Marcus, and the like.

PRENZLOW, a city, the capital of a circle of the same name, in the province of Potsdam in Prussia. It is situated on the river Ucker, and on the north bank of the lake Unteruck. It contains seven Protestant churches, and an institution for education, with nine professors, several hospitals and poor-houses, about nine hundred houses and 10,000 inhabitants, amongst whom is a colony of Frenchmen, established by Protestant refugees. It has considerable manufactures of linen, woollen, and cotton goods, besides tanneries, distilleries and breweries.

PREPARATION, in a general sense, the act of disposing things in such a manner as to render any foreseen event more advantageous or less hurtful according to its nature.

PREPOSITION, in *Grammar*, is one of the parts of speech, being an indeclinable particle which yet serves to govern the nouns that follow it; such as *per, pro, propter*, through, for, with. Buffier allows it to be only a modificative of a part of speech, serving to circumstantiate a noun.

PRERAU, a city of the Austrian province of Moravia, the capital of a circle of the same name, which extends over 1254 square miles. It comprehends 31 cities and towns, 393 villages, and 54,000 families, consisting of 267,600 persons. The city is situated on the river Betschwa, has a fortress on a neighbouring hill, and contains 460 houses, with 3400 inhabitants.

PREROGATIVE, an exclusive or peculiar privilege.

ROYAL PREROGATIVE, that special pre-eminence which the king has over and above all other persons, and out of the ordinary course of the common law, in right of his regal dignity. It signifies in its etymology (from *præ* and *rogo*) something that is required or demanded before, or in preference to, all others; and hence it follows, that it must be in its nature singular and eccentrical, and that it can only be applied to those rights and capacities which the king alone enjoys in contradistinction to others, and not to those which he enjoys in common with any of his subjects. For if once any one prerogative of the crown could be held in common with the subject, it would cease to be any longer prerogative; and, therefore, Finch lays it down as a maxim, that the prerogative is that law in the case of the king, which is law in no case of the subject.

Prerogative are either *direct* or *incidental*. The *direct* are such positive substantial parts of the royal character and authority, as are rooted in, and spring from, the king's political person, considered merely by itself, without reference to any other extrinsic circumstance; as, the right of sending ambassadors, of creating peers, and of making war or peace. But such prerogatives as are *incidental* bear always a relation to something else, distinct from the king's person, and are indeed only exceptions, in favour of the crown, to those general rules that are established for the rest of the community; such as, that no costs shall be recovered against the king, that the king can never be a joint tenant, and that his debt shall be preferred before a debt to any of his subjects.

These substantive or direct prerogatives may again be divided into three kinds, being such as regard, first, the king's royal *character* or *dignity;* secondly, his royal *authority* or *power;* and, lastly, his royal *income*. These are necessary, to secure reverence to his person, obedience to his commands, and an affluent supply for the ordinary expenses of government; without all of which it is impossible to maintain the executive power in due independence and vigour. Yet, in every branch of this large and extensive dominion, our free constitution has interposed such seasonable checks and restrictions, as may curb it from trampling on those liberties which it was meant to secure and establish. The enormous weight of prerogative, if left to itself, spreads havoc and destruction amongst all the inferior movements; but, when balanced and bridled, as with us, by its proper counterpoise, timely and judiciously applied, its operations are then equable and regular; it invigorates the whole machine, and enables every part to answer the end of its construction.

I. Of the royal *dignity*. Under every monarchical establishment, it is necessary to distinguish the prince from his subjects, not only by the outward pomp and decorations of majesty, but also by ascribing to him certain qualities as inherent in his royal capacity, distinct from, and superior to, those of any other individual in the nation. For though a philosophical mind will, says Blackstone, consider the royal person merely as one man appointed by mutual consent to preside over many others, and will pay him that reverence and duty which the principles of society demand; yet the mass of mankind will be apt to grow insolent and refractory, if taught to consider their prince as a man of no greater perfection than themselves. The law therefore ascribes to the king, in his high political character, not only large powers and emoluments, which form his prerogative and revenue, but likewise certain attributes of a great and transcendent nature; by which the people are led to consider him in the light of a superior being, and to pay him that awful respect which may enable him with greater ease to carry on the business of government. This is what we understand by the royal dignity; the several branches of which we shall now proceed to enumerate.

1. And, first, the law ascribes to the king the attribute of *sovereignty*, or pre-eminency.

2. " The law also," according to Blackstone, " ascribes to the king, in his political capacity, absolute *perfection*. ' The king can do no wrong;' which ancient and fundamental maxim,' says he, ' is not to be understood as if every thing transacted by the government was of course just and lawful. It means only two things. The first is, that whatever is exceptionable in the conduct of public affairs, is not to be imputed to the king, nor is he answerable for it personally to his people; for this doctrine would totally destroy that constitutional independence of the crown, which is necessary for the balance of power, in our free and active, and therefore compounded, constitution. And, secondly, it means that the prerogative of the crown extends not to do any injury; it is created for the benefit of the people, and therefore cannot be exerted to their prejudice. The king, moreover," he observes, " is not only incapable of *doing* wrong, but even of *thinking* wrong; he can never mean to do an improper thing: in him is no folly or weakness. And, therefore, if the crown should be induced to grant any franchise or privilege to a subject contrary to reason, or in anywise prejudicial to the commonwealth or a private person, the law will not suppose the king to have meant either an unwise or an injurious action, but declares that the king was deceived in his grant; and thereupon such grant is rendered void, merely upon the foundation of fraud and deception, either by or upon those agents whom the crown has thought proper to employ. For the law will not cast an imputation on that magistrate whom it entrusts with the executive power, as if he was capable of intentionally disregarding his trust; but attributes to mere imposition, to which the most perfect of sublunary beings must still continue liable, those little inadvertencies, which, if charged on the will of the prince, might lessen him in the eyes of his subjects."

But this doctrine has been exposed as ridiculous and absurd, by Lord Abingdon, in his *Dedication to the collective Body of the People of England*. " Let us see," says he, " how these maxims and their comments agree with the constitution, with nature, with reason, with common sense, with experience, with fact, with precedent, and with Sir William Blackstone himself; and whether, by the application of these rules of evidence thereto, it will not be found, that (from the want of attention to that important line of distinction which the constitution has drawn between the *king* of England and the *crown* of England) what was attributed to the *monarchy* has not been given to the *monarch*, what meant for the *kingship* conveyed to the *king*, what designed for the *thing* transferred to the *person*, what intended for *theory* applied to *practice;* and so in consequence, that whilst the premises (of the perfection of the monarchy) be true, the conclusion (that the king can do no wrong) be not false.

" And, first, in reference to the constitution; to which if this matter be applied (meaning what it expresses, and if it do not it is unworthy of notice), it is subversive of a principle in the constitution, upon which the preservation of the constitution depends; I mean the principle of *resistance;* a principle which, whilst no man will now venture to gainsay, Sir William Blackstone himself admits ' *is justifiable to the person of the prince;*' when the being of the state is endangered, and the public voice proclaims such resistance necessary; and thus, by such admission, both disproves the maxim, and oversets his own comment thereupon; for to say that ' the king can do no wrong,' and that ' he is incapable even of thinking wrong,' and then to admit that ' resistance to his person is justifiable, are such jarring contradictions in themselves, that, until reconciled, the necessity of argument is suspended.

" With respect then, in the next place, to the agreement of this maxim, and its comment, with nature, with reason, and with common sense, I should have thought myself sufficiently justified in appealing to every man's own reflection for decision, if I had not been made to understand that nature, reason, and common sense, had nothing to do with either. Sir William Blackstone says, ' That though a philosophical mind will consider the royal person merely as one man appointed by mutual consent to preside over others, and will pay him that reverence and duty which the principles of society demand, yet the mass of mankind will be apt to grow insolent and refractory if taught to consider their prince as a man of no greater perfection than themselves; and therefore the law ascribes to the king, in his high political character, certain attributes of a great and transcendent nature, by which the people are led to consider him in the light of a superior being, and to pay him that awful respect which may enable him with greater ease to carry on the business of government.' So that, in order to govern with greater ease (which, by the bye, is mere assertion without any proof), it is necessary to deceive the mass of mankind, by making them believe not only what a philosophical mind cannot believe, but what it is impossible for any mind to believe; and therefore, in the investigation of this subject, according to Sir William, neither nature, reason, nor common sense, can have any concern.

" It remains to examine in how much this maxim and its comment agree with experience, with fact, with precedent, and with Sir William Blackstone himself. And here it is matter of most curious speculation, to observe a maxim laid down, and which is intended for a rule of government, not only without a single case in support of it, but with a string of cases, that may be carried back to Egbert the first monarch of England, in direct opposition to the doctrine. Who is the man, that, reading the past history of this country, will show us any king that has done no wrong. Who is the reader that will not find that all the wrongs and injuries which the free constitution of this country has hitherto suffered, have been solely derived from the arbitrary measures of our kings? And yet the mass of mankind are to look upon the king as a superior being; and the maxim, that ' the king can do no wrong,' is to remain as an article of belief. But, without pushing this inquiry any farther, let us see what encouragement Sir William Blackstone himself has given for our credulity. After stating the maxim, and presenting us with a most lively picture, ' of our sovereign lord thus all perfect and immortal,' what does he make this all-perfection and immortality in the end to come to? His words are those: 'For when King Charles's deluded brother attempted to *enslave* the nation,' (*no wrong this, to be sure*), he found it was beyond his power; the people both *could*, and *did*, resist him; and in consequence of such resistance, obliged him to quit his enterprise and his throne together."[1]

The sum of all is this: That the crown of England and the king of England are distinguishable, and not synonymous terms: that allegiance is due to the crown and through the crown to the king; that the attributes of the crown are sovereignty, perfection, and perpetuity; but that it does not therefore follow that the king can do no wrong. It is indeed to be admitted, that in high respect for the crown, high respect is also due to the wearer of that crown; that is, to the king; but the crown is to be preferred to the king, for the first veneration is due to the constitution. It is likewise *to be supposed* that the king *will* do no wrong; and as, to prevent this, a privy council is appointed by the constitution to assist the king in the execution of the government; so if any wrong be done, 'these men, as Montesquieu expresses it, 'may be examined and punished.'

"But if any future king shall think to screen these evil counsellors from the just vengeance of the people, by becoming his own minister; and in so doing, shall take for his sanction the attribute of perfection, shall trust to the deception of his being a superior being, and cloak himself under the maxim that the king can do no wrong; I say, in such a case, let the appeal already made to the constitution, to nature, to reason, to common sense, to experience, to fact, to precedent, and to Sir William Blackstone himself, suffice, and preclude the necessity of any further remarks from me."

To proceed now to other particulars, The law determines, that in the king there can be no negligence or *laches;* and therefore no delay will bar his right. *Nullum tempus occurrit regi*, is the standing maxim upon all occasions; for the law intends that the king is always busied for the public good, and therefore has not leisure to assert his right within the times limited to subjects. In the king also can be no stain or corruption of blood; for if the heir to the crown were attainted of treason or felony, and afterwards the crown should descend to him, this would purge the attainder *ipso facto*. And therefore, when Henry VII., who as earl of Richmond stood attainted, came to the crown, it was not thought necessary to pass an act of parliament to reverse this attainder; because, as Lord Bacon in his history of that prince informs us, it was agreed that the assumption of the crown had at once purged all attainders. Neither can the king, in judgment of law, as king, ever be a minor or under age; and therefore his royal grants and assents to acts of parliament are good, though he has not in his natural capacity attained the legal age of twenty-one. By a statute, indeed, 28 Henry VIII. c. 17, power was given to future kings to rescind and revoke all acts of parliament that should be made while they were under the age of twenty-four; but this was repealed by the statute 1 Edward VI. c. 11, so far as related to that prince, and both statutes are declared to be determined by 24 Geo. II. c. 24. It hath also been usually thought prudent, when the heir-apparent has been very young, to appoint a protector, guardian, or regent, for a limited time; but the very necessity of such extraordinary provision is sufficient to demonstrate the truth of that maxim of common law, that in the king is no minority; and therefore he hath no legal guardian.

3. A third attribute of the king's majesty is his *perpetuity*. The law ascribes to him, in his political capacity, an absolute immortality. The king never dies. Henry, Edward, or George, may die; but the king survives them all. For, immediately upon the decease of the reigning prince in his natural capacity, his kingship or imperial dignity, by act of law, without any *interregnum* or interval, is vested at once in his heir; who is, *eo instanti*, king to all intents and purposes. And so tender is the law of supposing even a possibility of his death, that his natural dissolution is generally called his *demise, dimissio vel regis vel coronæ;* an expression which signifies merely a transfer of property; for, as is observed in Plowden, when we say the demise of the crown, we mean only, that, in consequence of the disunion of the king's body-natural from his body-politic, the kingdom is transferred or demised to his successor, and so the royal dignity remains perpetual. Thus, too, when Edward IV., in the tenth year of his reign, was driven from his throne for a few months by the house of Lancaster, this temporary transfer of his dignity was denominated his *demise;* and all process was held to be discontinued, as upon a natural death of the king.

II. We are next to consider those branches of the royal prerogative which invest this our sovereign lord with a number of *authorities* and *powers;* in the exertion whereof consists the executive part of government. This is wisely placed in a single hand by the British constitution, for the sake of unanimity, strength, and despatch. Were it placed in many hands, it would be subject to many wills. Many wills, if disunited and drawing different ways, create weakness in a government; and to unite those several wills, and reduce them to one, is a work of more time and delay than the exigencies of state will afford. The king of England is therefore not only the chief, but properly, the sole magistrate of the nation; all others acting by commission from, and in due subordination to him; in like manner as, upon the great revolution in the Roman state, all the powers of the ancient magistracy of the commonwealth were concentred in the new emperor; so that, as Gravina expresses it, *In ejus unius persona veteris reipublicæ, vis atque majestas per cumulatas magistratuum potestates exprimebatur.*

In the exertion of lawful prerogative the king is held to be absolute; that is, so far absolute, that there is no legal authority which can either delay or resist him. He may reject what bills, may make what treaties, may coin what money, may create what peers, may pardon what offences, he pleases; unless where the constitution has expressly, or by evident consequence, laid down some exception or boundary, declaring, that thus far the prerogative shall go and no farther. For otherwise the power of the crown would indeed be but a name and a shadow, insufficient for the ends of government, if, where its jurisdiction is clearly established and allowed, any man or body of men were permitted to disobey it, in the ordinary course of law. We do not now speak of those *extraordinary* recourses to the first principles, which are necessary when the contracts of society are in danger of dissolution, and the law proves too weak a defence against the violence of fraud or oppression. And yet the want of attending to this obvious distinction has occasioned these doctrines, of absolute power in the prince and of national resistance by the people, to be much misunderstood and perverted, by the advocates for slavery on the one hand, and the demagogues of faction on the other. The former, observing the absolute sovereignty and transcendent dominion of the crown laid down, as it certainly is, most strongly and emphatically in our law-books as well as our homilies, have denied that any case can be excepted from so general and positive a rule; forgetting how impossible it is, in any practical system of laws, to point out beforehand those eccentrical remedies, which the sudden emergence of national distress may dictate, and which that alone can justify. On the other hand, over-zealous republicans, feeling the absurdity of unlimited passive obedience, have fancifully, or sometimes factiously, gone over to the other extreme; and, because resistance is justifiable to the person of the prince when the being of the state is endangered, and the public voice proclaims such resistance necessary, they have therefore allowed to every individual the right of determining this expedience, and of employing private force to resist even private oppression; a doctrine productive of anarchy, and, in consequence, equally fatal to civil liberty as tyranny itself. For civil liberty, rightly understood, consists in protecting the rights of individuals by the united force of society. Society cannot be maintained, and of course can exert no protection, without obedience to some sovereign power; and obedience is an empty name, if every individual has a right to decide how far he himself shall obey.

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[1] *Commentaries,* vol. iv. p. 433.

In the exertion, therefore, of those prerogatives which the law has given him, the king is irresistible and absolute, according to the forms of the constitution. And yet, if the consequence of that exertion be manifestly to the grievance or dishonour of the kingdom, the parliament will call his advisers to a just and severe account. For prerogative consisting, as Mr. Locke has well defined it, in the discretionary power of acting for the public good where the positive laws are silent, if that discretionary power be abused to the public detriment, such prerogative is exerted in an unconstitutional manner. Thus the king may make a treaty with a foreign state, which shall irrevocably bind the nation; and yet, when such treaties have been judged pernicious, impeachments have pursued those ministers by whose agency or advice they were concluded.

The prerogatives of the crown, in the sense under which we are now considering them, respect either this nation's intercourse with foreign nations, or its own domestic government and civil polity.

With regard to *foreign concerns*, the king is the delegate or representative of his people It is impossible that the individuals of a state, in their collective capacity, can transact the affairs of that state with another community equally numerous as themselves. Unanimity must be wanting to their measures, and strength to the execution of their counsels. In the king, therefore, as in a centre, all the rays of his people are united, and form by that union a consistency, splendour, and power, that make him feared and respected by foreign potentates; who would scruple to enter into any engagement, that must afterwards be revised and ratified by a popular assembly. What is done by the royal authority, with regard to foreign powers, is the act of the whole nation: what is done without the king's concurrence, is the act only of private men. And so far is this point carried by our law, that it hath been held, that should all the subjects of England make war with a king in league with the king of England, without the royal assent, such war is no breach of the league. And by the statute 2 Henry V. c. 6, any subject committing acts of hostility upon any nation in league with the king, was declared to be guilty of high treason: and, though that act was repealed by the statute 20 Henry VI. c. 11, so far as relates to the making this offence high treason, yet still it remains a very great offence against the law of nations, and punishable by our laws, either capitally or otherwise, according to the circumstances of the case.

1. The king, therefore, considered as the representative of his people, has the sole power of sending ambassadors to foreign states, and receiving ambassadors at home.

2. It is likewise the king's prerogative to make treaties, leagues, and alliances, with foreign states and princes. For by the law of nations, it is essential to the goodness of a league, that it be made by the sovereign power; and then it is binding upon the whole community: And in Britain the sovereign power, *quoad hoc*, is vested in the person of the king. Whatever contracts, therefore, he engages in, no other power in the kingdom can legally delay, resist, or annul. And yet, lest this plenitude of authority should be abused to the detriment of the public, the constitution (as was hinted before) has here interposed a check, by the means of parliamentary impeachment, for the punishment of such ministers as from criminal motives advise or conclude any treaty, which shall afterwards be judged to derogate from the honour and interest of the nation.

3. Upon the same principle the sovereign has also the sole prerogative of making war and peace. For it is held by all the writers on the law of nature and nations, that the right of making war, which by nature subsisted in every individual, is given up by all private persons that enter into society, and is vested in the sovereign power: and this right is given up, not only by individuals, but even by the entire body of people that are under the dominion of a sovereign. It would indeed be extremely improper, that any number of subjects should have the power of binding the supreme magistrate, and putting him against his will in a state of war. Whatever hostilities, therefore, may be committed by private citizens, the state ought not to be affected thereby; unless that should justify their proceedings, and thereby become partner in the guilt. And the reason which is given by Grotius, why, according to the law of nations, a denunciation of war ought always to precede the actual commencement of hostilities, is not so much that the enemy may be put upon his guard, (which is matter rather of magnanimity than right), but that it may be certainly clear that the war is not undertaken by private persons, but by the will of the whole community; whose right of willing is in this case transferred to the supreme magistrate by the fundamental laws of society. So that, in order to make a war completely effectual, it is necessary with us in Britain that it be publicly declared and duly proclaimed by the king's authority; and then all parts of both the contending nations, from the highest to the lowest, are bound by it. And wherever the right resides of beginning a national war, there also must reside the right of ending it, or the power of making peace. And the same check of parliamentary impeachment, for improper or inglorious conduct, in beginning, conducting, or concluding a national war, is in general sufficient to restrain the ministers of the crown from a wanton or injurious exertion of this great prerogative.

4. But, as the delay of making war may sometimes be detrimental to individuals who have suffered by depredations from foreign potentates, our laws have in some respects armed the subject with powers to impel the prerogative; by directing the ministers of the crown to issue letters of marque and reprisal upon due demand: the prerogative of granting which is nearly related to, and plainly derived from, that other of making war; this being indeed only an incomplete state of hostilities, and generally ending in a formal denunciation of war. These letters are grantable, by the law of nations, whenever the subjects of one state are oppressed and injured by those of another, and justice is denied by that state to which the oppressor belongs. In this case, letters of marque and reprisal (words in themselves synonymous, and signifying a taking in return) may be obtained, in order to seize the bodies or goods of the subjects of the offending state, until satisfaction be made, wherever they happen to be found. And indeed this custom of reprisals seems dictated by nature herself; for which reason we find in the most ancient times very notable instances of it. But here the necessity is obvious of calling in the sovereign power, to determine when reprisals may be made; else every private sufferer would be a judge in his own cause. In pursuance of which principle, it is with us declared by the statute 4 Hen. V. c. 7, that if any subjects of the realm are oppressed in time of truce by any foreigners, the king will grant marque in due form to all that feel themselves grieved.

Prerogative.

Prerogative.

5. Upon exactly the same reason stands the prerogative of granting safe-conducts; without which, by the law of nations, no member of one society has a right to intrude into another. And therefore Puffendorf very justly resolves, that it is left in the power of all states to take such measures about the admission of strangers as they think convenient; those being ever excepted who are driven on the coasts by necessity, or by any cause that deserves pity or compassion. Great tenderness is shown by our laws, not only to foreigners in distress, but with regard also to the admission of strangers who come spontaneously: for so long as their nation continues at peace with ours, and they themselves behave peaceably, they are under the king's protection; though liable to be sent home whenever the king sees occasion. But no subject of a nation at war with us can, by the law of nations, come into the realm, nor can travel himself upon the high seas, or send his goods and merchandise from one place to another, without danger of being seized by our subjects, unless he has letters of safe-conduct; which, by divers ancient statutes, must be granted under the king's great seal and enrolled in chancery, or else they are of no effect; the king being supposed the best judge of such emergencies as may deserve exception from the general law of arms. But passports under the king's sign manual, or licenses from his ambassadors abroad, are now more usually obtained, and are allowed to be of equal validity.

These are the principal prerogatives of the king respecting this nation's intercourse with foreign nations; in all of which he is considered as the delegate or representative of his people. But in domestic affairs, he is considered in a great variety of characters, and from thence there arises an abundant number of other prerogatives.

1. He is a constituent part of the supreme legislative power; and, as such, has the prerogative of rejecting such provisions in parliament as he judges improper to be passed. The expediency of which constitution has before been evinced at large under the article Parliament. We shall only further remark, that the king is not bound by any act of parliament, unless he be named therein by special and particular words. The most general words that can be devised (any person or persons, bodies politic, or corporate, &c.) affect not him in the least, if they may tend to restrain or diminish any of his rights or interests. For it would be of most mischeivous consequence to the public, if the strength of the executive power were liable to be curtailed, without its own express consent, by constructions and implications of the subject. Yet, where an act of parliament is expressly made for the preservation of public rights and the suppression of public wrongs, and does not interfere with the established rights of the crown, it is said to be binding as well upon the king as upon the subject: and, likewise, the king may take the benefit of any particular act, though he be not especially named.

2. The king is considered, in the next place, as the generalissimo, or the first in military command, within the kingdom. The great end of society is to protect the weakness of individuals by the united strength of the community; and the principal use of government is to direct that united strength in the best and most effectual manner, to answer the end proposed. Monarchical government is allowed to be the fittest of any for this purpose: it follows therefore, from the very end of its institution, that in a monarchy the military power must be trusted in the hands of the prince.

In this capacity, therefore, of general of the kingdom, the king has the sole power of raising and regulating fleets and armies. We are now to consider the prerogative of enlisting and governing them: which indeed was disputed and claimed, contrary to all reason and precedent, by the long parliament of king Charles I.; but, upon the restoration of his son, was solemnly declared by the statute 13 Charles II. c. 6, to be in the king alone: for that the sole supreme government and command of the militia within all his majesty's realms and dominions, and of all forces by sea and land, and of all forts and places of strength, ever was and is the undoubted right of his majesty, and his royal predecessors, kings and queens of England; and that both or either house of parliament cannot, nor ought, to pretend to the same.

This statute, it is obvious to observe, extends not only to fleets and armies, but also to forts and other places of strength within the realm; the sole prerogative, as well of erecting, as manning and governing of which, belongs to the king in his capacity of general of the kingdom; and all lands were formerly subject to a tax, for building of castles wherever the king thought proper. This was one of the three things, from contributing to the performance of which no lands were exempted, and therefore called by the Anglo-Saxons the *trinoda necessitas; scilicet pontis reparatio, arcis constructio, et expeditio contra hostem.* And this they were called upon to do so often, that, as Sir Edward Coke from M. Paris assures us, there was in the time of Henry II. 1115 castles subsisting in England. The inconveniencies of which, when granted out to private subjects, the lordly barons of those times, were severely felt by the whole kingdom; for, as William of Newburgh remarks, in the reign of king Stephen, *erant in Anglia quodammodo tot reges, vel potius tyranni, quot domini castellorum;* but it was felt by none more sensibly than by two succeeding princes, king John and king Henry III. And therefore, the greatest part of them being demolished in the barons' wars, the kings of after times have been very cautious of suffering them to be rebuilt in a fortified manner: and Sir Edward Coke lays it down, that no subject can build a castle, or house of strength imbattled, or other fortress defensible, without the license of the king; for the danger which might ensue, if every man at his pleasure might do it.

It is partly upon the same, and partly upon a fiscal foundation, to secure his marine revenue, that the king has the prerogative of appointing ports and havens, or such places only, for persons and merchandise to pass into and out of the realm, as he in his wisdom sees proper. By the feudal law, all navigable rivers and havens were computed among the regalia, and were subject to the sovereign of the state. And in England it hath always been held, that the king is lord of the whole shore, and particularly, is the guardian of the ports and havens, which are the inlets and gates of the realm; and therefore, so early as the reign of king John, we find ships seized by the king's officers for putting in at a place that was not a legal port. These legal ports were undoubtedly at first assigned by the crown; since to each of them a court of portmote is incident, the jurisdiction of which must flow from the royal authority. The *great ports* of the sea are also referred to, as well known and established, by statute 4 Hen. IV. c. 20, which prohibits the landing elsewhere under pain of confiscation; and the statute 1 Eliz. c. 11, recites, that the franchise of lading and discharging had been frequently granted by the crown.

But though the king had a power of granting the franchise of havens and ports, yet he had not the power of resumption, or of narrowing and confining their limits when once established; but any person had a right to load or discharge his merchandise in any part of the haven, whereby the revenue of the custom was much impaired and diminished, by fraudulent landings in obscure and private corners. This occasioned the statutes of 1 Eliz. c. 11, and 13 and 14. Car. II. c. 11. § 14, which enable the crown by commission, to ascertain the limits of all ports, and to assign proper wharfs and quays in each port, for the exclusive landing and loading of merchandise.

The erection of beacons, light-houses, and sea-marks, is also a branch of the royal prerogative; whereof the first was anciently used in order to alarm the country in case of the approach of an enemy; and all of them are signally useful in guiding and preserving vessels at sea by night as well as by day.

3. Another capacity in which the king is considered in domestic affairs, is as the fountain of justice, and general conservator of the peace of the kingdom.

4. The king is likewise the fountain of honour, of office, and of privilege; and this in a different sense from that in which he is styled the *fountain of justice*; for here he is really the parent of them.

5. Another light in which the laws of England consider the king with regard to domestic concerns, is as the arbiter of commerce. By commerce, we at present mean domestic commerce only; for the king's prerogative with regard to which, see Money, Weights and Measures, &c.

6. The king is, lastly, considered by the laws of England as the head and supreme governor of the national church.

To enter into the reasons upon which this prerogative is founded, is matter rather of divinity than of law. We shall therefore only observe, that by statute 26 Hen. VIII. c. 1, (reciting that the king's majesty justly and rightfully is, and ought to be the supreme head of the church of England; and so had been recognised by the clergy of that kingdom in their convocation) it is enacted, that the king shall be reputed the only supreme head on earth of the church of England; and shall have annexed to the imperial crown of this realm, as well the title and style thereof, as all jurisdictions, authorities, and commodities, to the said dignity of supreme head of the church appertaining. And another statute to the same purport was made, 1 Eliz. c. 1.

In virtue of this authority the king convenes, prorogues, restrains, regulates, and dissolves, all ecclesiastical synods or convocations. This was an inherent prerogative of the crown long before the time of Henry VIII. as appears by the statute 8 Hen. VI. c. 1, and the many authors, both lawyers and historians, vouched by Sir Edward Coke. So that the statute 25 Hen. VIII. c. 19. which restrains the convocation from making or putting in execution any canons repugnant to the king's prerogative, or the laws, customs, and statutes of the realm, was merely declaratory of the old common law: that part of it only being new, which makes the king's royal assent actually necessary to the validity of every canon. The convocation or ecclesiastical synod, in England, differs considerably in its constitution from the synods of other Christian kingdoms: these consisting wholly of bishops; whereas in England the convocation is the miniature of a parliament, wherein the archbishop presides with regal state; the upper house of bishops represents the house of lords; and the lower house, composed of representatives of the several dioceses at large, and of each particular chapter therein, resembles the house of commons with its knights of the shire and burgesses. This constitution is said to be owing to the policy of Edward I. who thereby at one and the same time let in the inferior clergy to the privileges of forming ecclesiastical canons, which before they had not, and also introduced a method of taxing ecclesiastical benefices, by consent of convocation. From this prerogative also, of being the head of the church, arises the king's right of nomination to vacant bishoprics, and certain other ecclesiastical preferments.

PRESAGE, in *Antiquity*, denotes an augury, or sign of some future event; which was chiefly taken from the flight of birds, the entrails of victims, &c.

PRESBURG, a city of the Austrian province of Hither Danube in Hungary, the capital of the circle of the same name, which is more fertile than extensive, and contains about 260,000 inhabitants, in 5 cities, 23 market towns, and 292 villages. The city is on the Danube over which is a long bridge. It is the place in which the emperors of Austria have recently been crowned. It is well built, and contains an imperial palace, a cathedral, several churches and monasteries, an academy and other seminaries, and societies of various kinds for promoting science and literature. It has several manufactories of cloth and cotton, of looking-glasses, cutlery, silk and leather, and much transit and other trade. Its prosperity has kept pace with its population, the latter of which was in 1817, 26,000, and in 1827, 40,733, and it is said to have since increased. Lat. 48. 0. 5. Long. 17. 1. 0. E.

PRESBYTÆ, persons whose eyes are too flat to refract the rays sufficiently, so that unless the object is at some distance, the rays coming from it will pass through the retina before their union, consequently vision is confused; old people are usually the subjects of this disease. In order to remedy, or at least to palliate, this defect, the person should first use glasses which do not magnify, and from them pass gradually to more convex spectacles, which shorten the focus.

PRESBYTER, in the primitive Christian church, an elder, one belonging to the second order of ecclesiastics; the other two being bishops and deacons.

Presbyter, or elder, is a word borrowed from the Greek translation of the Old Testament, where it commonly signifies ruler or governor; it being a note of office and dignity, not of age; and in this sense bishops are sometimes called *presbyters* in the New Testament. The presbyters might baptize, preach, consecrate, and administer the eucharist in the bishop's absence, or in his presence, if he authorised and deputed them; and the bishops did scarcely anything in the government of the church without their advice, consent, and amicable concurrence.

The grand dispute between the followers of Geneva and Roman discipline, is about the sameness and difference of presbyters and bishops at the time of the apostles.

Discriminating principle of the presbyterians.

PRESBYTERIANS, Protestants, so called from their maintaining that the government of the church appointed in the New Testament was by presbyteries, that is, by associations of presbyters or elders, all possessed of equal powers, without any superiority among them either in office or in order.

The presbyterians believe, that the authority of their ministers to preach the gospel, to administer the sacraments of baptism and the Lord's supper, and to feed the flock of Christ, is in no respect inferior to the authority possessed by the ministers of any other church. They oppose the independent scheme of the common rights of Christians by the same arguments which are used for that purpose by the episcopalians, (see Episcocacy). They affirm, however, that in the church, as established by Christ and his apostles, there is no order superior to that of presbyters; that all ministers are equal by their commission; that *presbyter* and *bishop*, though different words, are of the same import; and that prelacy or diocesan episcopacy was gradually established upon the primitive practice of making the *moderator* or president of the presbytery a permanent officer.

Scriptural arguments against episcopacy.

These positions they maintain against the episcopalians by the following scriptural arguments. They observe, that the apostles planted churches by ordaining bishops and deacons in every city; that the ministers which in one verse are called bishops, are in the next perhaps denominated presbyters; that we nowhere read in the New Testament of bishops, presbyters, and deacons, in any one church; and that therefore we are under the necessity of concluding *bishop* and *presbyter* to be two names for the same church officer. This is apparent from Peter's exhortation to the *elders* or *presbyters* who were among the Jewish Christians. "The *elders* (presbyters) which are among you I exhort, who am also an *elder*, and a witness of the sufferings of Christ, and also a partaker of the glory that shall be revealed: Feed the flock of God which is among you, taking the *oversight* thereof (ἐπισκοποῦντες, acting as *bishops* thereof,) not by constraint, but willingly; not for filthy lucre, but of a ready mind; neither as being LORDS over God's heritage, but being ensamples to the flock."[1] From this passage it is evident, that the presbyters not only fed the flock of Christ, but also governed that flock with episcopal powers; and that the apostle himself, as an officer of the church, was nothing more than a presbyter or elder. The identity of the office of bishop and presbyter is still more apparent from Heb. xiii. 7. 17. and 1 Thess. v. 12; for the bishops are there represented as governing the flock, speaking to them the word of God, watching for their souls, and discharging various offices, which it is impossible for any man to perform to more than one congregation.

Reasons for supposing bishops and presbyters of the same order.

From the last cited text it is evident, that the bishops (προϊσταμένους) of the Thessalonian churches had the pastoral care of no more souls than they could hold personal communion with in God's worship; for they were such as all the people were to *know*, *esteem*, and *love*, as those that not only were *over them*, but also "closely laboured among them, and admonished them." But diocesan bishops, whom ordinarily the hundredth part of their flock never hear nor see, cannot be those bishops by whom that flock is admonished, nor can they be, what Peter requires the bishops of the Jewish converts to be, *ensamples to the flock*. It is the opinion of Dr. Hammond, who was a learned divine, and a zealot for episcopacy, that the *elders* whom the apostle James desires[2] the sick to call for, were of the highest permanent order of ecclesiastical officers; but it is self-evident that those elders cannot have been diocesan bishops, otherwise the sick must have been often beyond the reach of the remedy proposed to them.

There is no passage of Scripture on which the episcopalian is more ready to rest his cause, than the alleged episcopacy of Timothy and Titus; of whom the former is said to have been bishop of Ephesus, and the latter bishop of Crete; yet the presbyterian thinks it as clear as the noonday sun, that the presbyters of Ephesus were supreme governors under Christ of the Ephesian churches, at the very time that Timothy is pretended to have been their proper diocesan.

In Acts xx. 17, seq. we read, that "from Miletus Paul sent to Ephesus, and called the elders (presbyters) of the church. And when they were come to him, he said unto them, Ye know, from the first day that I came into Asia, after what manner I have been with you, at all seasons. And now I know that ye all, among whom I have gone preaching the kingdom of God, shall see my face no more. Wherefore I take you to record this day, that I am pure from the blood of all men. For I have not shunned to declare unto you all the counsel of God. Take heed therefore unto yourselves, and to all the flock over which the Holy Ghost hath made you overseers, (ἐπισκόπους, *bishops*), to feed the church of God, which he hath purchased with his own blood. For I know this, that after my departure shall grievous wolves enter in among you, not sparing the flock. Also of your ownselves shall men arise, speaking perverse things, to draw away disciples after them. Therefore watch, and remember, that by the space of three years, I ceased not to warn every one night and day with tears. And now, brethren, I recommend you to God, and to the word of his grace," &c.

The pastors of Ephesus of equal authority.

From this passage, it is evident that there was in the city of Ephesus a plurality of pastors of equal authority, without any superior pastor or bishop over them; for the apostle directs his discourse to them all in common, and gives them equal power over the whole flock. Dr. Hammond indeed imagines, that the elders whom Paul called to Miletus were the *bishops of Asia*, and that he sent for them to Ephesus, because that city was the metropolis of the province. But were this opinion well-founded, it is not conceivable that the sacred writer would have called them the elders of the church of *Ephesus*, but the elders of the *church in general*, or the elders of the *churches in Asia*. Besides, it is to be remembered, that the apostle was in such haste to visit Jerusalem, that the sacred historian measures his time by *days;* whereas it must have required several months to call together the bishops or elders of all the cities of Asia; and he might certainly have gone to meet them at Ephesus in less time than would be requisite for their meeting in that city and proceeding thence to him at Miletus. They must therefore have been either the joint pastors of one congregation, or the pastors of different congregations in one city; and as it was thus in Ephesus, so was it in Philippi; for we find the apostle addressing his epistle "to all the saints in Christ Jesus which are at Philippi, with the bishops and deacons." From the passage before us it is likewise plain, that the presbyters of Ephesus had not only the *name* but the whole *power* of bishops given to them by the Holy Ghost; for they are enjoined to do the whole work of bishops, ποιμαίνειν τὴν ἐκκλησίαν τοῦ Θεοῦ, which signifies, to *rule* as well as *feed* the church of God. Hence it is evident, that the apostle makes the power of *governing* inseparable from that of *preaching* and *watching;* and that according to him, all who are preachers of God's word, and watchmen of souls, are necessarily rulers or governors of the church, without being accountable for their management to any prelate, but only to their Lord Christ, from whom their power is derived.

Timothy no bishop.

It appears therefore that the apostle Paul left in the church of Ephesus, which he had planted, no other successors to himself than *presbyter-bishops*, or presbyterian ministers, and that he did not devolve his power upon any prelate. Timothy, whom the episcopalians allege to have been the first bishop of Ephesus, was present when this settlement was made;[3] and it is surely not to be supposed, that, had he been their bishop, the apostle would have devolved the whole episcopal power upon the presbyters before his face. If ever there was a season fitter than another for pointing out the duty of this supposed bishop to his diocese, and the duty of his presbyters to him, it was surely when Paul was taking his final leave of them, and discoursing so pathetically concerning the duty of *overseers*, the coming of ravenous wolves, and the consequent hazard of the flock. In this farewell discourse, he tells them that "he had not shunned to declare unto them all the counsel of God." But with what truth could this have been said, if obedience to a diocesan bishop had been any part of their duty either at the time of the apostle's speaking or at any future period? He foresaw that ravenous wolves would enter in among them, and that even some of themselves should arise speaking perverse things; and if, as the Episcopalians allege, diocesan episcopacy was the remedy provided for those evils, is it not strange, passing strange, that the inspired preacher did not foresee that Timothy, who was standing beside him, was destined to fill that important office; or if he did foresee it, that he omitted to recommend him to his future charge, and to give him proper instructions for the discharge of his duty?

Merely an evangelist.

But if Timothy was not bishop of Ephesus, what, it may be asked, was his office in that city? For that he resided there for some time, and was by the apostle invested with authority to ordain and rebuke presbyters, are facts about which all parties are agreed, and which indeed cannot be controverted by any reader of Paul's epistles. To this the presbyterian replies with confidence, that the power which Timothy exercised in the church of Ephesus was that of an evangelist,[4] and not a prelate. But, according to Eusebius, the work of an evangelist was, "to lay the foundations of the faith in barbarous nations, and to constitute among them pastors; after which he passed on to other countries." Accordingly we find, that Timothy was resident for a time at Philippi and Corinth,[1] as well as at Ephesus, and that he had as much authority over those churches as over that of which he is said to have been the fixed bishop. "Now, if Timotheus come, see that he may be with you without fear, for he worketh the work of the Lord, as I also do. Let no man therefore despise him." This text might lead us to suppose, that Timothy was bishop of Corinth as well as of Ephesus; for it affords a more plausible ground than that on which his episcopacy of the latter church is chiefly built. The apostle says, "I besought thee[2] to abide still at Ephesus when I went into Macedonia, that thou mightest charge some that they teach no other doctrine." But had Timothy been the permanent bishop of that city, there would surely have been no necessity for *beseeching* him to abide with his flock. It is likewise to be observed, that the first epistle to Timothy, which alone was written to him during his residence at Ephesus, was of a date prior to Paul's meeting with the elders of that church at Miletus; for in the epistle he hopes to come to him shortly, whereas he tells the elders at Miletus, that they should see his face no more. This being the case, it is evident that Timothy was left by the apostle at Ephesus only to supply his place during his temporary absence at Macedonia, and that he could not possibly have been constituted permanent bishop of that church, since the episcopal powers were afterwards committed to the presbyters by the Holy Ghost in his presence.

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[1] 1 Peter v. 1, 2, 3.

[2] Chap. v. 14.

[3] Acts xx. 5.

[4] 2 Tim. iv. 5.

Presbyterate the highest permanent office in the church.

The identity of the office of bishop and presbyter being thus clearly established, it follows, that the presbyterate is the highest permanent office in the church, and that every faithful pastor of a flock is successor to the apostles in every thing in which they were to have any successors. In the apostolic office there were indeed some things peculiar and extraordinary, such as their immediate call by Christ, their infallibility, their being witnesses of our Lord's resurrection, and their unlimited jurisdiction over the whole world. These powers and privileges could not be conveyed by imposition of hands to any successors, whether called presbyters or bishops; but as rulers or office-bearers in particular churches, we have the confession of "the very chiefest apostles," Peter and John, that they were nothing more than presbyters or labouring pastors. This being the case, the dispute, which has been so warmly agitated, concerning the validity of presbyterian ordination, may be soon decided; for if the ceremony of ordination be at all essential, it is obvious that such a ceremony performed by presbyters must be valid, as there is no higher order of ecclesiastics in the church by whom it can be performed. Accordingly, we find, that Timothy himself, though said to be a bishop, was ordained by the laying on of the hands of a presbytery. At that ordination indeed St. Paul presided, but he could preside only as *primus in paribus;* for we have seen that, as permanent officers in the church of Christ, the apostles themselves were no more than presbyters. If the apostles' hands were imposed for any other purpose, it must have been to communicate those *charismata* or miraculous gifts of the Holy Spirit, which were then so frequent, but which no modern presbyter or bishop will pretend to give, unless his understanding be clouded by the grossest ignorance, or perverted by the most frantic enthusiasm.

Rise of Episcopacy

But if the office of bishop and presbyter was originally the same, how, it will be asked, came diocesan episcopacy to prevail so universally, as it is confessed to have done, before the conversion of Constantine, and the civil establishment of Christianity in the Roman empire? To give a satisfactory answer to this question is certainly the most arduous task which the advocate for presbytery has to perform; but the difficulties attending this task are not insurmountable.

From many passages in the New Testament,[3] it is evident, that when the apostles planted churches in different cities, they generally settled more than one pastor in the same church, to feed and govern it with joint authority. The propriety of this constitution is obvious. In those days, when the disciples of Christ were persecuted for their religion, and often obliged to meet in the "night for fear of the Jews," they could not with any degree of prudence assemble in large numbers; and therefore, had there been no more than one pastor in a city, the Christian converts, though, when assembled, they might have amounted to but a small congregation, could not all have enjoyed the benefit of public worship on the same day; at least it is obvious that they could not possibly have assembled for this purpose so often as their want of instruction, and the duty of "breaking of bread and of prayer," required them to meet. It was therefore with great wisdom that the apostles ordained several presbyters in the same church; but as these presbyters would have occasion to meet frequently, and to deliberate on the state of the flock which it was their duty to feed, and over which they had all equal authority, they would be under the necessity of electing one of their own number to be president or *moderator* of the presbytery, that order might be preserved, and all things done with decency. At first there is reason to believe that those presidents held their office no longer than while the presbyteries sat in which they were elected. Among the apostles themselves there was no fixed president. Peter indeed appears to have been most frequently admitted to that honour; but there is one very memorable occasion on record, when James, the Lord's brother, presided in an assembly of apostles, elders, and brethren, held at Jerusalem, to determine the question concerning the necessity of circumcising the Gentiles, and commanding them to keep the law of Moses.

According to Jerom.

Upon this model were the primitive presbyteries formed. They consisted of several presbyters possessed of equal powers, who at their meetings appointed one of their own number to discharge the office of moderator or temporary president; but to this president they gave no prelatical powers or negative voice over the deliberations of his brethren; for, as Jerom informs us, the church was then governed *communi presbyterorum concilio*, "by a common council of presbyters." It appears however that when an apostle, an apostolical man, or an evangelist, fixed his residence in any city, and took upon himself the pastoral care of part of the flock, his co-presbyters, from respect to his singular gifts, made him their constant and fixed moderator. Hence Timothy, during his abode at Ephesus, was moderator of the presbytery; and hence, too, Mark the evangelist, who resided many years in Alexandria, has been called the first bishop of that church, though he appears to have been nothing more than permanent moderator. We advance this upon the authority of Jerom, one of the most learned fathers of the Christian church, who informs us, that upon the death of the evangelist, the presbyters of Alexandria, for more than two hundred years, chose their bishops from their own number, and placed them in the episcopal chair, without dreaming that they ought to be raised to a higher order by a new consecration; "presbyteri unum ex se electum in excelsiori gradu collocatum, episcopum nominabant." As this practice of making the moderator of the presbytery of Alexandria a permanent officer, was thought a good expedient to guard the infant churches against schisms and divisions, those churches gradually adopted it. For, as Jerom tells us, "postquam

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[1] Phil. ii. 19. 1 Cor. iv. 17; xvi. 10, 11.

[2] 1 Tim. i. 3.

[3] Acts xi. 29; xiii. 1, 2, 3; xv. Tit. i. v.

[4] Acts xv.

unusquisque eos quos baptisaverat, suos putabat esse, non Christi, in toto orbe decretum est, ut unus de presbyteris electus, superponeretur cæteris, ad quem omnis ecclesiæ cura pertineret, et schismatum semina tollerentur."

The advantages which, in displaying his talents and authority, the perpetual president or speaker of any assembly has over his colleagues in office, are so obvious, that when the practice of electing their moderators for life became universal among the presbyteries of the primitive church, it is easy to conceive how ambitious men might so magnify the difficulties and importance of their station, as to introduce the custom of filling it by a new consecration of the bishop elect. But when this was done, diocesan episcopacy, with all its powers and prerogatives, would follow as a matter of course, until "by little and little," as Jerom expresses himself, "the whole pastoral care of the flock was devolved upon one man."

Our limits will not permit us to trace more minutely the rise and progress of this ecclesiastical usurpation, as the Presbyterian calls it; but the reader who wishes for fuller information, after studying the remains of the four first centuries of the Christian church, may consult, "An Inquiry into the Constitution, Discipline, and Worship, of the Primitive Church," written by Lord King, chancellor of England. As an impartial lover of truth, he will do well to consult also a book entitled, "An original Draught of the Primitive Church," which was published as an answer to the Inquiry; and he may read with much advantage to himself, "A Letter from a Parochial Bishop to a Prelatical Gentleman," with "An Apology for the Church of Scotland," both written by Mr. Willison of Dundee, and both evincing considerable learning, and great ingenuity, in their pious author. But during our own age, the presbyterian cause has been most ably maintained by Dr. Campbell, in his "Lectures on Ecclesiastical History," and by Dr. Mitchell, in his "Presbyterian Letters."[1]

The church of Scotland

Of the churches at present formed upon this model, we believe, that without incurring the imputation of national prejudice, we may safely affirm the church of Scotland to be the most efficient. Her mode of worship is simple and solemn; her established faith agreeable to the confessions of most of the other Protestant churches; her judicatories are calculated to maintain the rights of the people; and her pastors are eminently distinguished by their fidelity and zeal. In this respect, a gradual and very perceptible change has taken place in the course of the passing century. We cannot more properly conclude this article than with a short view of her constitution, as being that in which our Presbyterian readers are undoubtedly most interested.

No one is ignorant, that from the first dawn of reformation among us, till the era of the revolution, there was a perpetual struggle between the court and the people for the establishment of an Episcopal or a Presbyterian form of church government. The former model of ecclesiastical polity was patronised by the house of Stewart on account of the support which it gave to the prerogatives of the crown; the latter was the favourite of the majority of the people, perhaps not so much on account of its superior claim to apostolical institution, as because the laity are mixed with the clergy in ecclesiastical judicatories, and the two orders, which under episcopacy are kept so distinct, incorporated into one body. In the Scottish church, every regulation of public worship, every act of discipline, and every ecclesiastical censure, which in other churches flows from the authority of a diocesan bishop, or from a convocation of the clergy, is the joint work of a certain number of clergymen and laymen acting together with equal authority, and deciding every question by a majority of votes. The laymen who thus form an essential part of the ecclesiastical courts of Scotland, are called *ruling elders;* and hold the same office, as well as the same name, with those brethren[2] who joined with the apostles and elders at Jerusalem in determining the important question concerning the necessity of imposing upon the Gentile converts the ritual observances of the law of Moses. These lay-elders Paul enjoined Timothy[3] to account worthy of double honour, if they should rule well, and discharge the duties for which they were separated from the multitude of their brethren. In the church of Scotland every parish has several of those lay-elders, who are, or ought to be, grave and serious persons, chosen from among the heads of families, of known orthodoxy, and steady adherence to the worship, discipline, and government of the church. Being solemnly engaged to use their utmost endeavours for the suppression of vice and the cherishing of piety and virtue, and to exercise discipline faithfully and diligently, the minister, in the presence of the congregation, sets them apart to their office by solemn prayer; and concludes the ceremony, which is sometimes called ordination, with exhorting both elders and people to their respective duties.

governed by clergymen and laymen.

The kirk-session.

The kirk-session, which is the lowest ecclesiastical judicatory, consists of the minister and those elders of the congregation. The minister is *ex officio* moderator, but has no negative voice over the decision of the session; nor indeed has he a right to vote at all, unless when the voices of the elders are equal and opposite. He may indeed enter his protest against their sentence, if he think it improper, and appeal to the decision of the presbytery; but this privilege belongs equally to every elder, as well as to every person who may believe himself aggrieved by the proceedings of the session. The deacons, whose proper office is to take care of the poor, may be present in every session, and offer their counsel on all questions that come before it; but except in what relates to the distribution of alms, they have no decisive vote with the minister and elders.

The presbytery.

The next judicatory is the *presbytery,* which consists of all the pastors within a certain district, and one ruling elder from each parish, commissioned by his brethren to represent, in conjunction with the minister, the session of that parish. The presbytery treats of such matters as concern the particular churches within its limits; as the examination, admission, ordination, and censuring of ministers; the licensing of probationers, rebuking of gross or contumacious sinners, the directing of the sentence of excommunication, the deciding upon references and appeals from kirk-sessions, resolving cases of conscience, explaining difficulties in doctrine or discipline; and censuring, according to the word of God, any heresy or erroneous doctrine which hath either been publicly or privately maintained within the limits of its jurisdiction. Partial as we may be thought to our own church, we frankly acknowledge that we cannot altogether approve of that part of her constitution which gives an equal vote, in questions of heresy, to a plain mechanic and his educated pastor. In presbyteries, the only prerogatives which the pastors have over the ruling elders, are the power of ordination, and the privilege of having the moderator chosen from their body.

The provincial synod.

From the judgment of the presbytery, an appeal lies to the provincial synod, which commonly meets twice a-year, and which exercises over the presbyteries within the province a jurisdiction similar to that which is vested in each presbytery over its several kirk-sessions. Of these synods there are in the church of Scotland fifteen, which are composed of the members of the several presbyteries within the respective provinces which give names to the synods.

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[1] Presbyterian Letters, addressed to Bishop Skinner of Aberdeen, on his Vindication of Primitive Truth and Order: to which is prefixed, a Preliminary Discourse on the Present State of the Controversy concerning Ecclesiastical Government. By Patrick Mitchell, D.D., Minister of Kemnay, Aberdeenshire. Aberdeen, 1809, 8vo.

[2] Acts xv.

[3] 1 Tim. v. 17.

The general assembly.

The highest authority in the church is the general assembly, which consists of a certain number of ministers and ruling elders delegated from each presbytery, and of commissioners from the universities and royal burghs. A presbytery in which there are fewer than twelve parishes, sends to the general assembly two ministers and one ruling elder: if it contain between twelve and eighteen ministers, it sends three of these, and one ruling elder: if it contains between eighteen and twenty-four ministers, it sends four ministers and two ruling elders: and of twenty-four ministers, when it contains so many, it sends five with two ruling elders. Every royal burgh sends one ruling elder, and Edinburgh two. Their election must be attested by the kirk-sessions of the respective burghs. Every university sends one commissioner from its own body. The commissioners are annually chosen, six weeks before the meeting of the assembly: and the ruling elders are often men of the first eminence in the kingdom for rank and talents. In this assembly, which meets once a-year, the king presides by his commissioner, who is always a nobleman; but he has no voice in their deliberations. The order of their proceedings is regular, though sometimes the number of members creates a confusion, which the moderator, who is chosen from among the ministers, to be the chairman or speaker of the house, has not sufficient authority to prevent. To the general assembly appeals are brought from all the other ecclesiastical courts of Scotland; and in questions purely religious, no appeal lies from its determinations. In the subordination of these assemblies, parochial, presbyterial, provincial, and national, consists the external order, strength, and stedfastness, of the church of Scotland.

PRESCIENCE, in *Theology*, prevision or foreknowledge; that knowledge which God has of things to come.

PRESCOT, a market-town of the county of Lancaster, in the hundred of West Derby, 198 miles from London, and eight from Liverpool. It is a manufacturing place for making watches, and various kinds of cotton goods. The church is a fine structure, and has a steeple of most elegant appearance, 156 feet high. There is a good market on Thursday. The population was, in 1801, 3465; in 1811, 3678; in 1821, 4468; and in 1831, 5055; but the whole parish, which comprehends fourteen other townships, at the last census, had 28,034 inhabitants.

PRESCRIPTION, in *Law*, denotes a particular mode of establishing a Right or Title.

PRESCRIPTION, in *Medicine*, signifies much the same with what in common language is called a *receipt*, being a form of direction for the preparation and administration of some compound medicine. These medical receipts are commonly called *formulæ* by physicians; and the term *prescription* is applied to what is written by a physician on seeing his patient, instructing the apothecary what medicines are to be prepared, how they are to be composed, and how administered to the patient. In this sense, a prescription may contain two or more *formulæ*.

These prescriptions are almost always writen in Latin, and are expressed in a peculiar style, which, though well known to physicians and apothecaries, may require the illustration of an example. The following is a specimen of a modern prescription, as it would be written by a physician, according to the nomenclature of the pharmacopœia:

For Mr. Muddleton.
℞. Pulv. Rad. Rhei palmati gr. xxv.
Tartratis Potassæ ʒij.
Tincturæ Sennæ compositæ,
Syrupi Rosæ centifoliæ āā ʒij.
Aquæ Menthæ piperitæ ℥iss.
M.f. *Potio summo mane sumenda.*
Jan. 31, 1839.

From the above example, it will be seen that a prescription, properly so called, contains several circumstances beside the *formulæ* or receipts, as the name of the patient, for whom the prescription is written; the signature of the physician, as J. B. for John Balfour, and the *date of prescribing;* none of which should be omitted, as the prescriptions are carefully preserved by the apothecary, for future reference.

It may be proper to explain some circumstances respecting the *formula* given in the above prescription. The ℞ with which it commences signifies *recipe* or *take;* and is prefixed to all medical receipts. Then follow the several ingredients of which the medicine is to be composed, with the quantities of each. These quantities are usually marked by peculiar characters or symbols, and the numbers employed are usually the Roman numerals. After the ingredients have been enumerated, and their quantities specified, there follows the title of the medicine, as *Potio* in the present instance, signifying *potion* or *purging draught*, with M. f. prefixed to it, which stand for *misce fiat*, or *misce ut fiat*, mix to make; and lastly, the direction how the medicine is to be taken or administered, *summo mane sumenda*, to be taken early in the morning.

The ingredients of which a formula is composed have been, by writers on medical prescriptions, arranged under four heads: 1. The *basis* of the formula, which in the present instance is the rhubarb, constituting the principal ingredient, on whose action, modified where necessary, the chief success of the medicine, in fulfilling the required indication, is to depend. 2. The *adjuvant* or auxiliary, added to the basis, for the purpose of increasing its power, expediting its action, or rendering it more easily soluble in the juices of the stomach; in the above formula the *tartrate of potash* is the principal adjuvant. 3. The *corrector*, added to the basis, when we wish to moderate or delay its action, to correct some unpleasant or injurious property of it, such as its odour, taste, acrimony, &c., or to prevent it from acting on the body in a different manner from that which the indication requires: thus, in the present formula, the warm *tincture of senna* is added, rather to correct the griping quality of the rhubarb, than to increase its action, and the *syrup of roses* to correct the unpleasant taste of the medicine; and *the essential oil* in the peppermint-water contributes to both these purposes: these, therefore, are to be considered as the correctors. 4. The *constituent*, or that ingredient which serves to reduce the rest into the form which is considered as most convenient for the exhibition of the medicine; in the present case the *peppermint-water* is the constituent, serving to reduce the medicine to the form of a potion or draught.

Medical *formulæ* are either *officinal*, or *extemporaneous;* the former being such as are directed by authority of some public medical college to be kept in the shops of apothecaries, and the preparation of which is described in their *pharmacopœias* or dispensatories; the latter such as are prescribed by the physician or surgeon, as occasion may require.

PRESENCE, a term of relation, used in opposition to absence, and signifying the existence of a person in a certain place.

PRESENT TENSE, in *Grammar*, the first tense of a verb, expressing the present time, or that something is now performing; as *scribo*, I write, or am writing.

PRESENTATION, in ecclesiastical law. See PATRONAGE.

PRESENTATION OF THE VIRGIN, is a feast of the Catholic church, celebrated on the 21st of November, in memory of the blessed Virgin being presented by her parents in the temple, to be there educated. Emanuel Comnenus, who began to reign in 1143, makes mention of this feast in his Constitutions. Some imagine it to have been established amongst the Greeks in the 11th century; and think they discover evident proofs of it in some homilies of George of Nicomedia, who lived in the time of Photius. Its institution in the west is ascribed to Gregory XI. in 1372. Others think it was instituted in memory of the ceremony practised amongst the Jews for their newly-born females, and corresponded to the circumcision on the eighth day for males.

Presentation of our Lady also gives the title to three orders of nuns. The first of these was that projected in 1618, by a maid named Joan of Cambray. The habit of the nuns was to be a grey gown of natural wool; but this project was never accomplished. The second was established in France, about the year 1627, by Nicholas Sanguin, bishop of Senlis, and approved by Urban VIII. This order never made any great progress. The third was established in 1664, when Frederick Borromeo, being apostolical visitor in the Valteline, was intreated by some devout maids of Morbegno to allow them to live in community in a retired place; a request which he granted, and erected them into a congregation, under the title of the Congregation of our Lady. They live under the rule of St. Augustin.

PRESIDENT, Præses, is an officer, created or elected to preside over a company or assembly, and is so called in contradistinction to the other members, who are termed *residents.*

Lord President of the Council, is a great officer of the crown, who has precedence next after the lord chancellor and the lord treasurer. The lord president is as ancient as the time of king John, when he was styled *consiliarius capitalis.* His office is to attend upon the king, to propose business at the council-table, and to report to the king the several matters transacted there.

PRESS, in the mechanical arts, is a machine made of iron or wood, and serving to squeeze or compress any body.

The ordinary presses consist of six members, or pieces, viz. two flat smooth planks, between which the things to be pressed are laid; two screws, or worms, fastened to the lower plank, and passing through two holes in the upper; and two nuts, in the form of an S, serving to drive the upper plank, that is moveable against the lower, which is stable, and without motion.

Presses *used for expressing liquors*, are of various kinds; some of them being, in most respects, the same with the common presses, excepting that the under plank is perforated with a great number of holes to let the juice expressed run through into a tub, or receiver, underneath.

Press *used by Joiners*, to keep close the pieces they have glued, such as panels of wainscot, is very simple. It consists of four members, viz. two screws, and two pieces of wood, four or five inches square, and two or three feet in length, the holes of which at the two ends serve for nuts to the screws.

Press *used by Inlayers* resembles the joiner's press, except that the pieces of wood are thicker, and only one of them is moveable; the other, which is in the form of a tressel, being sustained by two legs or pillars, joined to it at each end. This press serves for sawing and cleaving the pieces of wood required in marquetry or inlaid work.

Founder's Press, is a strong square frame, consisting of four pieces of wood, firmly joined together with tenons and otherwise. This press is of various sizes, according to the sizes of the moulds. Two of them are required to each mould, at the two extremities of which they are placed; so that, by driving wooden wedges between the mould and the sides of the presses, the two parts of the mould in which the metal is to be run may be pressed close together.

Printing-Press. See Printing.

Rolling-Press, is a machine used for taking off prints from copper-plates. It is much less complex than that of the letter-press printers.

Binder's Cutting-Press, is a machine used equally by book-binders, stationers, and pasteboard-makers, and consists of two large pieces of wood, in the form of cheeks, connected by two strong wooden screws, which, being turned by an iron bar, draw together, or set asunder, the cheeks, as much as is necessary for putting in the books or paper to be cut. The cheeks are placed lengthwise on a wooden stand, in the form of a chest, into which the cuttings fall. Beside the cheeks are two pieces of wood, of the same length with the screws, and which serve to direct the cheeks, and prevent their opening unequally. Upon the cheeks moves the plough, to which the cutting-knife is fastened by a screw; and this knife has its key to dismount it, when it requires to be sharpened.

The plough consists of several parts, and amongst the rest a wooden screw or worm, which, catching within the nuts of the two feet that sustain it on the cheeks, brings the knife to the book or paper, that is fastened in the press between two boards. This screw, which is pretty long, has two directories, which resemble those of the screws of the press. To make the plough slide square and even upon the cheeks, so that the knife may make an equal paring, the foot of the plough where the knife is not fixed, slides in a kind of groove, fastened along one of the cheeks. Lastly, the knife is a piece of steel, six or seven inches in length, flat, thin, and sharp, terminating at one end in a point, like that of a sword, and at the other in a square form, which serves to fasten it to the plough.

Press, in the woollen manufactory, is a large wooden machine, serving to press cloths, serges, rateens, &c., thereby to render them smooth and even, and impart to them a gloss.

This machine consists of several members, the principal whereof are the cheeks, the nut, and the worm or screw, accompanied with its bar, which serves to turn it round, and make it descend perpendicularly upon the middle of a thick wooden plank, under which the stuffs to be pressed are placed.

PRESSING, in manufactures, is the violently squeezing a cloth, piece of stuff, or other article, to render it smooth and glossy.

PRESTEIGN, a market-town of the county of Radnor, in South Wales. It is the county town, in which the assizes are held, being 151 miles from London, and 14 from Leominster, and is situated in a rich vale on the river Lug. The county jail is a fine building, and around the town are some pleasant walks and picturesque views. There is a good market, which is held on Saturday. The population was, in 1801, 1152; in 1811, 1211; in 1821, 1387; and in 1831, 1629; but the parish, a part of which is within the English county of Hereford, contained at the last census 3282 inhabitants.

PRESTER JOHN, an appellation formerly given to an emperor of the Tartars, who was overcome and killed by Genghiz Khan. Since that time it has been applied to the Emperor of Abyssinia or Ethiopia; but in Ethiopia itself this name is utterly unknown.

Prester, a meteor, consisting of an exhalation thrown downwards from the clouds with such violence, that by the collison it is set on fire. The word is Greek, πρηστηρ, the name of a kind of serpent, called also *dipsas*, to which this meteor is supposed to bear a resemblance. The *prester* differs from the thunderbolt in the manner of its inflammation, and in its burning and breaking every thing it touches with greater violence.

PRESTO, in the Italian music, intimates to perform quickly; and hence, *prestissimo* denotes extreme quickness.

PRESTON, a town of the county of Lancaster, in the hundred of Amounderness, 216 miles from London. It is situated on the river Ribble, and is a corporate place, governed by a mayor, recorder, twelve aldermen, and thirty-six common councilmen; for which purpose it is now divided into six wards, and returns two members to the House of Commons. The town has good wide streets, many fine houses, a very extensive town-hall and assembly-rooms, a recently built jail, and several charity-schools. It is a place of great manufacturing industry for various kinds of cotton goods, especially cambric muslins; and to the introduction of this trade the town is indebted for its extension in the last forty years. Though the river Ribble is only navigable for small craft, yet it is connected by canals with almost every part of the kingdom, and can, by these means, easily disperse its productions in every direction. It has well-supplied markets on Wednesday, Friday, and Saturday. The two first are well provided with fish for the Roman Catholics, who are very numerous. The population was, in 1801, 11,887; in 1811, 17,065; in 1821, 24,557; and in 1831, 33,112; but, at the last census, the whole parish, consisting of eight other townships, contained 36,336 inhabitants.

PRESTONPANS, a parish and town of Scotland, in Haddingtonshire, about eight miles east from Edinburgh. It has considerable salt-works and manufactures of earthenware, bricks, tiles, &c. It was in the fields to the south of the village that in 1745 Prince Charles Edward defeated the King's troops, under Sir John Cope. The population of the parish in 1831 amounted to 2377.

PRESTWICH, a township of the hundred of Salford, in the county of Lancaster, 184 miles from London, and four from Manchester. It is inhabited chiefly by cotton manufacturers. The population amounted in 1801 to 1811; in 1811 to 2175; in 1821 to 2724; and in 1831 to 2941.

PRETERITE, in *Grammar*, a tense which expresses the time just past, or an action now completely finished, as *scripsi*, I have written, or just finished the act of writing.

PRETERITION, or PRETERMISSION, in *Rhetoric*, is a figure by which, in pretending to pass over a thing untouched, summary mention is nevertheless made of it. Thus, I will not say he is valiant, he is learned, he is just. The most artful praises are those given by way of preterition.

PRETEXT, a colour or motive, whether real or feigned, for doing something.

TOGA PRETEXTA, amongst the ancient Romans, a long white gown, with a border of purple round the edges. It was worn by children of quality till the age of puberty; that is, by the boys till the age of seventeen, when they changed it for the *toga virilis*, and by the girls till marriage.

PRETOR, or PRÆTOR, a magistrate amongst the ancient Romans, not unlike our Lord Chief-Justice, or Lord Chancellor, or both in one, being vested with the power of distributing justice amongst the citizens. At first there was only one prætor; but afterwards, another being created, the first or chief one had the title of *prætor urbanus*, or the city prætor, and the other was called *prætor peregrinus*, as being chief judge in all matters relating to foreigners. But, besides these, there were afterwards created many provincial prætors, who were not only judges, but also assisted the consuls in the government of the provinces, and were even invested with the government of provinces themselves.

PRETORIAN GUARDS, in Roman antiquity, were the guards of the Emperor, who were at length increased to ten thousand. They received this denomination, according to some, from their being stationed at a place called the *prætorium;* and their commander was styled *præfectus prætorii.*

PRETORIUM, or PRÆTORIUM, amongst the Romans, denoted the hall or court in which the prætor lived, and wherein also he administered justice.

PRIAM, King of Troy, was the son of Laomedon. He was carried into Greece after the taking of that city by Hercules; but was afterwards ransomed, upon which he obtained the name of *Priam*, a Greek word signifying "ransomed." After his return he rebuilt Ilium, and extended the bounds of the kingdom of Troy, which under his reign became very flourishing. He married Hecuba, the daughter of Cisseus, King of Thrace, by whom he had nineteen children, and amongst the rest Paris, who carried off Helen, and occasioned the ruin of Troy, which is supposed to have been sacked by the Greeks about 1184 before Christ, when Priam was killed by Pyrrhus, the son of Achilles, at the foot of an altar, where he had taken refuge, after a reign of fifty-two years.

PRIAMAN, a town on the south-west coast of Sumatra. In 1685 this was the chief settlement of the East India Company on the island. Long. 99. 43. E. Lat. 0. 36. S.

PRIAPUS, in Pagan worship, the son of Bacchus and Venus, who presided over gardens and the most indecent exhibitions. He was particularly adored at Lampsacus, a city at the mouth of the Hellespont, said to have been the place of his birth; and his image was placed in gardens to defend them from thieves and birds destructive of fruit. He was usually represented naked, with a stern countenance, matted hair, and holding either a wooden sword or sickle in his hand. The sacrifice offered to this obscene deity was the ass; either on account of the natural uncomeliness of this animal, and its propensity to venery, or from the disappointment which Priapus met with on his attempting the chastity of Vesta, whilst that goddess was asleep, when she escaped the intended injury by being awakened in consequence of the braying of old Silenus's ass.

PRICE, RICHARD, D.D. and LL.D., Fellow of the Royal Society of London, and of the Academy of Sciences, New England, was born at Tynton, in Glamorganshire, on the 22d of February 1723. His father was a dissenting minister at Bridgend, in that county, and died in 1739. At eight years of age he was placed under a Mr. Simmons of Neath; and four years afterwards he was removed to Pentwyn, in Caermarthenshire, where he was placed under the Rev. Samuel Jones, whom he represented as a man of a very enlarged mind, and who first inspired him with liberal sentiments of religion. Having lived as long with him as with Mr. Simmons, he was sent to Mr. Griffith's academy at Talgarth, in Breconshire. In 1740 he lost his mother, upon which he quitted the academy and proceeded to London. Here he was settled at the academy, of which Mr. Eames acted as the principal tutor, under the patronage of his uncle, the Rev. S. Price, who was, for upwards of forty years, co-pastor with Dr. Watts. At the end of four years he left this academy, and resided with Mr. Streatfield, of Stoke Newington, in the quality of domestic chaplain; whilst at the same time he regularly assisted Dr. Chandler at the Old Jewry, and occasionally assisted others. Having lived with Mr. Streatfield nearly thirteen years, he was induced to change his situation, and in the year 1757 married Miss Blundell of Leicestershire. He then settled at Hackney, but being shortly afterwards chosen minister at Newington Green, he lived there until the death of his wife, which took place in 1786, when he returned to Hackney. He was next chosen afternoon-preacher at the meeting-house in Poor Jewry Street; but this he resigned on being elected pastor of the Gravel-pit Meeting, Hackney, and afternoon-preacher at Newington Green. These he resigned with a farewell-sermon in February 1791. Shortly afterwards he was attacked with a nervous fever, which disappeared and was succeeded by a disorder in his bladder, which reduced him to such a degree, that, worn out with agony and disease, he died without a groan on the 19th of April 1791. He bequeathed his property to a sister and two nephews.

In morals, Dr. Price's principles were those of Cudworth and Clarke; and by many persons who have themselves adopted a very different theory, he is allowed to have defended these principles with greater ability than any other writer in the English language. In metaphysics he was perhaps too great an admirer of Plato, from whom he has borrowed a doctrine concerning ideas which we confess ourselves unable to comprehend. He was a firm believer in the immateriality of the soul; but, with Dr. Law, the learned bishop of Carlisle, he thought that, from death to the resurrection of the body, it remains in a dormant and quiescent state. He contended for its indivisibility, but maintained, at the same time, its extension; which, in the celebrated controversy with Dr. Priestley, furnished the latter with some advantages which his own acuteness would never have obtained. In propagating his political principles, which were republican, he sometimes expressed himself with undue vehemence; and he was a zealous enemy to all religious establishments, which, in his opinion, encroach upon that liberty with which Christ has made us free. His faith respecting the Son of God was what has sometimes been called Low Arianism, and sometimes Semi-Arianism. From a very early age he claimed the privilege of thinking for himself on every subject. His father was a rigid Calvinist, and spared no pains to instil his own theological dogmas into the tender mind of his son; but young Richard would often start his doubts and difficulties, and sometimes incur the old man's displeasure by arguing against his favourite system with an ingenuity that perplexed, and a solidity that could not easily be overturned. He had once the misfortune to be caught reading a volume of Clarke's sermons, which his father, in great wrath, snatched from him, and threw into the fire. Perhaps he could not have taken a more effectual method to make the book a favourite, or to excite the young man's curiosity in regard to the other works of the same author; and it is by no means improbable that this orthodox bigotry contributed more than any other circumstance to lay the foundation of his son's Arianism.

In 1763 or 1764 he was chosen a fellow of the Royal Society, and contributed largely to the transactions of that learned body; in 1769 he received from Aberdeen a diploma creating him Doctor of Divinity; and in 1783 the degree of Doctor of Laws was conferred upon him by the college of Yale in Connecticut. As in the year 1770 he refused an American degree, which had been conveyed to him by Dr. Franklin, his acceptance of one, thirteen years afterwards, can be attributed only to his extravagant attachment to a republican form of government.

To posterity his works will be his monument. They are, 1, A Review of the Principal Questions and Difficulties in Morals, 1758, 8vo.; 2, Dissertations on Providence, 1767, 8vo.; 3, Observations on Reversionary Payments, 1771, 8vo.; 4, Appeal on the National Debt, 1773, 8vo.; 5, Observations on the Nature of Civil Liberty, 1776; 6, On Materialism and Necessity, in a correspondence between Dr. Price and Dr. Priestley, 1779; 7, On Annuities, Assurances, and Population, 1779, 8vo.; 8, On the Population of England, 1780; 9, On the Public Debts, Finances, and Loans, 1783, 8vo.; 10, On Reversionary Payments, 1783, 2 vols.; 11, On the Importance of the American Revolution, 1784; besides Sermons, and a variety of Papers in the *Philosophical Transactions* on Astronomy, and other philosophical subjects.

PRIDE, a term indicating inordinate and unreasonable self-esteem, attended with insolence and rude treatment of others. It is frequently confounded with vanity, and sometimes with dignity; but to the former passion it has no resemblance, and in many circumstances it differs from the latter. Vanity is the parent of loquacious boasting; and the person subject to it, if his pretences be admitted, has no inclination to insult the company. The proud man, on the other hand, is naturally silent, and, wrapt up in his own importance; he seldom speaks except to make his audience feel their inferiority. It is this circumstance which distinguishes pride from dignity. Every man, possesed of great powers of mind, is conscious of them, and feels that he holds a higher rank in the scale of existence than he whose powers are inferior. If he recollect, at the same time, that he has nothing which he did not receive, and that his superiority is owing to the good pleasure of Him who forms his creatures differently, as the potter forms his clay, he will be so far from insulting his inferiors, that, when necessarily in company with them, he will bear with their foibles, and, as far as is proper, make them lose sight of the distance which the laws of God and man have for ever placed between them and him. This condescension, however, if he be a man of dignity, will never lead him to join with them in any mean or unworthy action. He will even excuse in them many things which he would condemn in himself, and will give them his good wishes, after they have forfeited his esteem. Such a character is amiable and respectable; in short, what every man should labour to attain. From the weakness of human nature, however, it is too apt to degenerate into pride.

To a man of great intellectual powers and various erudition, the conversation of ordinary persons affords neither instruction nor amusement; and such conversation, when often repeated, must, from the nature of things, become tedious and irksome. But it requires great command of temper and of manners to prevent uneasiness, long felt, from sometimes betraying itself by external symptoms, such as peevish expressions, a forbidding look, or absence of mind; and these are the infallible indications of contempt for the company, the very worst ingredient in the passion of pride. If this contempt be often excited, it will be formed into a habit; and the proud man will be so much under its influence, as to insult his inferiors, and sometimes even his equals, without forming the resolution to insult either the one or the other. Such a character is hateful to every company, and is so far from indicating true dignity of mind in him to whom it belongs, that it is obviously associated with meanness, and indicates a consciousness of some radical defect. He who possesses real and conspicuous merit has no occasion to depress others for the purpose of raising himself; his superiority will be cheerfully acknowledged; but when a man of undoubted eminence, in one respect, is so swollen with pride as to make him wish to appear great in all respects, he has no other means of enforcing his ill-founded claim, than displaying his acknowledged superiority, with such insolence, as may drive to a distance from him every person by whom he is conscious that, in many instances, he might be more than rivalled. Whoever is proud of knowledge, would do well to consider how much knowledge he wants.

The same observations which we have made on pride of parts, will apply almost to every other species of pride, such as pride of birth, riches, or the like. The peace and order of society require difference of rank, accompanied with different degrees of authority; and he who inherits a title or office from his ancestors, may, without pride, be conscious of his superiority, provided he forget not that such superiority is conferred on families and individuals, not for their own sakes, but for the good of the community. The peer who keeps this circumstance in mind, may maintain his station, and repress the forward petulance of the plebeian, without giving offence to any thinking man; but if he dwell upon his rank with too much complacency, he will, in process of time, be apt to consider himself and his family as superior by nature to those upon whom no title has been conferred, and then his pride will become intolerable. If we could trace our descents, says Seneca, we would find all slaves to come from princes, and all princes from slaves. To be proud of knowledge, is to be blind in the light; to be proud of virtue, is to poison ourselves with the antidote; to be proud of authority, is to make our rise our downfall. The best way to humble a proud man is to neglect him.

PRIDEAUX, Humphry, a very learned clergyman of the Church of England, was born at Padstow, in Cornwall, in 1648. He studied three years at Westminster under Dr. Busby, and was then removed to Christ Church, Oxford. Here, in 1676, he published his *Marmora Oxonensia ex Arundelianis, Seldenianis, aliisque conflata, cum perpetuo Commentario*. This introduced him to the Lord Chancellor Finch, afterwards Earl of Nottingham, who, in 1679, presented him to the Rectory of St. Clement's, near Oxford, and, in 1681, bestowed on him a prebend of Norwich. Some years afterwards he was engaged in a controversy with the Catholics at Norwich, concerning the validity of the orders of the Church of England, which produced his book upon that subject. In 1688, he was installed in the archdeaconry of Suffolk, to which he was collated by Dr. Lloyd, then Bishop of Norwich. In 1691, upon the death of Dr. Edward Pococke, the Hebrew professorship at Oxford being vacant, was offered to Dr. Prideaux; but he refused it. In 1697, he published his Life of Mahommed; and, in 1702, he was installed dean of Norwich. In 1710, he was cut for the stone, which interrupted his studies during more than a year. Some time after his return to London, he proceeded with his *Connection of the History of the Old and New Testament,* which he had commenced when he laid aside the design of writing the *History of Appropriations.* He died in 1724.

PRIEST, a person set apart for the performance of sacrifice, and other offices and ceremonies of religion. Before the promulgation of the law of Moses, the first-born of every family, the fathers, the princes, and the kings, were priests. Thus Cain and Abel, Noah, Abraham, Melchizedec, Job, Isaac, and Jacob, offered themselves their own sacrifices. Amongst the Israelites, after their departure from Egypt, the priesthood was confined to one tribe, and it consisted of three orders; the high priest, priests, and Levites. The priesthood was made hereditary in the family of Aaron, and the first-born of the oldest branch of that family, if he had no legal blemish, was always the high priest. This divine appointment was observed with considerable accuracy until the Jews fell under the dominion of the Romans, and had their faith corrupted by a false philosophy. Then, indeed, the high priesthood was sometimes set up to sale, and instead of continuing for life, as it ought to have done, it seems, from some passages in the New Testament, to have been nothing more than an annual office. There is sufficient reason to believe, however, that it was never disposed of except to some descendant of Aaron, capable of filling it, if the older branches were extinct. In the time of David, the inferior priests were divided into twenty-four companies, who were required to serve in rotation, each company by itself, for a week. The order in which the several courses were to serve was determined by lot; and each course was, in all succeeding ages, called by the name of its original chiefs.

All nations have had their priests. The pagans had priests of Jupiter, Mars, Bacchus, Hercules, Osiris, Isis, and other divinities; and some deities had also priestesses. The Mahommedans have priests of different orders, called scheiks and muftis; and the Indians and Chinese have their Brahmins and Bonzes.

It has been very much disputed, whether, in the Christian church, there be any such officer as a priest, in the proper sense of the word. The Church of Rome, which holds the propitiatory sacrifice of the mass, has, of course, her proper priesthood. In the Church of England, the word priest is retained to denote the second order in her hierarchy, but with very different significations, according to the different opinions entertained of the Lord's supper. Some few of her divines, of great learning, and of undoubted Protestantism, maintain that the Lord's supper is a commemorative and eucharistical sacrifice, and consider all who are authorised to administer that sacrament as, in the strictest sense, priests. Others hold the Lord's supper to be a feast upon the sacrifice once offered on the cross; and these, too, must consider themselves as clothed with some kind of priesthood. Great numbers, however, of the English clergy, perhaps the majority, agree, with the Church of Scotland, in maintaining that the Lord's supper is a rite of no other moral import, than the mere commemoration of the death of Christ. These, therefore, cannot consider themselves as priests in the rigid sense of the word, but only as presbyters, or, in other words, elders.

PRIESTLEY, Joseph, LL.D. and F. R. S., a natural philosopher and theologian, was born upon the 24th of March 1773, at Field-head, in the parish of Bristall, in the west riding of Yorkshire. His father was a cloth-manufacturer, and both his parents were respectable Calvinistic dissenters. A strong desire of reading was one of the first passions which this philosopher exhibited, and which probably induced his parents and friends to change their mind respecting his destination, and, instead of bringing him up as a tradesman, to qualify him for some learned profession. He acquired a knowledge of Hebrew, Greek, and Latin, in the school of an eminent teacher at Bartley; and, at the age of nineteen, he became a theological student in the academy of Daventry. When about the age of twenty-two, he was made choice of as assistant minister to the Independent congregation of Needham Market, in Suffolk. Having resided at Needham for about three years, he received an invitation to become pastor of a small flock at Namptwitch, in Cheshire, which he accepted. Here he opened a day school, in the management of which he displayed that turn for research, and that spirit of improvement, which were afterwards destined to form such prominent features in his character. His reputation as a man of extraordinary talents and diligent inquiry, soon spread amongst his professional brethren; and when Dr. Aitken was chosen to succeed the reverend Dr. Taylor as professor of divinity at Warrington, the vacant department of belles lettres was assigned to Mr. Priestley.

His literary career may probably be said to have commenced at Warrington; and the extent, as well as the originality of his pursuits, were soon announced to the world by a variety of valuable publications. Much of his attention about this period was taken up with general politics, on which he delivered a number of lectures. Although it was reasonable to think that his time would be sufficiently occupied by his academical and literary employments, yet his unwearied activity and industry found means to accomplish the first great work in philosophy which laid a foundation for his future fame.

Having long amused himself with an electrical machine, and felt himself interested in the progress of discovery in that branch of physics, he undertook a history of electricity, with an account of its present state. This work made its first appearance at Warrington in the year 1767, and was so well received by the learned world, that it went through a fifth edition in quarto, in the year 1794. It is justly deemed a valuable performance, and its original experiments are allowed to be very ingenious.

About the year 1768, he was chosen as pastor of a large and respectable congregation of Protestant dissenters at Leeds, which led him to give a very large share of his attention to theological subjects. His mind is said to have been from childhood strongly impressed with sentiments of piety and devotion; and although he changed most of those religious sentiments in which he had been instructed, for such as he regarded more rational and consistent with truth, his piety and devotion never deserted him. He was at the head of the moderate Unitarians, whose leading tenet is the proper humanity of Christ; confining every species of religious worship and adoration to the one Supreme Being. Some, we believe, have charged him with a design to subvert the Christian religion; but, since zeal for Christianity, as a divine dispensation, and the most valuable of all gifts bestowed upon the human race, was his ruling passion, such an imputation cannot, in fairness, be admitted.

His *History and Present State of Discoveries relating to Vision, Light, and Colours,* appeared in 1772, in two volumes quarto. This is allowed to be a performance of great merit and lucid arrangement; but it did not bring him such a large share of popularity as his *History of Electricity,* because it is probable that he was scarcely qualified to explain the more abstruse parts of the science. In the year

1770, he quitted the town of Leeds for a situation entirely different from that which he had held there. His philosophical writings and the recommendation of Dr. Price had made him favourably known to the Earl of Shelburne, who held out to him such advantageous proposals for residing with him, that a regard for his family did not permit him to reject them. The domestic tuition of Lord Shelburne's sons having been previously committed to a man of merit, they received no instructions from Dr. Priestley further than some courses of experimental philosophy. He also attended his Lordship in a visit to Paris, where he had an opportunity of seeing some of the most celebrated men of science in that country, whom he astonished by asserting a firm belief in revealed religion, which had been presented to their minds in such colours, that they thought no man of sense could hesitate in rejecting it as an idle fable.

In the year 1775, he published his *Examination* of Dr. Reid on the Human Mind; Dr. Beattie on the Nature and Immutability of Truth; and Dr. Oswald's Appeal to Common Sense. The design of this volume was to refute the doctrine of Common Sense, said to be employed as the test of truth by the metaphysicians of Scotland. He never intentionally misrepresented either the arguments or the purposes of an opponent; but he measured the respect with which he treated him by that which he conceived for him in his own mind. In the year 1777, he published his disquisitions relating to *Matter and Spirit*, in which he gave a history of the philosophical doctrine respecting the soul, and openly supported the material system, which makes it homogeneous with the body. This subjected him to more odium than any of his other productions. As he materialized spirit so he in some measure spiritualized matter, by assigning to it penetrability and several other subtle qualities. About the same period he became the champion of philosophical necessity; a doctrine not less obnoxious to many than the former, on account of its supposed, or rather inevitable, effects on morality. So astonishing was the versatility of his mind, that he at the same time carried on that course of discovery concerning aeriform bodies, which has rendered his name so illustrious amongst philosophical chemists. A second volume was published in 1775, and a third in 1777. Some of his most memorable discoveries were those of nitrous and dephlogisticated or pure air; of the restoration of vitiated air by vegetation; of the influence of light on vegetables; and of the effects of respiration on the blood.

The name of Priestley was by these means spread throughout all the countries of Europe, and honours were heaped upon him by scientific bodies in various parts. The term of his engagement with Lord Shelburne having expired, Dr. Priestley found himself at liberty to choose a new situation, and retired with a pension for life of L.150 a-year. He chose the vicinity of the populous town of Birmingham, which was then the residence of several men of science, such as Watt, Withering, Bolton, and Keir, whose names are well known to the public. Here he was invited to become pastor of a dissenting congregation, an offer which he accepted about the latter end of the year 1780. Soon after this appeared his Letters to Bishop Newcome, *On the Duration of Christ's Ministry*, and his *History of the Corruptions of Christianity*, works which were afterwards followed by his *History of Early Opinions*. He displayed his attachment to freedom by his *Essay on the First Principles of Government*, and by an anonymous pamphlet on the *State of Public Liberty* in this country; and he evinced a warm interest in the cause of America at the time of its unfortunate quarrel with the mother country.

On the 14th of July, 1791, the celebration of the anniversary of the destruction of the Bastille, by a public dinner, at which Dr. Priestley was not present, gave the signal for those riots which have brought lasting disgrace on the town of Birmingham, and in some degree upon the national character. Amidst the conflagration of places of worship and of private dwellings, Dr. Priestley was the great object of popular rage; his house, library, manuscripts, and apparatus, were given as a prey to the flames; he was hunted like a criminal, and experienced not only the furious outrages of a mob, but the most unhandsome treatment from some who ought to have supported the character of gentlemen and friends of good order. He now lay under a load of public odium and suspicion, and, besides, he was constantly harassed by the petty malignity of bigotry. It was not to be wondered at, therefore, that he looked for an asylum in a country to which he had always shewn a friendly attachment, and which, he supposed, was in full possession of all the blessings of civil and religious liberty. In the year 1794, he took leave of his native country, and embarked for North America. He took up his residence in Northumberland, a town in the interior of the state of Pennsylvania, which he selected on account of the purchase of landed property in its neighbourhood; otherwise its remoteness from the sea-ports, its want of many of the comforts of life, and of all the helps to scientific pursuit, rendered it a peculiarly undesirable abode for one of Dr. Priestley's habits and employments. The loss of his amiable wife, and of a most promising son, as well as repeated attacks of disease, severely tried the fortitude and resignation of this ill-fated philosopher.

In America he was received with general respect, and the angry contests of party were not able wholly to deprive him of the esteem due to his character. He was heard as a preacher by some of the most distinguished members of Congress; and he was offered, but declined, the place of chemical professor of Philadelphia. It became his great object to enable himself, in his retirement at Northumberland, to renew that course of philosophical experiment, and especially that train of theological writing, which had occupied so many of the best years of his life. By numerous experiments on the constitution of airs, he became more and more fixed in his belief of the phlogistic theory, and in his opposition to the new French chemical system, of which he lived to be the only opponent of any celebrity. By the liberal contributions of his friends in England, he was enabled to commence the printing of two extensive works, upon which he was zealously bent, a *Church History*, and an *Exposition of the Scriptures;* and during the progress of his final decline, he unremittingly urged their completion.

Since an illness which seized him at Philadelphia, in the year 1801, he never recovered his former state of health. His complaint was constant indigestion, and a difficulty of swallowing food of any kind. But during this period of general debility, he was busily employed in printing his *Church History*, in writing the first volume of his *Notes on the Scriptures*, and in making new and original experiments. During this period, likewise, he composed his pamphlet of *Jesus and Socrates Compared*, and reprinted his *Essay on Phlogiston.*

From about the beginning of November 1803, till the middle of January 1804, his complaint grew more serious; yet, by judicious medical treatment and strict attention to diet, he, after a time, seemed to be, if not regaining strength, at least not getting worse; and his friends fondly hoped that his health would continue to improve as the season advanced. He, however, considered his life as very precarious. Even at this time, besides his miscellaneous reading, which was at all times very extensive, he read through all the works which are quoted in his *Comparison of the different Systems of Grecian Philosophers with Christianity;* composed that work; and transcribed the whole of it in less than three months, thus leaving it ready for the press.

In the last fortnight of January, his fits of indigestion became more alarming than ever, his legs swelled, and his weakness increased. Within two days of his death he became so weak, that he could walk but a little way, and that with great difficulty. He was fully sensible that he had not long to live, yet he talked with cheerfulness to all who called for him. He dwelt upon the peculiarly happy situation in which it had pleased the Divine Being to place him in life; the great advantage he had enjoyed in the acquaintance and friendship of some of the best and wisest men of the age in which he lived; and the satisfaction he derived from having led an useful as well as a happy life. On the 9th of February 1804, he breathed his last, so easily, that those who were sitting close to him did not immediately perceive his exit. He had put his hand to his face, which prevented them from observing the last moment of his being.

In the constitution of Dr. Priestley's mind, great ardour and vivacity of intellect were united with a mild and placid temper. With a zeal for the propagation of truth which nothing could subdue, he joined a calm patience, and an unruffled serenity of temper, which rendered him proof against disappointments. The rights of private judgment were rendered sacred to him by every principle of his understanding, and his heart would not have suffered him to injure his bitterest enemy. He was naturally disposed to be cheerful, and when his mind was not occupied with serious thoughts, he could unbend, with playful ease and negligence, in the private circle of friends; but in large and mixed companies, he commonly spoke little. In the domestic relations of life he was uniformly kind and affectionate; his parental feelings were those of the tenderest and best of fathers; and not even malice itself could ever fix a stain upon his private conduct, or impeach his integrity.

PRIMÆ VIÆ, amongst physicians, denote the whole alimentary ducts; including the œsophagus, stomach, and intestines, with their appendages.

PRIMARY, first in dignity, chief, or principal.

PRIMARY QUALITIES OF BODIES. See METAPHYSICS.

PRIMATE, in church polity, an archbishop, who is invested with a jurisdiction over other bishops.

PRIME, PRIMUS, an appellation given to whatever is first in order, degree, or dignity, amongst several things of the same or a similar kind. Thus we say, the prime minister, prime cost, and so of others.

Prime is sometimes used to denote the same with decimal, or the tenth part of an unit.

PRIME FIGURE, in *Geometry*, one which cannot be divided into any other figures more simple than itself; as a triangle amongst planes, and the pyramid amongst solids.

PRIME OF THE MOON, is the new moon when she first appears, which is about three days after the change.

PRIME VERTICAL, is that vertical circle which passes through the poles of the meridian, on the east and west points of the horizon; and hence dials projected on the plane of this circle are called *prime vertical*, or *north and south dials*.

PRIME, in the Catholic Church, is the first of the canonical hours succeeding to lauds.

PRIMER SEISIN, in *feudal law*, was a feudal burden, only incident to the king's tenants *in capite*, and not to those who held of inferior or mesne lords. It was a right which the king had, when any of his tenants *in capite* died seized of a knight's fee, to receive of the heir, provided he were of full age, one whole year's profits of the lands if they were in immediate possession, and half a year's profits if the lands were in reversion expectant upon an estate for life. This seems to be little more than an additional relief; but grounded upon this feodal reason, that by the ancient law of feuds, immediately upon the death of a vassal the superior was entitled to enter and take seisin or possession of the land, by way of protection against intruders, till the heir appeared to claim it, and receive investiture; and for the time the lord so held it, he was entitled to take the profits; and unless the heir claimed within a year and day, it was by the strict law a forfeiture. This practice, however, seems not to have long obtained in England, if it ever did, with regard to tenures under inferior lords; but, as to the king's tenures *in capite*, this *prima seisina* was expressly declared, under Henry III. and Edward II., to belong to the king by prerogative, in contradistinction to other lords; and the king was entitled to enter and receive the whole profits of the land till livery was sued; which suit being commonly within a year and day next after the death of the tenant, therefore the king used to take at an average the *first-fruits*, that is to say one year's profits of the land. And this afterwards gave a handle to the pontiffs, who pretended to be feudal lords of the church, to claim, in like manner, from every clergyman in England, the first year's profits of his benefice, by way of *primitiæ* or first-fruits. But all the charges arising by primer seisin were taken away by the 12 Car. II., c. 24.

PRIMING, in *Gunnery*, the train of powder that is laid from the opening of the vent along the gutter or channel on the upper part of the breech of the gun, which, when fired, conveys the flame to the vent, by which it is further communicated to the charge, in order to discharge the piece. This operation is only used on shipboard at the proof, and sometimes in garrison; for, upon all other occasions, tubes are used for the purpose.

PRIMING, amongst painters, signifies the laying on of the first or original colour.

PRIMIPILUS, in *Antiquity*, the centurion of the first cohort of a legion, who had the charge of the Roman eagle.

PRIMITIÆ, the first-fruits gathered off the earth, and of which the ancients made presents to the gods.

PRIMITIVE, in *Grammar*, is a root or original word in a language, in contradistinction to *derivative*. Thus, *God* is a primitive; *godly*, a derivative; and *god-like*, a compound.

PRIMOGENITURE, or the right of the first-born, has amongst most nations been very considerable. The first-born son, in the patriarchal ages, had a superiority over his brethren, and, in the absence of his father, was the priest of the family. Amongst the Jews, he was consecrated to the Lord, had a double portion of the inheritance, and succeeded in the government of the family or kingdom. It is, however, remarkable, and unquestionably shows the connection between this institution and the birth and office of our Saviour, that if a woman's first child were a girl, neither she nor the children that came after her were consecrated.

In almost every nation of Europe, the right of primogeniture prevails at present in some degree, but it did not prevail always. The law which calls the elder-born to the crown, preferably to the others, was not introduced into France till a late period; it was unknown to the first race of kings, and even to the second. The four sons of Clovis shared the kingdom equally amongst themselves, and Louis le Debonnaire did the same; it was not till the race of Hugh Capet succeeded, that the prerogative of succession to the crown was appropriated to the first-born.

Mr. M'Culloch, in one of the Notes to his valuable edition of Smith's *Wealth of Nations*, makes the following observations on this subject. "Though there can be little doubt of the injurious consequences that must always flow from every attempt to regulate the succession to property by means of compulsory regulations, there are good grounds for thinking that the *custom* of primogeniture, or the custom of leaving the whole, or the greater part of the paternal estate, to the eldest son, to the exclusion of his brothers and sisters, has been advantageous. The prejudices of most political philosophers against primogeniture seem to rest on no solid foundation. Dr. Smith says, that it is a custom which, 'in order to enrich one, beggars all the rest of the children;' but, so far from agreeing in this opinion, we cannot help thinking, that to it may be fairly ascribed much of the industry, freedom, and civilization of modern Europe; and that were it abolished, and the custom of equally dividing landed property established in its stead, all the children of landlords, the youngest as well as the oldest, would be reduced to a state of comparative poverty, at the same time that the prosperity of the other classes would be greatly impaired."

"This custom of *gavelling*, or dividing the paternal inheritance, was not confined to any particular sort of property, but extended to leasehold as well as freehold. And so strongly was it rooted in the public esteem, that it was to no purpose that a landlord inserted a clause in the lease of a farm prohibiting its subdivision. The courts of law were hostile to such limitations; and the juries, before which a case of this description was occasionally tried, if they returned a verdict in favour of the landlord, almost uniformly awarded only nominal damages. The consequences resulting from the combined operation of this custom and law, have been exactly such as might have been anticipated. Instead of increasing with the increase of capital, and the more general diffusion of a knowledge of the correct principles of agriculture, the farms in the possession of the Irish tenantry have been gradually reduced in most instances to mere patches."

"In Scotland a totally different system has been followed, and with the happiest results. The succession to farms, as well as estates, has been long regulated in that part of the empire by the law of primogeniture. The tenant of a Scotch farm has no power, unless a provision to that effect be inserted in his lease, which is very rarely done, to devise his interest in it. He can neither sublet nor subdivide his farm; and, at his death, it descends entire to his heir-at-law. The younger children are not taught from infancy to trust to the land for support; on the contrary, they are early made aware that farming is not a profession on which they can enter, and that it is indispensable they should apply themselves to something else. In consequence, they either establish themselves in towns or emigrate to other countries; and perhaps there is no one circumstance that has contributed so much as this to inspire Scotchmen with the adventurous enterprising spirit for which they are celebrated. The agricultural population is, in this way, kept down to its proper level; and prudential habits are very generally diffused. Instead of becoming less, farms in Scotland are gradually becoming larger, according to the increase in the capital of those engaged in the business of agriculture. No one prosecutes farming as a means of acquiring a miserable subsistence, but as a means of employing capital with advantage. There is, however, great reason to fear that the enfranchising of the tenants will have a most injurious influence over agriculture."[1]

By the ancient custom of *Gavel-kind*, still preserved in Kent, and in some other parts of our island, primogeniture is of no account. "The lands," says Blackstone, "descend, not to the eldest, youngest, or any one son only, but to all the sons together."[2]

PRIMUM MOBILE, in the Ptolemaic astronomy, the ninth or highest sphere of the heavens, the centre of which is that of the world, and in comparison with which the earth is but a point. This is supposed to contain within it all other spheres, and to give them motion, turning them quite round, as well as revolving itself, in twenty-four hours.

PRINCE, Princeps, in polity, a person invested with the supreme command of a state, and independent of any superior.

Prince likewise denotes a person who is a sovereign in his own territories, yet holds of some other as his superior. Such are the princes of Germany, who, though absolute in their respective principalities, are bound to the emperor in certain services.

Prince also denotes the issue of princes, or those of the royal family. In France, before the Revolution, they were called "princes of the blood," and during the short continuance of the constitution of 1791, "French princes." In England the king's children are called "sons and daughters of England;" the eldest son is created Prince of Wales; the cadets are created dukes or earls, as the king pleases; and the title of all the children is "royal highness."

Prince of the Senate, in ancient Rome, the person who was the first called in the roll of senators, whenever it was renewed by the censors. He was always of consular and censorian dignity.

Prince's Metal, or **Pinchbeck**, an alloy of copper and zinc, which has a resemblance to gold.

Prince of Wales's Island, called also **Pulo Penang**, and **Betel-nut Island**, is situated on the western coast of the Malay peninsula, from which it is separated by a narrow strait, not more than two miles in breadth. It forms an excellent harbour, which is capacious, and well defended from all winds, and it affords anchorage for the largest ships. The principal entrance is from the north-west; but there is also a fine channel to the southward. There is an inner harbour, in which ships may receive every kind of repair that can be performed without going into dock. The area of the island is estimated at 160 square miles. It is nearly five leagues in length and seven or eight miles in breadth. It is of an irregular four-sided figure, which is highest on the north side and shortest on the south; and is intersected by a range of lofty hills, which decrease in magnitude as they approach the south, and in which are the sources of numerous streams, that supply the island with abundance of water. These hills are of a moderate height. The highest, namely, the Flag-staff Hill, does not rise to more than 2500 feet above the level of the sea. Here the heat is comparatively moderate; the thermometer seldom rises above 74°, and often falls to 66° whilst in the plains it ranges from 76° to 90°. The climate is moist, and the rains are heavy. Except in the dry hot months of January and February, scarcely a day passes without rain, which is heaviest in November and December.

The island generally possesses a fertile soil, being for the most part a light black mould, mixed with gravel, clay, and in many parts sandy. It is chiefly formed from the decayed leaves of trees, from which originated a fine vegetable mould, the whole island having been for ages covered with immense forests. This has in some degree disappeared as the woods were cleared and the surface exposed to the weather; but the soil in the interior is still adapted for any sort of tropical produce. Cultivation is extended over the northern, and nearly the whole of the southern and eastern sides of the island. The principal productions are pepper, betel-nut, betel-leaf, cocoa-nuts, coffee, sugar, parsley, ginger, yams, sweet potatoes, and a great variety of vegetables. The island abounds in many species of fruits, such as the mangosteen, rambosteen, pine-apples, guavas, oranges, citrons, pomegranates, and others. The island also produces cloves, nutmegs, cinnamon, pimento, kyapootee, cotatova, and numerous other plants from the Moluccas and Eastern Isles. Pepper is one of the chief articles of cultivation. This island also affords the elastic gum vine, or American caoutchouc. It grows to the thickness of an arm, creeping along the ground to the distance of two hundred paces, and then ascending amongst the branches of high trees. The forests which are found in this island abound in excellent timber for ship-building, and supply masts of any dimensions, lower masts of any size having been procured here for a seventy-four gun-ship.

This island was originally granted, in 1785, by the King of Queda, to Captain Francis Light, of a country ship, who had married his daughter. It was then transferred to the East India Company, and accepted; being peculiarly adapted as a mercantile station for vessels arriving from all the Malay ports, the Moluccas, Borneo, the Celebes, and the Philippine Islands. A small detachment was accordingly sent from Calcutta, under the command of Captain Light, who in 1786, took possession of the island, for the use of the East India Company. But those early settlers had great difficulty in clearing the country, encumbered with an immense forest, with swamps which required to be drained, and ravines which it was necessary to fill up. A town called George Town was, however, marked out, and within a year sixty Chinese families had settled in it, besides great numbers of Malays, Buggepes, and other Eastern traders. The port was made free to all nations, and in a very short time numerous adventurers flocked to the settlement, commerce and population rapidly increased, and cultivation was extended. In 1797 the population amounted to 6,937, exclusive of Europeans and the garrison; and in 1805, it had risen to 10,310. They have since been progressively increasing, and exhibit an uncommon diversity of races, consisting of British, Dutch, Portuguese, Americans, Arabs, Parsees, Chinese, Chulias, Malays, Buggepes, Birmans, Siamese, Javanese, &c. In 1805, the settlement having grown in wealth and importance, it was determined to erect it into a regular government, subordinate only to the Governor-General of India. But, on account of the enormous expense of this establishment, some modifications were made in these arrangements in the year 1808. This island is resorted to by invalids from the continent in search of health; but if we may judge from the number of governors who have died here, the change is scarcely for the better. Captain Light died in 1794; and he was succeeded by Mr. Manningham, who died soon after in Bengal. In 1796 Major Macdonald took the charge, and died at Madras in 1799. Sir George Leith, who succeeded him, lived and returned to Europe; but the Hon. C. Bruce, who arrived as governor in the year 1810, only survived till next December.

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[1] Smith's *Wealth of Nations*, with Notes by M'Culloch, p. 564. 1838, in one vol. 8vo.

[2] *Comment.* book ii. chap. 6.

The fort, which is called Fort Cornwallis, is incapable of defence. from its size and construction. It is built upon the north-eastern point of the island, and large sums have been spent without completing it. It contains barracks for the military, an arsenal, a magazine, and several military storehouses. Of late years the sea has made great encroachments on the northern face of the fort, and along the esplanade. The town is of considerable extent, and the streets, which cross each other at right angles, are spacious and airy. There is a large pier for landing and shipping goods; a government house, a church, a jail, and several substantial bridges have been built; whilst the fortifications have been improved and strengthened, and the public roads repaired and widened. The markets are well supplied with fish of various descriptions and of excellent quality; with poultry of all sorts, pork, grain of every description, and a profusion of vegetables and fruit. The beef and veal are not of a good quality. Sheep are imported from the continent of India; whilst Sumatra and the Malay peninsula furnish a supply of goats. Milk and butter are dear and scarce. A great trade is carried on with Europe, India, and the islands in the Eastern seas. Ships that are trading to the east, especially to China, touch here, where they procure such refreshments or articles of trade as they require. Vessels from Europe, bound for China, also touch here, and load large quantities of tin, canes, rattans, sago, pepper, betel-nut, luche-de-mar, edible birds' nests, &c., for the China market. This small island is the emporium of the whole trade of the Straits of Malacca and adjacent islands. The imports from Europe, either directly or from the other presidencies, are generally European manufactures in iron and steel, such as anchors, cutlery of all sorts, fire-arms, nails; also tin-ware, patent shot, sheet-lead, sheet-copper, iron in bars, books, pamphlets, boots and shoes, cables, canvas, cabinet ware, cloths, and cassimeres, glass ware, hats, haberdashery, hosiery, musical and mathematical instruments, oilmen's stones, painters' colours, plated wire, watches, malt liquor, and European wines of all sorts. From Bengal, the imports are opium, grain, iron, steel, marine stores, and piece goods; from the Coromandel coast, salt, tobacco, cloths, evir rope and yarns, handkerchiefs, chintzes, &c.; from Bombay and the Malabar coast, cotton, salt, a few piece goods, red wood, sandal wood, sharks' fins, myrrh, piece goods, &c.; from Sumatra, pepper, benzoin, camphire, and gold dust; from Acheen and Pedeer, gold dust, betel-nut, pepper, rice, and Acheen cloths. Tin is imported from the east coast and from Junkceylon; also pepper, sugar, oil, rice, tobacco, elephants' teeth, edible birds' nests, &c.; spices from the Moluccas; gold dust, sago, and black wood from Borneo; and from China, tea, sugar, lustrings, velvet, paper, umbrellas, china-ware, quicksilver, and generally every article required by the Chinese settlers, though British produce has in many cases superseded that of China. Other articles from China are, raw silk, copper ware, China camphor, China root alum. The exports consist of many of those articles which are sent to Sumatra, Junkceylon, Java, Borneo, China, Bengal, Coromandel, as they are required.

PRINCE'S ISLE, situated off the north-westernmost extremity of the Island of Java. The land is generally low and woody, and the highest eminence on it is called the Pike. It contains a town called Samadang, divided into two parts by a river. Such ships as touch here may be supplied with fish, deer, plantains, pine-apples, rice of the mountain kind, yams, and other vegetables. Long. 10512. E. Lat. 6. 30. S.

PRINCE WILLIAM'S ISLANDS, a cluster of islands in the Pacific Ocean, discovered by Tasman in 1643. Long. 179. E. Lat. 17. 19. S.

PRINCE WILLIAM HENRY'S ISLAND, in the Pacific Ocean, discovered in the year 1790 by Lieutenant Ball. It is about seventy miles in circumference, elevated, of a luxuriant and picturesque appearance, and well peopled. Long. 149. 30. E. Lat. 1. 32. S.

PRINCESS ROYAL'S HARBOUR, on the south-western coast of New Holland, and the western part of King George the Third's Sound. The passage into it is a quarter of a mile in width. Long. 118. 9. E. Lat. 35. 3. S.

PRINCIPAL, the chief and most necessary part of a thing. The principal of a college or hall is the master thereof.

In commerce, principal is the capital of a sum due or lent, and is so called in opposition to interest. It also denotes the first fund put by partners into a common stock, by which it is distinguished from the calls or accessions afterwards required.

PRINCIPAL, in *Music*, see ORGAN. The term principal is also used in music to designate the more distinguished part written for an instrument where there are several parts written in harmony, and where one of these parts is intended to be the chief and most conspicuous; as in a violin concerto, *Violino Principale*, and so of other instruments.

PRINCIPAL POINT, in *Perspective*, is a point in the perspective plane, upon which falls a line drawn from the eye perpendicular to the plane. This point, which is in the intersection of the horizontal and vertical plane, is also called the *point of sight*, and *point of the eye*.

PRINCIPAL RAY, in *Perspective*, is that which passes perpendicularly from the spectator's eye to the perspective plane, or picture. The point where this ray falls upon the plane, is thence denominated by some the *principal point*, but other writers call it *the centre of the picture*, and *the point of concurrence*.

PRINCIPLE, in science, is a truth, admitted without proof, from which other truths are inferred by a chain of reasoning. Principles are of two kinds, *primary* and *general;* and to the latter the name of *axioms* is sometimes given, on account of their importance and dignity. An axiom, or general principle, when the terms in which it is expressed are understood, must be a self-evident truth; but from its very nature it cannot be a first truth. Our first truths are all *particular.* A child knows that two particular lines, each an inch long, are equal to one another, before he has formed any general notions of length and equality. "Things equal to one and the same thing are equal to one another," is the first of Euclid's axioms; and an axiom it undoubtedly is, but to no man has it been a first truth. It is, if we may use the expression, a genus or class of truths, comprehending under it numberless individuals. Were a full-grown man introduced into the world without a single idea in his mind, as we may suppose Adam to have been, he would instantly perceive, upon laying together three pieces of wood, each a foot long, that they were all equal in length; and if he were to cut another to the same length with any one of them, he would find, upon trial, that it was of the same length with them all. After a few simple experiments of this kind, he would, by a law of human thought, infer, that all things equal in length, or in any other dimension, to any one thing, are in that dimension equal to one another.

It was not, therefore, with such weakness as some have imagined, that Hobbes declared those propositions commonly called axioms, not to be primary but secondary principles. A primary principle deserves not the name of an axiom, as it is only a particular truth including in it no other truth. There is not one of Euclid's axioms which has not been the result of induction, though we remember not the time at which the induction was made. That the whole is greater than any of its parts is a general truth which no man can controvert; but every one discovered that truth by observing, that his body was larger than his head, his foot, or his hand, that a mountain is larger than a mole-hill in the middle of it, and that a piece of timber, measuring what is called a yard, is longer than any one of the divisions marked upon it, which are termed inches. Particular objects are observed by the senses, and treasured up in the memory; and the intellect, by its constitution, compares them together, marks in what they agree and disagree, and thence draws its axioms or general principles. He, therefore, who should admit the truth of an axiom, and deny the evidence of sense and perception, would act as absurdly as he who accepts payment in a bank-bill, and refuses it in the individual pieces of gold or silver which that bill represents. General axioms are of infinite use in the pursuits of science; but it is not because they create new truths; they only shorten the process in the discovery of such as might be found, with labour, through the medium of particular propositions.

PRINGLE, Sir John, an eminent physician and philosopher, was a younger son of Sir John Pringle of Stitchel, in the shire of Roxburgh, baronet. He took the degree of doctor of physic at Leyden, in 1730, and published there his *Dissertatio Inauguralis.* After having been some years professor of moral philosophy at Edinburgh, he was, in June 1745, appointed physician to the Duke of Cumberland, and physician-general to the hospital of the forces in Flanders, where the Earl of Stair appears to have been his patron. In February 1746, Dr. Pringle, Dr. Armstrong, and Dr. Barker, were nominated physicians to the hospital of lame, maimed, and sick soldiers, behind Buckingham House; and in April 1749, he was appointed physician in ordinary to the king. The following year he published *Observations on the Nature and Cure of Hospital and Gaol Fevers, in a Letter to Dr. Mead,* 8vo.; and in 1752 he favoured the public with the result of his long experience, in an admirable treatise, under the title of *Observations on the Disorders of the Army in Camp and Garrison,* 8vo. On the 14th of April 1752, he married Charlotte, second daughter of Dr. Oliver, an eminent physician at Bath. In 1756 he was appointed, jointly with Doctor afterwards Sir Clifton Wintringham, physician to the hospital for the service of the forces of Great Britain. On the accession of George III., Dr. Pringle was appointed physician to the queen's household in 1761, and physician in ordinary to the queen in 1763, in which year he was admitted of the college of physicians in London; and on the 5th of June 1766, he was advanced to the dignity of baronet of Great Britain. In 1772 he was elected president of the Royal Society, where his speeches for five successive years, on delivering the prize-medal of Sir Godfrey Copley, gave the greatest satisfaction. Sir John Pringle was, in 1777, appointed physician-extraordinary to the king. He was also a fellow of the College of Physicians at Edinburgh, and of the Royal Medical Society at Paris, member of the Royal Academies of Paris, Stockholm, Göttingen, and of the Philosophical Societies at Edinburgh and Haerlem; and he continued president of the Royal Society till November 1778, after which period he gradually withdrew from the world, and in 1781 quitted his elegant house in Pall Mall, where he had long distinguished himself as the warm friend and patron of literary men of every nation and profession. Having made an excursion to his native country, he returned to London in the latter end of the year, and died on the 18th of January 1782, greatly beloved and respected. Having no children, he was succeeded in his estate, and also, agreeably to the limitation of the patent, in title, by his nephew, Sir James Pringle. Amongst his communications to the Royal Society, the following are the principal, viz. 1, Some Experiments on Substances resisting Putrefaction, *Phil. Trans.*, No. 495, p. 580, and No. 496, p. 525, 550, reprinted with additions in Martin's Abridgment, vol. xi. p. 1365; 2, Account of some Persons seized with the Gaol Fever by working in Newgate, and of the manner by which the Infection was communicated to one entire Family, vol. xlviii., p. 42; 3, A remarkable Case of Fragility, Flexibility, and Dissolution of the Bones, ib. p. 297; 4, Account of the Earthquake felt at Brussels, vol. xlix, p. 546; 5, Account of the sinking of a river near Pontypool in Monmouthshire, ibid., p. 547; 6, Account of an Earthquake, felt February 18, 1756, along the coast of England, between Margate and Dover, ibid., p. 579; 7, Account of the Earthquake felt at Glasgow and Dunbarton, also of a shower of dust falling on a Ship between Shetland and Iceland, ibid., p. 509; 8, Several Accounts of the Fiery Meteor which appeared on Sunday, November 26, 1758, between eight and nine at night, vol. l., p. 218; 9, Account of the Virtues of Soap in dissolving the Stone, in the Case of the Reverend Mr. Matthew Simson, ibid., p. 221; 10, Account of the effects of Electricity in Paralytic Cases, ibid., 481; 11, Some Account of the Success of the *Vitrum Ceratum Antimonii,* printed in the *Edinburgh Medical Essays,* vol. v.

PRINKIPO, the largest and most easterly of the Prince's islands. They are situated in the bay of Marmora, about a league distant from the coast of Asia Minor. It is about a mile in length and half a mile in breadth, and contains what was formerly a considerable and well-built town, but which is now in a ruinous condition. The island was formerly inhabited by the French merchants, who have however abandoned it, owing to the brackishness of the water. It is now inhabited by Greeks, who support themselves by selling wine and provisions to the pleasure parties which arrive from Constantinople. Long. 28. 56. E. Lat. 40. 51. N.

PRINTING.

Printing.

PRINTING is the art of taking one or more impressions from the same surface, whereby characters and signs, cast, engraven, drawn, or otherwise represented thereon, are caused to present their reverse images upon paper, vellum, parchment, linen, and other substances, in pigments of various hues, or by means of chemical combinations, of which the components are contained on or within the surface from which the impression is taken, or in the fabric of the thing impressed, or in both.

The most important branch of printing is what is called *letter-press* printing, or the method of taking impressions from letters and other characters *cast* in relief upon separate pieces of metal, and therefore capable of indefinite combination. The impressions are taken either by superficial or surface pressure, as in the common printing press, or by lineal or cylindrical pressure, as in the printing machine and roller-press. The pigments or inks, of whatever colour, are always upon the surface of the types; and the substances which may be impressed are various. Wood-cuts and other engravings *in relief* are also printed in this manner.

Copperplate printing is the reverse of the above, the characters being *engraven* in intaglio, and the pigments or inks contained within the lines of the engravings, and not upon the surface of the plate. The impressions are always taken by lineal or cylindrical pressure; the substances to be impressed, however, are more limited. All engravings in intaglio, on whatever material, are printed by this method.

Lithographic printing is from the surface of certain porous stones, upon which characters are *drawn* with peculiar pencils. The surface of the stone being wetted, the chemical colouring compound adheres to the drawing, and refuses the stone. The impression is taken by a scraper, that rubs violently upon the back of the substances impressed, which are fewer still in number. Drawings upon zinc and other materials are printed by this process. (See LITHOGRAPHY.)

Cotton and calico printing is from surfaces engraven either in relief or in intaglio. The chemical compounds are either on or within the characters, as pigments or chemical colours, or in the fabric to be printed, but mostly in both; the combination of chemical substances producing colour when the fabric and the engraving are brought into contact. The impression is either superficial or lineal, but mostly lineal. (See DYEING.)

LETTER-PRESS PRINTING.

History.

The origin and history of an art which has exercised such an influence on civilization, and contributed in so essential a manner to the cultivation of the human intellect, have naturally become a matter of inquiry amongst the learned, and have almost as naturally been the source of earnest controversy; for there are few effects of human invention or industry that have been originated and brought to perfection at a particular epoch, without any previous train of thought or circumstance, so that the precise day or year could be noted in which the perfect Minerva started forth in full maturity. On the contrary, it is difficult to say at what period of time the germ of the art of printing did not exist. So obvious is the reproduction of similar appearances from an impression of the same surface, that the most early of mankind must have noted it; and even the impression of a foot or a hand must have suggested a simple and intelligible mode of conveying an idea, before the invention of any kind of writing. Accordingly, these and similar signs are found to compose the chief characters of the earliest writing, which is the symbolic.

History.

Observing this general law of the gradual perfectibility of human arts, we must look back to the most remote ages for the first steps of that of printing. We shall accordingly find certain evidence, that, more than two thousand years before our era, a method of multiplying impressions, rude and imperfect in the extreme, was certainly practised; but although the general fact is universally allowed, it is extremely difficult to give satisfactory examples. Turning, however, to Egypt, we shall find such traces as sufficiently prove the truth of the general statement.

The ingenuity of mankind had for a long period confined itself principally to the more easy and beautiful art of colouring surfaces with pigments, in the imitation of surrounding objects; and had their desires been limited to the production of a single essay, they would have made no deviation from an art so beautiful, and so susceptible of taste and variety. But when the wants and conveniences of an advanced state of society required effects of a more lasting character, less costly, and of more general application, a method of producing the same, or nearly the same effect, with considerable rapidity, very soon presented itself; and the sacred inscriptions at first painted or engraved upon the figures of the deities, and possibly upon articles of domestic use, were impressed upon plastic models with equal ease and certainty.

Babylonian bricks.

Babylon presents us with some remarkable specimens of the progress of this art, which may be received as the earliest instances of *imprinting*, the epoch of which can be in any degree approximated. These are found on the bricks many of which have been discovered on the site of the departed city. That the Assyrians should have thought it worth while to print inscriptions upon materials destined to be built into their dwellings (and every *kiln-burned* brick amongst these vast ruins is stamped with an inscription), argues that the process was not only not an uncommon one, but also that there probably existed at the same time a more advanced and more elegant usage of imprinting in their domestic and ornamental arts. Specimens of these bricks may be seen in the library of Trinity College, Cambridge, in the British Museum, in the library of the East India Company, and in several private collections. Those at Cambridge are parallelopipeds of thirteen inches in length by three in thickness, and are made of clay mixed with reeds, and burned in the kiln. On one of the large surfaces is an indentation, produced by the forcible impression of a stamp, from the face of which a large portion has been cut away, leaving a series of figures in relief. The depression produced by this stamp is six inches and one eighth by three and five eighths in extent, and about three eighths of an inch in depth. It is exceedingly rude in execution, bearing a strong resemblance to the impressions of the names of the makers to be found upon the backs of inferior earthen-ware; and is produced by exactly the same means, the process of baking entirely destroying whatever sharpness the soft mass may have had. The inscription is clearly stamped in after the clay has been turned out of the mould, and is not produced by any part of it; for in all known specimens it is placed in different positions, and never stands parallel to the edges of the brick, being in fact put on more or less awry, according to the care and manual skill of the workman. The surface of the brick around the depression is forced up considerably, which is exactly the effect of pressing the hand or any substance into a plastic material; and the edges both of the parent depression and of the figures present the effect of the stamp having been drawn up whilst the clay was still damp and adherent to it. The inscription consists of six vertical columns, containing thirty-eight figures; the columns are divided by bold straight lines. The characters are those usually called the Persepolitan or arrow-headed, but better described by the French as nail-headed. They are found very widely spread over Asia, but most plentifully at Persepolis. No one has hitherto made any considerable progress in deciphering them, nor have the learned been able to determine whether they are alphabetic, syllabic, hieroglyphic, or signs representing one or more words, as in the Chinese.

Curious as are these specimens of Assyrian art, Babylon presents us with others still more choice. These are a kind of cylinder, shaped like a barrel, but rather longer in proportion to the width. The one described is seven inches in height, and three inches in diameter at the ends; it is made of fine clay, and baked. The inscriptions are in the same character as those found upon the bricks, arranged in vertical lines, commencing, or ending, according to the way of reading, near the middle of the cylinder, where it is of the greatest diameter, and running down to the foot. There are consequently two inscriptions, one on either half; and there is an interval running *round* the cylinder between the two, without any impression. Counting upon a drawing, there are thirty-two vertical lines in either inscription, and consequently they are less than a quarter of an inch in width. There are thirty figures in one of the columns; and each figure would therefore occupy a space of less than one eighth of an inch. The figures are perfectly sharp and distinct, and the whole cylinder is a beautiful specimen of art. The one to which we allude is in the library of Trinity College, Cambridge; but many very excellent specimens have lately been deposited in the British Museum, an actual inspection of which, and of other cognate relics, will enable the curious to form a much better idea of their excellence than any description, however diffuse. They are of all sizes, from a foot in height to the size of a signet, to which purpose probably they were sometimes applied, since some specimens are perforated as if intended for the insertion of a wire or cord; indeed there are specimens of somewhat similar cylinders with the wire inserted for thumb-rings. Perhaps those a little larger were hung round the neck as charms and amulets.

That a similar art was known to the inhabitants of the old world generally, may safely be assumed. It is therefore not a little remarkable that people so original and ingenious as the Greeks, and so imitative as the Romans, should have left almost no vestige of their having practised any such mean as this to multiply their beautiful creations of fancy, or to embellish the tasteful appliances of domestic life; especially when we consider the easy adaptation of the art to pottery, and the beauty, taste, and ingenuity which they exhibited in that manufacture. For, excepting a few paltry designs *en creux* on some of the coarser specimens, and a few marks upon the Roman military vessels, evidently stamped, there is no appearance of either people having had any idea of this kind; the sister art of taking impressions in seals not being fairly to be classed under this head. There are, however, in the British Museum some instruments presenting a singular instance of how very nearly one may approach to an important discovery, and yet pass on unheeding. These stamps are of brass, and amongst others the signet of C. Cæcilius Hermia. The face of this is two inches by four fifths of an inch, and the inscription,

CICAECILI

HERMIAE. SN.

with a border, is in relief, the surrounding parts being cut away to a considerable depth. It should be especially noticed, that the surface of the field is very rough; and there is a ring at the back by which it could be handled or suspended.[1] These circumstances render the use of it very clear. It would be very much easier to incise the required inscription, and to let the field stand (indeed the art of engraving *en creux* was well known and used), than to cut away the field and leave the letters in relief; and it would produce a much more beautiful effect if it were used to impress any soft substance; whereas, cut as it is, the impression sunk into the wax or clay would not only be ugly, but illegible, and the rough surface of the field would present the most ungainly appearance upon the prominent parts of the wax, being the parts most presented to the eye. Its use therefore is evident. The relieved inscription, and no other part, being covered with ink or pigment, was impressed upon an even surface (papyrus, linen, parchment), and consequently left a perfect but reversed imprint of itself. This is the precise effect of printing with types. Now, from the circumstance of Cæcilius being a person of no known eminence, it is a fair conclusion that such an instrument was not uncommon amongst those who either were not able to write, or were engaged in public employments requiring a great number of signatures, or who were accustomed to commit the signing of documents to subordinates on their behalf. From the Greek agnomen, Cæcilius probably lived under the emperors, when literature had become one of the pursuits of the great, and when the difficulties and expense of procuring books by the slow proecss of copying were bitterly felt. It is singular, therefore, that they should have overlooked so obvious an improvement upon their own signets as the engraving whole sentences and compositions upon blocks, and thence transferring them to paper, even if they had gone no farther than this.[2]

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[1] The Antiquarian Society of Newcastle possesses a similar stamp with a Greek inscription.

[2] The Chinese printing is not unlike this, and must by no means be supposed to have much similarity to the modern art. They assert that it was used by them several centuries before it was known in Europe; in fact, fifty years before the Christian era. They certainly may have used their method centuries before our art, for it differs in nothing but extent from that of the old Roman. The following is a description of their method at the present day, and it is probably the same in every respect as that in practice two thousand years ago in an empire where nothing is changed. As their written language consists of from eighty to one hundred thousand characters, it would be utterly impracticable to use moveable types, and the use of block-printing would be the most easy and rapid. The sentences, therefore, desired to be multiplied, being drawn upon their thin paper, this is made to adhere with the face downward to a block of soft wood, so that the characters appear through *reversed*. The plain wood is then cut away with most wonderful rapidity, and the drawing left in relief. Both sides of the block are similarly operated upon. The engraved wood is then properly arranged upon a frame, and the artist, with a large brush, covers the whole surface, the field as well as the relief, with a very thin ink; he then lays very lightly over it a sheet of paper, and passes a large soft brush over it, so slightly, yet so surely, that the paper is pressed upon the raised figures, and upon no other part. The rapidity with which this is performed is extraordinary; for Du Halde asserts that one man can print ten thousand sheets in one day, a number which would appear incredible, did not very good testimony exist at the present time that one man can print seven hundred sheets per hour. The method of putting the thin sheets together when printed, is as different from ours as their printing and mode of reading. The sheets are printed on one side only; but instead of the blanks being pasted together to form one leaf, the sheet is so folded that no single edge of paper is presented to the reader, but only the double-folded edge; the loose edges being all at the back of the book.

From this time a vast period elapses before any circumstance can safely be instanced as showing that the practice of transferring characters was known to any, even comparatively civilized people. From the rough and imperfect attempts above indicated, the first and most obvious advance was engraving pictures upon wooden blocks. The first practice of this is involved in obscurity, but most writers on the fine arts agree that the art was invented towards the end of the thirteenth century, by a brother and sister of the illustrious family of Cunio, lords of Imola, in Italy. By some the whole narrative is considered as apocryphal, but it is nevertheless generally admitted. The engravings were discovered by a Frenchman of the name of Papillon, in the possession of a Swiss gentleman, M. de Grœder, who deciphered for him the manuscript annotations found upon the leaves of the book in which they were bound. These purported that the book had been given to Jan. Jacq. Turine, a native of Berne, by the Count of Cunio, with whose family he, Turine, appears to have been intimately acquainted. Then follows a romantic history of the twins, and the cause of their invention. The book is entitled "The Heroic Actions, represented in figures, of the great and magnanimous Macedonian king, the bold and valiant Alexander; dedicated, presented, and humbly offered to the most Holy Father Pope Honorius IV., the glory and support of the church, and to our illustrious and generous father and mother, by us Alessandro Alberico Cunio, cavaliere, and Isabella Cunio, twin brother and sister; first reduced, imagined, and attempted to be executed in relief, with a small knife, on blocks of wood, made even and polished by this learned and dear sister; continued and finished by us together, at Ravenna, from the eight pictures of our invention painted six times larger than here represented; engraved, explained by verses, and thus marked upon the paper, to perpetuate the number of them, and to enable us to present them to our relations and friends, in testimony of gratitude, friendship, and affection. All this was done and finished by us when only sixteen years of age." This title is here given at full length, because, if genuine, it presents us at once with the origin, execution, and design of these first attempts at block-printing. The book consists of nine engravings including the title; the figures are tolerably well designed, and the draperies graceful, with here and there attempts at cross-hatching; under the principal personages are their names; above, are inscriptions indicating the subject, and below, four lines of poetical Latin explanatory of it; and in some part of each print is an inscription indicating the share the twins respectively had in the execution. The colour of the pigment is gray.

The first subject is Alexander on Bucephalus. Upon a stone, *Isabel. Cunio pinx. et scalp.*

The second subject, the Passage of the Granicus. *Alex. Alb. Cunio Equ. pinx. Isabel. Cunio scalp.*

The third subject, Alexander cutting the Gordian Knot. *Alex. Albe. Cunio Equ. pinx. et scalp.*

The fourth subject, Alexander in the tent of Darius. *Isabel. Cunio pinx. et scalp.*

The fifth, Alexander giving Campaspe to Apelles. *Alex. Alb. Cunio Eques pinx. et scalp.*

The sixth, the Battle of Arbela. *Alex. Alb. Equ. et Isabel. Cunio pictor. et scalp.*

The seventh, Porus brought to Alexander. *Isabel. Cunio pinx. et scalp.*

The eighth, the triumph of Alexander upon his entry into Babylon. *Alex. Alb. Equ. et Isabel. Cunio pictor et scalp.*[1]

From the dedication of this book to Pope Honorius IV., it is deduced that these engravings must have been executed between 1284 and 1285, inasmuch as this pope only enjoyed the pontificate two years; and it is suggested that a copy of it might be found in the library of the Vatican. The narrative appears to be confirmed by many incidental circumstances, which bear every evidence of not being the invention either of Papillon or his informer. The name of Alberico seems to have been a favourite with the family of Cunio, and a count of that name actually figures in history in the very year of the presumed invention; a relative of the twins, of course, not the male artist himself.

The interval between the time of the twin Cunio and the next mention of any similar usage is very perplexing; but upon examination it will appear that that long period was not altogether a blank in the art. The next earliest evidence is a document of the government of Venice, discovered amongst the archives of the Company of Printers in that city. It bears the date of 1441, and as it throws some degree of light upon the controversy relative to the invention of printing, it is here given from Ottley's History of Engraving.

"M CCCC XLI. October the 11th. Whereas the art and mystery of making cards and printed figures, which is used at Venice, has fallen into total decay; and this in consequence of the great quantity of playing cards, and coloured figures printed, which are made out of Venice; to which evil it is necessary to apply some remedy; in order that the said artists, who are a great many in family, may find encouragement rather than foreigners. Let it be ordered and established, according to that which the said masters have supplicated, that from this time in future, no work of the said art that is printed or painted on cloth or on paper, that is to say, altar-pieces (or images), and playing-cards, and whatever other work of the said art is done with a brush or printed, shall be allowed to be brought or imported into this city, under pain of forfeiting the works so imported, and xxx livres and xii soldi, of which fine one third shall go to the state, one third to the Signori Giustizieri Vecchi, to whom the affair is committed, and one third to the accuser. With this condition, however, that the artists who make the said works in this city may not expose the said works to sale in any other place but their own shops, under the pain aforesaid, except on the day of Wednesday at St Paolo, and on Saturday at St Marco, under the pain aforesaid."

From this it seems manifest that the art of printing from wood-blocks was not lost, but, on the contrary, had been so long practised as to become an extensive and profitable business in Venice, and to spread over the Continent to such a degree as in turn to destroy the trade of the Venetian artists. The establishment of an important manufacture, and its decay, necessarily infer a long period. From the constant conjunction of the two arts of painting and printing in this document, we may infer (what the existence of prints and cards of later date prove) the method in which these figures and cards were manufactured, namely, that the outline was first printed, and that the colours and shading were filled in by the printer and illuminator. The history of playing-cards now becomes of some importance to the narrative. When cards first came into use is uncertain; but mention is made of them in the year 1254, when they were interdicted by St Louis on his return from the Crusade: they were also forbidden by the council of Cologne in 1281. In 1299 they are expressly mentioned under the name *carte;* and in "Das Gülden Spiegel," printed by Gunther Zainer in the year 1472, it is said that cards first came into Germany in 1300. An old French poet, who wrote "En l'an mil iij cent xxviij," has the line,

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[1] It is not unlikely that the twins may have been directed in the choice of their subject by the identity of the name of the great conqueror with that of the brother; at least such coincidences are not without parallel in the history of literature.

"Jouent aux dex, aux cartes, aux tables." There is no evidence earlier than the Venetian decree to connect the art of printing from wood-blocks with the art of making cards; but as it is evident from that document that such connection did exist, it is a fair presumption that it originated not very long after the introduction of the game; and as the sum paid by Charles VI. for "trois jeux de cartes" was so small as fifty-six Parisian sols, it has been conjectured that they must have been illuminated prints. The Venetian decree against the importation of painted and printed figures from abroad now brings us to the country from which the chief export was made. It appears, therefore, that in the Low Countries the manufacture was carried on to a great extent; and we shall also find that in Holland and Germany, and probably over most of Europe, religion had called this art to her aid; that whilst the noble and wealthy recreated the mind and delighted the eye with the exquisite productions of the scribe and illuminator, the more humble were equally gratified with rude and simple illustrations of interesting portions of Scripture, or pictures of favourite saints. It is probable that the poorer classes hung up these drawings in their dwellings, where they excited as true and heartfelt devotion as the masterpieces of Raffaelle or Correggio in the oratories of the great. It cannot be ascertained how early this practice commenced, nor whether it preceded and suggested the printing of saints and sacred subjects, or was itself a consequence. Certain it is, that at the end of the fourteenth and the commencement of the fifteenth century the practice was very common. The impressions were taken by means of a burnisher, the gloss caused by the friction being distinctly visible on the backs both of cards and prints preserved to this time. As facility in practice increased, a distich or quotation illustrative of the print became a natural improvement; and to this was frequently added a coat of arms, the name of the saint, or the title of the subject, all in the field, or over the head of the figure; and, lastly, sometimes a date. The earliest print of which the date can be accurately ascertained, is a wood-cut of St Christopher carrying the infant Jesus across the sea. It is of folio size, and coloured in the manner of our playing-cards. At the bottom is the inscription,

Cristofori faciem die quacunque tueris — Milleſimo cccc°
Illa nempe die morte mala non morieris. — xx° terno.

It was found in the monastery of Buxheim, near Meiningen, and is now in the possession of Earl Spencer.

Block-books. *Biblia Pauperum.*

The next advance was obvious. Instead of a single block, a series of blocks were employed, with additional literary illustrations; and thus were the first printed books formed. The most important of these is the *Historiæ Veteris et Novi Testamenti seu Biblia Pauperum*, truly the Poor Man's Bible. It consists of forty leaves printed upon one side of the paper only, by friction, from as many blocks; the colour is brown; the pages are placed opposite to each other, and the blank backs being pasted together, form one strong leaf. The cuts are about ten inches in height and seven and a half in width. Each print contains three sacred subjects in compartments, and four half-length figures of prophets in smaller divisions, two above and two beneath the principal subjects. Latin inscriptions are on either side of the upper figures; rhythmical verses on either side of the lower, and additional inscriptions are on labels at the bottom of the whole. The central subjects are from the New Testament, the others from the Old, and in some manner allusive to the former. There are many copies of this work, evidently from different blocks, and of different dates. Indeed it appears to have been a most popular book, and was printed repeatedly long after the introduction of legitimate printing; there are several editions in which the inscriptions are actually printed with moveable types. The exact date of these curious works is not ascertained, but Dr Horne possessed a copy contained in one volume with the *Ars Moriendi* and the *Apocalypse*, all works of the same style, the binding of which bore the date of 142( ). The original composition and design of this work is attributed, and not without some show of reason, to Ansgarius, who was bishop of Hamburg and Bremen in the ninth century. (See Plate CCCCXIII.)

A similar book is the *Canticles*, a small folio volume of thirty-two subjects, two being printed on each leaf, and on only one side of the paper, and the leaves also pasted back to back. It differs from the *Biblia Pauperum* in that the inscriptions are engraven on scrolls fantastically dispersed amongst the figures. This is generally allowed to be of somewhat later date than the preceding, and to hold an intermediate space between it and the *Speculum Humanæ Salvationis*, to which a larger space must be devoted, on account of its importance in the controversy relative to the invention of printing.

Speculum Humanæ Salvationis.

This is not, strictly speaking, a block-book; for whilst the form of the design and the portion of Scripture represented are engraven on wood, the inscription is in some cases engraven on wood also, but in others printed in *moveable type*. The Latin edition, *perhaps* the first, consists of sixty-three leaves, divided into five unequal gatherings. The subjects are chiefly from the Old and New Testament; but sometimes such stories have been selected from ancient history as might seem in some way appropriate to the events recorded in sacred writ. Each subject has a short Latin inscription underneath it, and the text occupies the remainder of the page. Its size is folio; the impressions are taken with a burnisher, on one side of the paper; the colour of the ink is brown, and the backs are pasted together, as in the books previously described. The work is certainly of nearly the same date, though a little later, than the *Biblia Pauperum;* and it may even have been in part executed by the same artist, for in the earlier portions there is so much general resemblance, both in design and execution, as to make it probable that the same graver was employed in both. The latter part, however, is the work of another artist; the lines are not so bold, and there is an attempt at fineness of execution, of shading, and of distance, which the earlier master did not attempt. The design, though in better drawing, is not so spirited; the drapery is more correct, though not so graceful; and in fact the engraver was a better workman, but not so great an artist. It must be understood, that there are numerous editions of this work, many differing in essential particulars, but some so nearly similar as to require a microscopic eye to detect the variations; of four of these, two are in Latin, two in Dutch, and between these four lies the contest for antiquity. Mr Ottley (whose beautiful work on Engraving contains a well-drawn-up account of his inquiry, illustrated by most convincing examples) has, from a minute and laborious examination, decided that the two Latin and two Dutch are printed from the self-same blocks, and by comparing them, and finding evidences of fractures in the one which do not exist in the other, he has very satisfactorily awarded the palm of antiquity. First, although the Latin inscriptions in the earlier part of the *first* Latin edition (so called by commentators) are engraven on blocks of wood, these blocks are not of the same piece as the figures, the work having been divided between two artists, the one more skilled in engraving figures, and the other in engraving letters. Secondly, parts of the engraving broken in the *first* Dutch are perfect in the *first* Latin; parts imperfect in the *first* Latin are unbroken in the *second* Dutch, whilst the *second* Latin is the most perfect of all; from which the conclusion is drawn that the *second* Latin is the most ancient, then the *second* Dutch, next the *first* Latin, and lastly the *first* Dutch. The printing of this work is claimed for Laurence Koster.

We have now come fairly to the practice of printing in the real sense of the word; and we have also arrived at the long-pending, long-controverted question, of who invented it, and where? The honour is disputed by as many cities as contended for the birth of Homer. Only three of these can show the slightest argument for their pretensions; Harlem, Strasbourg, and Mentz. Harlem claims it for her citizen Laurence Koster, or Laurent Janszoon Koster (or Custos). The claim rests principally upon the narrative in the *Batavia* of Hadrianus Junius, a native of West Friesland, who dwelt at Harlem. The work was written in 1575, but not published until 1588. The following is a close translation of the narrative :—

Hadrian Junius's account.

"There lived, a hundred and twenty-eight years ago, at Harlem, in houses sufficiently splendid (as a workshop, which remains to this day entire, can serve as proof), overlooking the forum from the neighbourhood of the royal palace, Laurentius Joannes, by surname *Æditurus*, or Custos[1] (which at that time lucrative and honourable office an illustrious family of that name, *or a family illustrious by that name*, held by hereditary right), the person who now seeks back by just avouchments and oaths the relapsing (*recidivam gloriam*) glory of the invention of printing, nefariously possessed and seized upon by others (the man), with the greatest right to be presented with greater laurel of all honours (*summo jure omnium triumphorum laurea majore donandus*). He by chance, walking in a suburban grove (as was the fashion of citizens in easy means to do after dinner in those days), began first to fashion beech-bark into letters, which being impressed upon paper, reversed in the manner of a seal, produced one verse, then another, as his fancy pleased, to be for copies to the children of his son-in-law; which when he had happily accomplished, he began (for he was of great and acute genius) to agitate higher things in his mind, and first of all devised with his son-in-law, Thomas Peter, who left four children, all of whom attained the consular dignity (a thing which I mention that all may understand the art arose in an honourable and talented, not a servile family), a more glutinous and tenacious species of writing ink, which he had commonly used to draw letters; thence (*experiretur*) he expressed entire figured pictures with characters added; in which sort I have myself seen *Adversaria* printed by him, the traces of the works (*operarum*) being only on opposite pages, not printed on both sides (*haud opistographis*). That book was in the vernacular tongue by an anonymous author, bearing for title *Speculum Nostræ Salutis:* in which it is to be observed among the first beginnings of the art (for never any is found and perfected at once), that the reverse pages being smeared with glue, were stuck together, lest they, being blank, should present a deformity. Afterwards he changed beech-blocks for lead; afterwards he made them of tin, because it was a material more solid and less flexible, and more durable: from the relics which remained of which types, very ancient wine-flasks being made, they are to this day to be seen in those houses of Laurentius which I have mentioned looking upon the forum, inhabited afterwards by his grandson Gerard Thomas, whom I name for honour's sake, a noble citizen, who departed this life a few years ago. The studies of men favouring, as it happened, the new art, since a new merchandise, never before seen, brought buyers from every side with most eager quest, at once the love of the art increased, the establishment (*ministerium*) increased, workmen in the art being added to the family, the first touch of evil; among whom was a certain Joannes, either (as the suspicion is) that Faustus of ominous name, faithless and unlucky (*infaustus*) to his master, or some other of the same name, I do not greatly care which, because I am unwilling to disquiet the shades of the silenced, touched with the plague of conscience while they lived. He being sworn by oath to the processes of printing, after he had (as he thought) learned thoroughly the art of putting the characters together, the knowledge of fusile types, and whatever else may relate to the matter, taking an opportunity, than which he could not have found one more fit, on the very eve which is sacred to the birth of Christ, on which all in common are accustomed to labour at the sacred ceremonies, stole the whole materials,[2] tied up a package of the instruments of his master used in that art (*instrumentorum herilium ei artificio comparatorum supellecticem convasat*); thence with a servant hurried from the house, went in the beginning to Amsterdam, thence to Cologne, until he arrived at Mayence, as to the altar of an asylum, where he might live safe beyond the reach of arrows (as the saying is), and having opened an office, enjoyed the rich fruit of his robberies. Indeed, from it, in the space of the (or a) turning year, in the year 1442 from the birth of Christ, with the same types which Laurentius had used at Harlem, it is certain that he produced to light the *Doctrinale* of Alexander Gallus, which grammar was then in most famous use, with the *Tractates* of Peter Hispanus, his first productions. Those are, for the most part, things which I have formerly heard from aged men worthy of belief, who have received them as things delivered from hand to hand, as a torch in a race, and have found others relating and attesting the same things. I remember that Nicholaus Galius, the instructor of my youth, a man with iron memory, and venerable for his long years, related to me, that when a boy he had heard, not once only, a certain Cornelius, a bookbinder, and rendered serious by age, nor less than eighty years old (who had lived as an under workman in that office), relating with much mental anger, and with fervour, the course of the proceeding, the manner of the invention (as he had received it from his master), the improvement and increase of the art, and other things of the kind; and that the tears would burst from him against his will at the shame of the affair, as often as he talked of the robbery. Which things do not differ from the words of Quirinus Talesius Con., who confessed to me that he had formerly the same from the mouth of the same bookbinder."

Beyond this narrative of Hadrian Junius there is little, or rather no, testimony to the truth of Koster's claim, all subsequent argument being either drawn from or referred to this statement. Many very learned bibliographers have given full credence to Hadrian, whilst others not less acute absolutely deny Koster any pretence whatever, Santander calling in question his very existence; and there is a third party who, being unable to decide between the opposing arguments, and willing to take refuge in a middle course, allow to Koster the credit of having invented printing from blocks, but assign to his rivals that of printing from moveable types.

The whole argument may, however, be reduced into a reasonable compass. The probability of Hadrian's narrative will naturally be the subject of inquiry. *First*, the roundabout way in which this hearsay evidence reached Hadrian, is in itself a very suspicious circumstance. Little belief can be accorded to an uncertain bookbinder, even had any circumstances been adduced besides the name Cornelius, by which this bookbinder could be identified. *Secondly*, Talesius was many years secretary to Erasmus, who, although a Dutchman, and resident in Holland, repeatedly and unhesitatingly ascribes the invention to John Gutenberg of Strasbourg at Mentz.[1] It is not at all probable, that had Erasmus ever heard of this story, or given the slightest credence to it if he had, he would have omitted some mention of a circumstance so gratifying to his national vanity; or that he should have remained in ignorance of a story well known to his secretary, and commonly bruited about, and therefore known to some of the learned men amongst whom Erasmus lived. *Thirdly*, the story of the engraving on beech-bark accidentally, when it is quite certain that the art of taking impressions from wood-blocks for saints and cards was at the time known and extensively practised in Holland and Germany, and also in Italy, is absurd. *Fourthly*, every author who has written upon the matter has given up all claim on Koster's behalf for the invention of cast type, the evidence in favour of others being too strong to be got over. *Fifthly*, the tale of the conversion of these types into drinking-cups, when Hadrian afterwards states that Fust carried them off with him, is incredible; for Koster's death is variously stated as having occurred in 1440 or 1442, and Hadrian says that Fust published his *Doctrinale* in 1442, within a year of his unlicensed departure; and therefore Koster could not have had time to construct the types afterwards converted into cups. *Sixthly*, the story of John Fust having stolen all his printing materials on the eve of Christmas, and decamped, first to Amsterdam, then to Cologne, and lastly to Mentz, and his publishing there within the same year, is self-contradictory; for type is not a very portable commodity; nor would he easily have escaped pursuit at Amsterdam, a town under the same government. Again, John Fust was originally no printer, but a wealthy goldsmith of Mentz, and certainly never worked as any body's journeyman. Indeed this is such a palpable misstatement, that commentators upon Hadrian have boldly supposed that the thief was John Gutenberg, not he of Mentz, but a brother, also named John. Unfortunately Gutenberg's brother was not named John, but Friele, and in no future document is there any mention of him or his father having practised the art even when known to John; nor is it at all likely that members of a noble family, and wealthy men, should have worked in the service of any man. If it should be asserted that it was *the* John Gutenberg, his time is so well accounted for that it is impossible, since he was then resident at Strasbourg, and never was at Amsterdam or Cologne. Thus, then, the narrative of Hadrian Junius appears, upon examination, to be utterly incredible, being at once at variance with itself and with all probability.

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[1] In the original, Koster is simply said to have been surnamed *Æditurus*, seu *Custos*, but no mention is made of the Cathedral. The statement, therefore, that he was custos of the cathedral, is a gratuitous insertion of after narrators. The word custos has been Dutchified into Coster or Koster; but there is no apparent reason why we may not suppose that *Custos* was a barbarous Latin word for keeper, or constable, or any other translation the word will bear.

[2] Or whatever else *choragium* may mean; literally it signifies the *properties* of a theatre.

There are, moreover, other arguments not precisely resting upon this narrative; for although these circumstances are not to be believed, the main facts *may*, nevertheless, be correct. Koster *may* have printed the *Speculum* and other block-books attributed to him. Ottley says that they were certainly printed in Holland, for that the types are not those used in Germany, but closely resembled such as were afterwards cut or cast in Holland; and that they are of greater antiquity than any books printed by those who afterwards used the art in the Low Countries. He also attempts to show, by the water-marks in the paper, that the works in question were produced in these parts. Water-marks, however, and some bearing a general resemblance to these, were common in the papers used by printers of Cologne, Louvain, and elsewhere; and the argument is worth little or nothing, for no evidence can be given of the positive dates of these works, and much less of the printer. The *Speculum* was printed again and again after the invention of letter-press printing; nor is there the slightest evidence, supposing these assertions to be correct, to connect them with the name of Koster. It is a conclusive argument *against* him, that those other works ascribed to him and his descendants are executed with the self-same types used at Utrecht in 1473 by Ketelaer and De Leempt. Van Mander, who lived at Harlem in 1580, in his History of the Lives of Dutch Painters and Engravers, treats the claim of Harlem with contempt; for, speaking of printing, he describes it as an art "of which Harlem, with much presumption, arrogates to herself the honour of the invention;" nor does he make the slightest mention of his famous fellow-citizen.

There is not the least evidence that his *three* grandsons (not *four*, as Hadrian says) ever carried on his business; for where are their works? and in their time printers had become so proud of their art, as not only to put their names to every work, but even to add a long history of their undertaking and progress. Where are the books ascribed to them? what mention is made of them by their contemporaries? In a subsequent part of this article it will be seen that Caxton, the first English printer, is said to have been sent to Harlem to learn the art, and if possible to carry off one of the workmen. These things being also matter of controversy, cannot fairly be used in argument; nevertheless it is of some value that Caxton, who, supposing it to be true, would be an excellent witness in favour of Harlem, upon all occasions refers the invention to Gutenberg, and makes no mention whatever of Harlem or Koster.

Santander labours to disprove the very existence of any such person. But there is no necessity to go so far as Santander; we may allow Koster's identity; we may even allow that he practised the art of taking impressions from wood-blocks; but this is very different from acknowledging any claim to the invention of the art of printing. The most strenuous champion of Koster is Meerman, an eminent French bibliographer of the last century, who, in his *Origines Typographicæ*, published at the Hague in 1765, strongly maintains this narrative of Hadrian; which is not a little singular, seeing that the Newcastle Typographical Society published a letter from him to Wagenaar, of eight years prior date, in which he expresses a precisely contrary opinion. He calls Seitz's (Hadrian's) story a mere supposition, and the chronology a romantic invention; gives to the *Speculum* the date of 1470 as the earliest possible; attributes the honour to Gutenberg, and incidentally mentions his intention of publishing a pamphlet on the subject. Notwithstanding this, in his work, without any new fact whatever, he accredits Hadrian's story, finds consistency in the dates, believes the *Speculum*, and denies John Gutenberg; completely reversing his previous opinion, though, by changing the predicates, his narrative may still stand. The *Divisiechronyk*, in 1517, places printing amongst foreign discoveries.

All evidence, and the general consent of the learned, in failure of Koster, unhesitatingly ascribe this invention to

Gutenberg.

JOHN GUTENBERG, surnamed Genzfleisch, Gensfleisch, or Gensefleisch, von Solgenloch, or Sorgenloch. He was a native of Mentz, and of a noble family, possessed of considerable property in various places in the neighbourhood. Fortunately the life of Gutenberg does not rest merely upon hearsay evidence, or the doubtful guesses of bibliographers from dateless wood-cuts; legal documents supply most important information. It appears that, for some reasons unknown, he resided for many years at Strasbourg, and had even acquired rights of citizenship. The first document presents him in no amiable light. It is a lawsuit instituted to compel him to perform his marriage-contract with Anne von Isernen Thür; and it would appear that he was compelled to make good his promise, the name of Anne Gutenberg being found in the same register of the nobility liable to the wine-duty in the city of Strasbourg, in which Gutenberg's name also appears. The next document is so curious that an ample abstract of it cannot but be interesting.

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[1] Anno Christi 1440. Magnum quoddam ac pene divinum beneficium collatum est universo terrarum orbi, a Johanne Gutenberg Argentinensi, novo scribendi genere reperto. Is cum primus artem impressoriam, quem Latini vocant *excusoriam*, in urbe Argentinensi invenit; inde Moguntiam veniens eandem feliciter complevit. (*Epit. Rerum Germ. Script.* 1502, cap. 95.)

It appears that he had contracted an engagement with Andrew Dritzehen, John Riffe, and Andrew Heilmann, to instruct them in the secrets of certain arts, and had entered into partnership with them for their better advantage. Andrew Dritzehen and Andrew Heilmann having called upon him one day, perceived that he was engaged in a wonderful and unknown art, the secret of which he was desirous of keeping to himself; that, moved by their importunities, he consented to enter into partnership with them for the term of five years, on two conditions, first, that they should pay him the sum of 250 florins, 100 immediately, and the remainder at a certain fixed period; second, that if any one of the partners should die during the term of the copartnership, the survivors should pay to his heirs the sum of 100 florins, in consideration of which the effects should become the property of the surviving partners. Andrew Dritzehen died before the expiration of the period agreed on, being still indebted to Gutenberg in the sum of eighty-five florins. George and Nicholas, brothers of the deceased, demanded to be admitted to the partnership, and on refusal brought an action against Gutenberg as principal partner. The magistrates gave judgment on the 12th of December 1439, relieving Gutenberg from the demand upon payment of the sum of fifteen florins, being the difference of the sum of 100 florins stipulated to be paid to the heirs of a deceasing partner, and the sum of eighty-five florins due to Gutenberg by Andrew on the original contract. The following evidence was produced on the trial:—

"Anna, the wife of John Schultheiss, an engraver on wood, deposed, that on one occasion Nicholas Beildeck came to her house to Nicholas Dreizehen, her relation, and said to him, 'My Nicholas Dreizehen, Andrew Dreizehen, of happy memory, has placed four pages (*stücke*) in a press, which Gutenberg has desired that you will take away and separate, that no man may know what they are, for he is unwilling that any one should see them.'

"Also John Schultheiss says, that Laurence Beildeck sometime came to his house to Nicholas Dreizehen, when Andrew Dreizehen his brother was dead, and that the said Laurence Beildeck thus spoke to said Nicholas Dreizehen: 'Andrew Dreizehen, of happy memory, has placed four pages on a press, which John Gutenberg desires you to take therefrom, and place them on the press and break them from one another, so that no man may see what they are.'

"Also Conrad Sahspach deposed, that sometime Andrew Heilman came to him upon the Street of Merchants and said, 'My Conrad, as Andrew Dreizehen is dead, and you made that press, and know all about the matter, go hence and take the pieces from that press and lay them separate from one another, so that no man may know what it is.'

"Laurence Beildeck says that he was sent by John Gutenberg to Nicholas Dreizehen, after the death of Andrew his brother, to say to him that he should show to no one the press that he had, and that he should see to it. He added, that Gutenberg had moreover commanded him that he should go suddenly to the presses, and open that press which was furnished with two *screws* or spindles (*cochleis*), that the pages should fall into pieces, and place those pieces within or upon the press, so that no one should see the matter, or understand what it was.

"The same witness also said that he knew well that Gutenberg, a little before the feast of the Nativity, had sent his servant to both Andrews to take away all forms, which were broken up in his sight, that none of them might be found perfect. Moreover, after the death of Andrew, this witness was not ignorant that many were desirous of seeing the presses, and that Gutenberg had commanded that some one should be sent who might hinder any one from seeing the presses, and that his servant was sent to break them up.

"Also John Dunne, goldsmith, said, that three years or thereabouts previous he had received from Gutenberg about 300 florins for materials relating to printing."

From this curious document may be learnt, that separate types were used; for if they were blocks arranged so as to print four pages, how could they be so pulled to pieces that no one should know what they were, or how could the abstraction of two screws cause them to fall to pieces? It appears that some sort of presses were used, and the transfers no longer taken by a burnisher or roller; and, lastly, that the art was still a great secret at the time when Koster was at the point of death. Hence it is manifest, that the ingenuity of Gutenberg had made a vast advance from the rude methods of the time, and had in fact invented a new and hitherto unknown art.

These documents would be decisive in favour of Strasbourg as the place in which printing was invented, had it appeared that any effects were produced by this establishment. This, however, does not seem to have been the case, as Gutenberg and his successors make no mention of the fact, but, on the contrary, claim for themselves the production of the first book at Mentz. Indeed the partnership appears to have expired without any attempt at entering into fresh engagements; for, about the year 1450, Gutenberg returned to his native city with all his materials, without any opposition from his partner. In this place he entered into partnership with John Fust, a wealthy goldsmith and citizen, who engaged, upon being taught the secrets of the art, and being admitted into a participation of the profits, to advance the necessary funds; and he did accordingly advance the considerable sum of 2020 florins, a fact that completely overthrows the fable of his having been one of Koster's workmen, and of his having stolen his types. The new partnership immediately commenced operations, and hired a house called Zum Jungen, and took into their employ Peter Schœffer and others. Their subsequent operations we again find curiously chronicled in the records of another lawsuit,[1] in which Gutenberg was soon engaged with his new ally; for Fust, dissatisfied with their proceedings, sought to recover from Gutenberg money advanced, with interest, including 800 florins of the sum advanced in virtue of the deed of partnership. Gutenberg in defence alleged, that the 800 florins had not been paid at once, as stipulated; and that they had been expended in preparation for the work (apparently meaning thereby, that this sum of money should have been paid down for his own use, in consideration of his communicating the secrets of his art, and that instead of so applying it to his private purposes, he had expended it for the joint benefit); whilst, as to the other sums, he offered to give an account of their appropriation, but denied that he was liable for the interest. The judges awarded that Gutenberg should pay the interest, as well as the part which his accounts showed he had applied to his individual use. This decision took place on the 6th of November 1455. Upon this Fust obtained from the public notary the following document:

"To the Glory of God, Amen. Be it known unto all those who shall see or hear read this instrument, that in the year of Our Lord 1455, third indiction, on Thursday the sixth day of November, the first year of the Pontificate of our very Holy Father the Pope, Calixtus III., appeared here at Mayence, in the great parlour of the Bare-footed Friars, between eleven o'clock and mid-day, before me, the Notary, and the undersigned witnesses, the honourable and discrete person, James Fust, citizen of Mayence, who, in the name of his brother, John Fust, also present, has said and declared clearly, that on this same day, and at the present hour, and in this same parlour of the Bare-footed Friars, John Gutenberg should see and hear taken by John Fust an oath, conformable to the sentence pronounced between them. And this sentence read in the presence of the honourable Henry Gunter, Curé of St Christopher of Mayence, of Henry Keffer, and De Bechtoff de Hanaw, servant and valet of the said Gutenberg; John Fust, placing his hand upon the Holy Evangelists, has sworn between the hands of me, the Notary Public, conformable to the sentence pronounced, and to a letter which he has sent to me, and has taken the following oath, word for word: I, John Fust, have borrowed 1550 florins, which I have transmitted to John Gutenberg, which have been employed for our common labour, and of which I have payed the rent and annual interest, of which I still owe a part. Reckoning, therefore, for each hundred florins borrowed, as above is recited, six florins per annum, I demand of him the repayment and the interest, conformably to the sentence pronounced; which I will prove in equity to be legal, in consequence of my claim upon the said John Gutenberg. In presence of the honourable Henry Gunter, of Henry Keffer, and of Bechtoff de Hanaw aforesaid, John Fust has demanded of me an authentic instrument, to serve him as much and as often as he hath need, in the faith of which I have signed this instrument, and have set thereto my seal."

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[1] Wolfii *Monumenta Typographica*. Fournier, *Origine de l'Imprimerie*.

From this it would appear (indeed the mortgage of his printing materials to Fust, mentioned in this document, proves) that Gutenberg had expended the whole of his considerable private fortune in his experiments, and had fallen into the power of his more wealthy associate; for in consequence of this judgment, and owing probably to his being unable to repay the sums demanded, the whole of his materials, constructed with so much perseverance, fell into Fust's hands; for the initial letters used by Gutenberg and his partners, in works known and supposed to have been executed between 1450 and 1455, are likewise used by Fust and Schœffer in the Psalter of 1457 and 1459. After such a mortifying result of so many years' labour, it would have been no matter for wonder had Gutenberg abandoned the unprofitable pursuit. On the contrary, he appears to have immediately started anew with fresh vigour, and this time with success. Another legal document gives curious information.

"We, Henne (John) Genszfleisch de Sulgeloch, named Gudinburg, and Friele Genszfleisch, brothers, do affirm and publicly declare by these presents, and make known to all, that, with the advice and consent of our dear cousins, John, and Friele, and Pedirmann Genszfleisch, brothers, of Mentz, we have renounced and do renounce, by these presents, for us and for our heirs, simply, totally, and at once, without fraud or deceit, all the property which has passed by means of our sister Hebele, to the convent of St Claire of Mentz, in which she has become a nun, whether the said property has come to it on the part of our father Henne Genszfleisch, who gave it himself, or in whatsoever manner the property may have come to it, whether in grain, ready money, furniture, jewels, or whatever it may be, that the respectable nuns, the abbess, and sisters of the said convent, have received in common or individually, or other persons of the convent (have received), from the said Hebele, be it little or much; and we have promised and do promise, by these presents, in good faith, for us and for our heirs, that neither we, nor any person on our part, nor yet our said cousins, nor any of their heirs, nor any person on their part, shall either demand, gain, nor claim of the said convent, nor of the abbess, nor of the convent in general, nor of the persons who may be found therein individually, the said property, of whatever kind it may be, either wholly nor in part, and that we will never demand it again, either through an ecclesiastical or civil court, or without the aid of the law; and that neither we nor our heirs will ever molest the said convent, either by words or deeds, either secretly or publicly, in any manner. And as to the books, which I, the said Henne, have given to the library of the convent, they are to remain there always and for ever; and I, the said Henne, propose also to give in future, without disguise, to the library of the said convent, for the use of the present and future nuns, for their religious worship, either for reading or chaunting, or in whatever manner they may wish to make use of them according to the rules of their order, *all the books which I, the said Henne, have printed up to this hour, or which I shall hereafter print, in such quantities as they may wish to make use of;* and for this the said abbess, the successors and nuns of the said convent of St Claire, have declared and promised to acquit me and my heirs of the claim which my sister Hebele had to the sixty florins, which I and my said brother Friele had promised to pay and deliver to the said Hebele, as her portion and share arising from the house which Henne, our father, assigned to him for his share, in virtue of the writings which were drawn up thereupon, without fraud or deceit. And in order that this may be observed by us and by our heirs, steadfastly and to its full extent, we have given the said nuns and their convent and order these present writings, sealed with our seals. Signed and delivered the year of the birth of J. C. 1459, on the day of St. Margaret."

From this it will appear, that his new establishment had actually produced the long wished-for effect. He appears to have carried on the business ten years; for in 1465 he entered into the service of Elector Adolphus of Nassau, as one of his band of gentlemen pensioners, with a handsome salary, as appears from the letters patent, dated the 17th January 1465, and finally abandoned the pursuit of an art which, though it caused him infinite trouble and vexation, has been more effectual in preserving his name and the memory of his acts, than all the warlike deeds and great achievements of his renowned master and all his house. Gutenberg died on the 24th of February 1468. His printing-office and materials had passed into the hands of Conrad Humery, syndic of Mentz, who had probably assisted him with money, and who appears to have been in some degree his partner. He afterwards sold them to Nicholas Bechtermunze of Elfield, whose works are greatly sought after by the curious, as they afford much proof, by collation, of the genuineness of the works attributed to his great predecessor.

Fust and Schœffer.

There does not appear to be any record of the early life of John Fust or Peter Schœffer before their partnership with Gutenberg, save that the former was a wealthy goldsmith and an ingenious man, and that Schœffer, surnamed de Gernsheim, was a scribe. It is very likely that the combination of character and qualifications of these three men may afford a good clue to the wonderful taste and beauty which distinguish the works issued from their press, and consequently to the great general improvement of the art during their life. The ingenuity of Gutenberg would readily suggest a new and expeditious method of manufacturing types; the practical skill of Fust as a worker in metals (and the working in gold and silver had at that time attained a most extraordinary nicety and beauty), and his large pecuniary resources, would readily supply the necessary appliances, while the taste of Schœffer would give all possible grace and beauty to the new forms. For Schœffer, it must be recollected, was a scribe, one of the ancient and honourable craft whose occupation was destined to fall before the new art; a transcriber, perhaps an illuminator, of the manuscript works in use before printed books; and those who have had the happiness of viewing those exquisite specimens of skill which beguiled our ancestors into study and devotion (when will modern typography produce such feasts for mind, and eye, and imagination?) will readily conceive that Schœffer's eye was already schooled for the conception, and his hand for the execution, of all the beauty the trammels of a new art and limited skill would allow. Aided by his own taste and his partners' invention and wealth, Schœffer proceeded to a new enterprise, namely, the *casting* of type. The entire conception and execution of this invention has been generally attributed and allowed to Schœffer. It seems most probable, however, that where three ingenious men are bound together by art and interest, no one of them can lay exclusive claim to any invention or undertaking executed in the workshops and for the mutual benefit of all. Allowing, therefore, to Schœffer the honour of having suggested some such plan, the other two may fairly put in a claim for their portion of the credit on the score of their suggestion and assistance, especially since Fust, as a worker in metals, would have been the party to engage workmen to elaborate the conceptions of his partners' brain. Accordingly the only evidence upon the subject appears to show that the firm had for some time practised a method of taking casts of type in moulds of plaster; for it must be remembered that the types of Gutenberg's earlier efforts, both at Strasbourg and at Mentz, were cut out of single pieces of wood or metal with infinite labour and imperfection. The method of casting, however, although a great improvement, was at best but a slow and tedious process. Every new letter required a new mould; no skill or care could enable the workman to impress so small a thing as a type is at the face, yet so elongated in the shank, fully, freely, and steadily, into a soft material; and it would be necessary afterwards, under the most favourable circumstances, that the squareness and sharpness so indispensable in type should be given by another slow process, so that at best this advance was but an imperfect and tedious operation. Schœffer has therefore an undoubted claim to be considered as one of the three inventors of printing; for he it was who first suggested the cutting of punches, whereby not only might the most beautiful form of type the taste and skill of the artist could suggest be fairly stamped upon the matrix, but a degree of sharpness and finish quite unattainable in type cut in metal or wood could be given to the face; whilst to the shank, by the very same process by which the face was cast, the mould would give perfect sharpness and precision of angle. Add to this, that the punch being once approved of, could be kept ready to stamp a new matrix in precisely the same condition and form as the first, should that be worn out or mislaid, or make a duplicate should the demands of business require it. It is nevertheless rather singular, that the mould represented on the right side of the press of Ascensius, shortly after the time of Schœffer, should be precisely the same in form and manner of use as that of the present day. This was evidently an immense stride towards perfection; let Schœffer therefore take a place on the right hand of the inventor.

Within eighteen months of their separation from Gutenberg, Fust and Schœffer produced the celebrated Psalter. This was printed with large cut type. As it was impossible to prepare a new fount and print this splendid work in that short space, it must be evident that the partners did great injustice to Gutenberg in suppressing his name from the colophon. This book was produced in the month of August 1457, and is the first book which bears the name of the place where it was printed, those of its printers, and the date of the year in which it was printed. The first book, however, bearing date, was issued by Fust and Schœffer in 1455, viz. the *Literæ Indulgentiarum Nicholai V.*; it is on a single piece of parchment. This Psalter was reprinted in 1459, 1490, and 1502, and always in the same type, which, it is remarkable, was never used for any other work, probably because its great size made it unfit for any other works than those not intended for popular reading, but to lay on desks like our church Bibles. On the 16th of October 1459, Fust and Schœffer published the *Durandi Rationale Divinorum Officiorum*, with an entirely new fount of type; in 1460 the *Constitutiones Clementis V.*; and in 1462 the celebrated Latin Bible. Fust enjoyed this successful and glorious practice of his art but ten short years; yet in this period what an immense advance from the misshapen and irregular lumps of their first efforts, ugly in themselves, and more ugly in their utter want of relative proportion and allignement, to the well-proportioned, evenly standing type of the Bible! The plague carried him off in Paris about the year 1466, full of years, and perchance full of honours. Schœffer survived many years, and, in conjunction with Conrad Henlif, produced a great number of works. His name is found in the colophon of the fourth edition of the Bible of 1502, about which time he is supposed to have deceased.

Were we to take tradition for our guide as regards the character of Fust, we should regard him as a conjurer and an adept in the black art. The popular story (and many "grave and discrete old men" have given credit to the tale) runs, that having kept these proceedings profoundly secret, as soon as their Bible was finished, Fust transferred himself to Paris with many copies of the new work, and palmed them upon the learned as manuscripts, to which, as they were printed on vellum, in a type bearing much resemblance to the written books of the period, and the vignettes and initial letters were splendidly illuminated, they were not very dissimilar; that some eager scholar or devotee became the possessor of the first copy, supposing it to be a rare chance, at the moderate price of four or five hundred crowns; that as he brought the work into the market, the price fell rapidly to sixty, and then to thirty crowns, by which time the extraordinary glut produced suspicion, and Fust was accused of multiplying Holy Writ by the aid of the devil, and was accordingly persecuted by the priesthood, whilst the laity, looking to their temporal interests, prosecuted him for his inroad into their pockets; and that from these things Fust was obliged to quit Paris precipitately. The whole story is an impossible fabrication.

Having thus given a sketch of the origin and history of the art of printing, a brief account of the works issued by the illustrious triumvirate will not only be proper here, but will give the general reader a better idea of the astonishing perfection to which the art rose under the taste and genius of its inventors. There is not a single work of Gutenberg which bears his name; yet, as before remarked, there are several which bear such internal evidences, that the literati of all parties and opinions are unanimous in attributing them to his press.

Of these works, Dr Dibdin, the well-known bibliographer, gives the following account:

"First, as to the *character of the type* used by the early Mentz printers. This appears to have been uniformly what is called *Gothic;* and if we except the varieties of the larger type (from three eighths to two eighths or to a quarter of an inch), which appear in the Psalters of 1457, 1459, and 1490 (the type common to most works executed about the same period), we shall observe three distinct sets or forms of letters used in the printing-office of Faust and Schoiffher. Of these three typographical characters, two only (if we except the one with which the Bible of 1455 was executed) are visible in the publications which appear to have been printed in the lifetime of Faust; that is to say, the larger Gothic used in the Bible of 1462, and the smaller Gothic in the Offices of Cicero, of the dates of 1465 and 1466. These appeared united, the former, for the first time, in the *Constitutions of Pope Clement V.*, of the date of 1460. Schoiffher introduced a type of an intermediate size, which may be seen, among other works, in the *Rudi-*

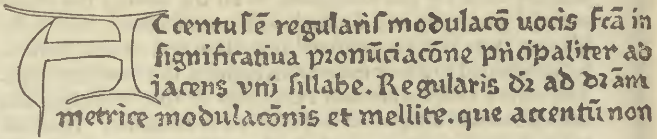
ments of Grammar of 1468, and in the *Decretals of Pope Gregory the Ninth*, of the date of 1479. This intermediate type is of a narrower form, and prints very closely. Of the three types here mentioned, the largest is undoubtedly of the handsomest dimensions; but they all partake of the *Secretary Gothic*, and may be said to be the model of that peculiar character which was adopted by the early Leipsic printers, Thanner and Boëttiger, and was more especially used by John Schoiffher and the other German printers for nearly the whole of the sixteenth century. Shew me Lisardo, one book, nay, one leaf only, printed in the *Roman type*, in the colophon of which the name of Faust or of Peter Schoiffher appears, and you shall immediately have the amount of the balance in my favour, at my banker's, be it great or small, be it L.200 or L.20, for such a precious and unheard-of curiosity.

"We shall now, in the second place, say a few words as to the *character of the printing*, or of the *mechanical skill*, of the early Mentz press. There can be but one opinion upon this point. Everything is perfect of the kind, the paper, the ink, and the register, or regularity of setting up the page. The Bible of the supposed date of 1455 is quite a miracle in this way;[1] but the Psalters are not less miraculous, nor is less praise due to the *Constitutions of Pope Clement V.*, of the date of 1460, and the *Bible* of 1462; while the *Durandus*, of the earlier date of 1459, exhibiting the first specimen of the smallest letter, strikes one as among the most marvellous monuments extant of the perfection of early typography. Almost all the known works before the year 1462 are printed *upon vellum*, doubtless because they ventured upon limited impressions; and even of the Bible of 1462 more copies have been described upon vellum than upon paper. Upon the whole, the vellum used by Faust and Schoiffher, although inferior to the Venetian, is exceedingly good, being generally both white and substantial.

"In the third place, let us notice the nature or character of the works which have issued from the press of Faust and Schoiffher. Whatever may be our partiality towards that establishment from which the public were first gratified with the sight of a printed book, candour obliges us to confess that the fathers of printing were not fortunate, upon the whole, in the choice of books which issued from their press.

"In the fourth place (for I told you I should be somewhat tautologous), consider what is the typographical appearance of those books which Gutenberg is really supposed to have executed. It is quite unique. A little barbarous, and certainly wholly dissimilar from any thing we observe in other contemporaneous productions of the Mentz press. You will please to understand that I think very doubtfully of the *Donatuses*, which are considered to have been printed by him; as well as of the *Speculum Sacerdotum*, and *Celebratio Missarum*; concluding the *Catholicon* of 1460, and the *Vocabularies* of 1467 and 1469, to be the more genuine productions of his press, or of the types used by him. Is it not surprising, I ask, that these works are executed in types quite different from anything we observe in the Mentz productions? and this from a man who is considered as the parent of printing in that city. No wonder, if they *be* the actual productions of Gutenberg, that Faust and Schoiffher thought so meanly of his talents, and that on a dissolution of partnership they adopted a different and a very superior character."

In confirmation of these remarks of the learned bibliographer, we shall here insert a specimen of Gutenberg's *Balbus de Janua*, which will also be a curious illustration of ancient art. Notwithstanding the appearance of these types, the reader is assured that the original is really printed from separate pieces of metal.[2]



Accentuſ ē regulariſ modulacō uocis fcā in
ſignificatiua pronūciacōne pricipaliter ad
iacens vni ſillabe. Regularis dr ad drām
metrice modulacōnis et mellite. que accentū non

Dr Horne, in the appendix to his Introduction to Bibliography, says of the Psalter, "This precious work, as Santander justly calls it, is one of the most known among early printed books, from the various and correct descriptions of it which have been given by different bibliographers. Until the discovery of Pope Nicholas' *Literæ Indulgentiarum*, this was supposed to be the very first article ever printed with a date affixed; the book is executed on vellum, and of such extreme rarity that not more than six or seven copies are known to be in existence; all of which, however, differ from each other in some respect or other. The most perfect copy known is that in the imperial library at Vienna; it comprises 175 leaves, of which the Psalter occupies the 135 first and the recto of the 136th. The remainder is appropriated to the litany, prayers, responses, vigils, &c. The psalms are executed in larger characters than the hymns, similar to those used for missals prior to the invention of printing; but all are distinguished for their uncommon blackness. The capital letters, 288 in number, are cut on wood with a degree of delicacy and boldness which are truly surprising; the largest of these, the initial letters of the psalms, which are black, red, and blue, must (as Lichtenberger has remarked) have passed *three times* through the press. Copies are now in the Queen's library at Windsor, and in that of Earl Spencer at Spencer House." A facsimile of the initial B, and a portion of the first verse of this beautiful book, and of the colophon at the end, will be found in Plate CCCCXIV.

The extraordinary praise awarded by these eminent bibliomaniacs to the first productions of the Mentz press may perchance excite in the minds of the more sober public a suspicion that these writers have been led away by their enthusiasm beyond the limits of matter-of-fact truth, and have seen merit in defects, beauty in deformity, and lustre in antiquity. Assuredly, nevertheless, such is by no means the case; and the happy individual who gains access to the *chef-d'œuvres* of Fust and Schœffer will return from the inspection a wiser man; for the beauty of these works is inconceivable. England fortunately possesses several of these treasures of art, there being copies of the Bible of the supposed date of 1450-55 in the Royal Library, in the Bodleian, and in those of Earl Spencer and Sir M. Sykes; whilst of the six known copies of the Psalter of 1457, two are in England, namely, one at Windsor, and one in the possession of Lord Spencer. Of the Latin Bible of Fust and Schœffer, 1462 (the first bearing date), there are copies *on vellum* at Blenheim, in the libraries of Lord Spencer, the Earl of Jersey, and Sir M. Sykes, in the British Museum, and imperfect in the Bodleian. Copies *on paper* are rarer still, there being but three in this country, viz. those in the Royal Library and the British Museum, and one lately in the possession of Mr Willett.

Apparently, in retaliation of the injustice done to Gutenberg by his partners in depriving him of any share of

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[1] This is even sober praise. The mechanism of the press-work, and appearance of the ink, beautiful, regular, and glossy as the whole appears, does not strike one with more astonishment than the manufacture of the paper. "Charta," says Tungendres, "ejusdem est crassitudinis, qualem illo tempore libris imprimendis consumere mos fuit." And again, "Charta ob ejus densitatem atque spissitudinem haud ingratam ubique se maxime commendat." (*Disq. de Not. Charact. Libror.* p. 27, p. 46.) And see Meerman's testimony in favour of the paper of the Soubiaco press, *Orig. Typog.* vol. i. p. 9, note.

[2] The initial A is illuminated in a very brilliant blue. The reader who is desirous of obtaining the full effect of this specimen can fill up the printed outline in water-colour.

History.

the honour of producing the Psalter of 1457, which, as before stated, must be the joint production of all three, although it was not finished until after the secession of Gutenberg, bibliographers have generally agreed in attributing the printing of the Bible of 1450-55 to Gutenberg alone, when it is equally manifest that Fust and Schœffer had as much claim to the honour as their coadjutor. It is an exceedingly beautiful book, in two very large folio volumes, in two columns, containing from forty-one to forty-three lines each, in very large well-cut types. It consists of six hundred and forty-one leaves; it has no title, paging, signatures, or catch-words; the initial letters are not printed, but painted in by illuminators, and the initial letters of each verse of the psalms are painted alternately red and black, by way of guide to the priests in their alternate reading. From the lustre and blackness of the ink, its evenness of colour, and beautiful execution, it is a very superb book; but it is nevertheless surpassed by the Fust and Schœffer edition of 1462, when they had attained greater experience in the practice of the art. By far the choicest, however, of these *editiones principes* is the Mentz Psalter or *Codex Psalmorum* before mentioned, the initial B and first few lines of which form part of Plate CCCCXIV. Dr Horne says that the six known copies of this edition differ from each other in some respects, and proceeds to give some particulars in which variations are found; but, upon a comparison of the royal copy with Earl Spencer's, it will be found, that although they bear the same date, they are in fact two distinct editions. It would have excited no great surprise had it been found that the printed ornaments differed, as nothing would be more easy than to change the colours with which the different blocks were worked; but the text varies in such a manner that there can be no doubt of their perfect distinctness. By comparing the following terminations of the lines of the Windsor copy with the specimen, this will be clear. The first line of the Windsor copy ends with abijt; the second with the contracted et; the third with stetit; the fourth with non; the fifth with vni; the sixth with lege. This will be found to arise from a difference in the contractions of the following words:

	Windsor Copy.		Earl Spencer's Copy.
First line	q̄	instead of	qui;
Second line,	consilio	instead of	ꝯsilio;
Third line,	pec̄or̄ nō	instead of	pecatorm̄ non;
Fourth line,	ī	instead of	in;
Fifth line,	nō	instead of	non.

These differences arise apparently from the desire of so apportioning the words that each line shall be completely justified out in the Windsor copy, which (as may be seen in the plate) is not the case in Lord Spencer's copy; from which circumstance it is probable that the latter is the earliest. The book[1] is a very large folio, on vellum, consisting of about a hundred and thirty leaves, printed on both sides. There are generally twenty-three lines in a page, in Gothic type. Every psalm begins with a splendid initial letter, about two thirds of the size of the B, *printed* in two colours in almost every case. Occasionally, however, this appears to have been neglected, and then the letter is painted in by the illuminator, but *not* in imitation of the printed letters. The initials consist (like the B) of a bold character, of Gothic cut, surrounded by a scroll, which is sometimes of great length, that of the B extending from the top to the bottom of the page. The same wooden block is used as often as the letter occurs, but it is not always of the same colour; moreover, every *verse* commences with a smaller initial printed in a red colour, in the same manner as the s in the specimen. Nor is this work destitute of the embellishments of the illuminator; for at the commencement of every psalm is a rubric, painted in a most brilliant red, in a smaller letter, of precisely the same character as the text, and also the music of the chant, with the words underneath it painted in black. The initial letters of both are splendidly illuminated in various colours. The paint is used in such profusion that the letters are absolutely in relief, often to the extent of one sixteenth of an inch; and besides these, the letter following the grand initial has a broad bar painted down it, and very frequently the first letter after the pauses indicated in our authorized version by a colon is illuminated in a similar manner. One page is particularly splendid; it consists of short verses, in which the first words are constantly repeated. It commences with a grand initial, and there are twenty-two smaller initials to the verses; the second letter of the first verse, and the first letter after every pause (twenty-three in number), having the broad illuminated bar. Wherever the psalm commences too near the bottom to allow of the full exuberance of the scroll, a piece of paper appears to have been laid over a portion of the cut, to prevent the impression from appearing; and in one psalm where the chant is of unusual length, the lower part of the initial O, and a corresponding portion of the scroll, are thus suppressed; the music being illuminated in its place, and the scroll continued below it. Sometimes the illuminator has omitted to add his initial letter; and in this copy the double device is omitted. The accuracy with which the coloured blocks are printed within the text and within each other is perfectly astonishing. From this description it may be conceived how very superb is the *first* book ever printed, the date, and place, and artist, of which can be accurately ascertained. Dr Dibdin in the *Bibliotheca Spenceriana*, Mr Savage in his work on *Decorative Printing*, Dr Horne, whose wood-block is not coloured, and several other writers, have given fac-similes of the same copy (Lord Spencer's), which, however, all differ from one another. The lines given in the specimen in Plate CCCCXIV. are copied from Dibdin, whose initial B does not accord with that of the Windsor copy; the B here given is very accurate, and the colours are as similar as possible to the latter copy, but the colour of the scroll in the original seems somewhat faded.

Early printers.

The capture of the city of Mentz by Count Adolphus of Nassau in the year 1462 had the effect of interrupting the labours of Fust and Schœffer; and moreover the distracted state of the city enabled, perhaps compelled, the workmen initiated in the mysteries of the art to flee into the neighbouring states, and thus spread its practice over the whole civilized globe. Such, indeed, was the fame it had already acquired, and such the idea entertained of its importance, that every community with the slightest pretensions to literature appears to have sought a knowledge of it with the greatest avidity. Thus, within six years of the publication of the Psalter, it had spread to several cities having some connection with Mentz, and within fifteen years to almost every town of consideration in Christian Europe. A chronological list of the cities which first seized upon the invention would be greatly too long for this article; it may be interesting, however, to extract a few of the principal, with a notice of such printers as are remarkable either for the beauty or the scarcity of their works. The reader is not to suppose that all, or indeed any great number of these, learned the practice of the art under the tuition of the first masters. A few are known to have been pupils of the inventors, and it is probable that many others of them were so; but the majority, in all likelihood, were men of learning, enterprise, or capital, who derived their typographical knowledge from such facts as had transpired, or from inferior workmen of Fust and Schœffer or Gutenberg, supplying deficiencies by their own ingenuity.

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[1] The copy described is that at Windsor: the illuminations, no doubt, vary in every copy.

Strasbourg. Mentelin. Some writers have claimed for Mentelin the invention of printing, representing that Gutenberg was his servant, without, however, showing the slightest ground for their assertions; but others, more reasonable, say that he was acquainted with Gutenberg, and instructed by him, and that on the latter's quitting Strasbourg he established a printing-office, and carried on the business successfully. Mentelin most probably printed about the year 1458. His type is rude and inelegant. The only book bearing his name is Beauvais' *Speculum Historiale*, of date 1473. Schæpflin says, that he, as well as Fust and Schœffer at Mentz, printed 300 sheets per day.

In 1461. *Bamberg.* Albert Pfister. He printed a collection of *Fables*, of date 1461. This book is excessively rare; it is printed with cast metal type, and is illustrated with 101 wood-cuts, in much the same style as the old *Biblia Pauperum.* All his other works are printed in the same type.

1465. *Subiaco* and *Rome.* Schweynheym and Pannartz. Their known works are, a *Donatus*, without date; Lactantius, 1465; St Augustin on *the City of God*, 1467; Cicero *de Oratore*, without date; and the *Commentary of De Lyra on the Bible*, 1471, all in folio. These works were printed in a new letter, very closely resembling the type now in use called *Roman*, and of which they were the introducers. In *De Lyra* are the earliest specimens of Greek types worthy of the name; some few letters appear in the *Cicero de Officiis* printed at Mentz, but so wretchedly imperfect that they are unworthy of mention. It is curious that the Greek fount of Schweynheym and Pannartz at Subiaco was evidently very small; but upon their removal to Rome they cast a much larger fount. The cut and appearance of this Greek is more than respectable. There is a very curious petition from them to the pope, praying for assistance on the ground that they had entirely ruined themselves by printing *De Lyra*, for which there was no sale, and representing that they had on their hands no less than eleven hundred folio volumes of that work. Subiaco is the first place in Italy in which printing was practised. At Rome Ulric Han and Lignamine were contemporaries. Their works, particularly those of Han, are excessively rare.

1467. *Elfield.* Henry and Nicholas Bechtermunze. They purchased from Conrad Humery the types and materials of Gutenberg. Their works are not at all remarkable for beauty, but are very rare, and much sought for as affording evidence of Gutenberg's works.

1467. *Cologne.* Ulric Zell. His type is Gothic, and of no beauty; but his works are rare.

1468. *Augsburg.* Ginther Zainer printed the first book in Germany with Roman type.

1469. *Venice.* John de Spira, whose works are of the utmost beauty. His edition of Pliny is splendid, and enormous sums have been given for those printed in vellum. He did not use Greek characters; but Greek passages are composed in Roman types. In the same city, at the same time, printed Nicholas Jenson, whose works are equal, if not superior, to those of Spira; they are not so rare, but are almost equally sought after. A copy of his folio Latin Bible of 1479, printed in Gothic type, was sold at Mr Edwards' sale for L.115. 10s. Venice was also the residence of Christopher Valdarfar, whose works gave rise to a most extraordinary event connected with bibliography, viz. the sale of the first edition of *Il Decamerone di Boccaccio*, printed by him in 1471. For many years it had been known that a single copy of this work was in existence, and the most devoted bibliomaniacs had used their utmost endeavours to discover it, but in vain. At length, about 1740, an ancestor of the Duke of Roxburghe obtained possession of it for the sum of one hundred guineas. In lapse of time it became the property of John duke of Roxburghe, the accomplished, indefatigable, and undaunted bibliomaniac, after whose death the gorgeous library was dispersed by the auctioneer in the year 1811. The interest excited amongst the learned by this sale was intense. It was known that the collection contained the most superb specimens of every kind of ancient lore; that the illuminated manuscripts were the most brilliant, the ballads the most obscure, the *editiones principes* the most complete that the world could produce; that the rarest Caxtons, the finest Pynsons, and grandest specimens of the foreign printers, were here to be found; above all, it was rumoured that a mysterious edition of Boccaccio's Decameron would become a bone of contention amongst the noblest of the literati. The public, learned and unlearned, were infected with the mania, and the daily papers teemed with notices of the sale. At length the important day arrived, the 17th of June 1811. St James' Square was the place. Mr Evans presided. The room was crowded; Earl Spencer, the Marquis of Blandford, the Duke of Devonshire, and an agent of Napoleon, were amongst the most prominent. The book was a small folio, in faded yellow morocco binding, black-letter. "Silence followed his (Mr Evans') address," says Dibdin. "On his right hand, standing against the wall, stood Earl Spencer: a little lower down, and standing at right angles with his lordship, appeared the Marquis of Blandford. The duke, I believe, was not then present; but my Lord Althorpe stood a little backward, to the right of his father Earl Spencer. Such was 'the ground taken up' by the adverse hosts. The honour of firing the first shot was due to a gentleman of Shropshire, unused to this species of warfare, and who seemed to recoil from the reverberation of the report himself had made. 'One hundred guineas,' he exclaimed. Again a pause ensued; but anon the biddings rose rapidly to five hundred guineas. Hitherto, however, it was manifest that the firing was but masked and desultory. At length all random shots ceased, and the champions before named stood gallantly up to each other, resolving not to flinch from a trial of their respective strengths. 'A thousand guineas' were bid by Earl Spencer; to which the marquis added 'ten.' You might have heard a pin drop. All eyes were turned; all breathing well nigh stopped. Every sword was put home within its scabbard, and not a piece of steel was seen to move or to glitter save that which each of these champions brandished in his valorous hand. See, see; they parry, they lunge, they hit; yet their strength is undiminished, and no thought of yielding is entertained by either. 'Two thousand pounds' are offered by the marquis. Then it was that Earl Spencer, as a prudent general, began to think of an useless effusion of blood and expenditure of ammunition, seeing that his adversary was as resolute and fresh as at the onset. For a quarter of a minute he paused, when my Lord Althorpe advanced one step forward, as if to supply his father with another spear for the purpose of renewing the contest. His countenance was marked with a fixed determination to gain the prize, if prudence in its most commanding form, and with a frown of unusual intensity of expression, had not bade him desist. The father and son for a few seconds converse apart; and the biddings are resumed. 'Two thousand two hundred and fifty pounds,' said Lord Spencer. The spectators are now absolutely electrified. The marquis quietly adds his usual 'ten,' and there is an end of the contest. Mr Evans, ere his hammer fell, made a due pause, and, indeed, as if by something preternatural, the ebony instrument seemed itself to be charmed or suspended 'in mid air.' However, at length down dropped the hammer, and, as Lisardo has not merely poetically expressed himself, 'the echo' of the sound of that fallen hammer 'was heard in the libraries of Rome, of Milan, and Saint Mark.' Not the least surprising incident of this extraordinary sale is, that the marquis already possessed a copy of the work, which wanted a few leaves at the end; he therefore paid this enormous sum for the honour of possessing a few pages. The prize of this contest is now in the possession of Earl Spencer."

1469. *Milan.* Lavagna. In 1476 Dionysius Palavasinus printed the Greek Grammar of Constantine Lascaris, in quarto, which is the first book printed entirely in Greek. The first printing in Hebrew characters was performed at Soncino, in the duchy of Milan, in 1482.

1470. *Paris.* Ulricus Gering, M. Crantz, and M. Friburger.

1471. *Florence.* Bernard Cennini. In 1488 Demetrius of Crete printed the first edition of Homer's works, in most beautiful Greek.

1474. *Basle.* Bernardus Richel.

1474. *Valencia.* Alonzo Fernandes de Cordova.

1474. *Louvain.* Joannes de Westphalia.

1474. *Westminster.* William Caxton, the Game of Chess.

1475. *Lubeck.* Lucas Brandis.

1476. *Antwerp.* Thierry Martins of Alost.

1476. *Pilsen* in Bohemia. *Statuta Synodalia Pragensia;* printer's name not known.

1476. *Delft.* Maurice Yemantz.

1478. *Geneva.* Adam Steinschawer.

1478. *Oxford.* Theodericus Rood.

1480. *St Albans. Laurentii Guillielmi de Saona Rhetorica Nova;* printer's name not known.

1482. *Vienna.* John Winterburg.

1483. *Stockholm.* Johannes Snell.

1483. *Harlem. Formulæ Novitiorum,* by Johannes Andriesson. This is the earliest book printed at Harlem *with a date.* In giving this as the first work *known* to be printed at Harlem, the claims of Koster, his grandsons and successors, must, of course, be reserved.

1493. *Copenhagen.* Gothofridus de Ghemen.

1500. *Cracow.* Joannes Haller.

1500. *Munich.* Joannes Schobzer.

1500. *Amsterdam.* D. Pietersoen.

1507. *Edinburgh.* A Latin Breviary; no printer's name. From a patent of James IV. it appears that the first printing press was established at Edinburgh in 1507. From the style and types, it is probable that they were imported from France.

1551. *Dublin.* Ireland was apparently the last country in Europe into which printing was introduced. The first book printed is a black-letter edition of the Book of Common Prayer, printed by Humphrey Powell.

1569. *Mexico.* Antonio Spinoza, *Vocabulario en Lengua Castellana y Mexicana.*

1639. *United States,* at the town of Cambridge. Printer Stephen Daye.

It was the custom of the early printers to distinguish their books by the most fantastic devices; and by these their works may be readily recognised. Many of them were of exceeding beauty, and all the skill and appliances of their art were employed to render them striking; they are really an ornament to their works. The invention of these has been ascribed to Aldus; but the very first printers, Fust and Schœffer, used each for himself, yet conjoined, devices of rare excellence. Their celebrated Bible is adorned with one which is well worthy of being adopted as the arms of the art and mystery of printing. This is given in the plate of illustrations with those of Caxton, Wynkyn de Worde, and Pierre Regnault, who, with his brother, printed the first English Testament at Paris.

Our chronological arrangement has precluded us from mentioning some of the most skilful typographers. Their works, however, are so numerous, and their efforts so well known, as to render it unnecessary to do more than mention their names. Such men as the Aldi, Frobenius, Plantinus, Operinus, the Stephani, the Elzeviri, the Gryphii, the Giunti, the Moreti, and hosts of peers, have universal fame. The printing-office of Plantinus, in the Place Vendredi, at Antwerp, exists in its full integrity, and in the possession and use of his descendants the Moreti; the same presses, the same types, with the addition of every improvement modern skill has effected, are still in use, and an inspection of these singular relics of olden art will well repay the investigation of the curious.

The First Presses.

Of the mechanical means by which these beautiful impressions of the old printers were produced there is little or no record; but it is quite evident that they must have been effected by some more skilful process than mere manipulation, that is, than the appliance of a burnisher, as is evident in the first wood-cuts, or of a roller, or superficial pressure applied immediately by hand. It is very probable that one of the difficulties which Gutenberg found insuperable at Strasbourg, was the construction of a machine of sufficient power to take impressions of the types or blocks then employed; nor is it at all wonderful that the many years he resided at that city were insufficient to produce the requisite means; for, with cutting type, forming his screws, inventing and making ink, and the means of applying his ink when made, his time must have been amply occupied. Moreover, the construction of a press would require a versatile genius, and excellent mechanical skill, not to be looked for in one man. But upon his junction with Fust and Schœffer, the gold of the former, and the invention of all the three, would soon supply the defect; and, for aught that appears to the contrary, the press used in their office differed in no essential point from those in use until the improvements of Blaew in 1600–20. Fortunately, amongst the queer devices with which it pleased the earlier printers to distinguish their works, Badius Ascensius of Lyons (1495–1535) chose the press; and there are cuts of various sizes on the title-pages of his works. It appears from these, that, like that of Gutenberg, they could print only four pages at a time, and that at two pulls; and when it is stated that the table and tympan ran in, and that the platten was brought down by a powerful screw, by means of a lever inserted into the spindle, the professional reader will easily recognise the wooden presses laid up in ordinary in many old London houses.

The colour which the earliest typographers used was probably made according to the style of work in hand. The earliest copies of the *Speculum* and *Biblia Pauperum* were printed in a brown colour, of which raw umber is the principal ingredient. It appears to have been well ground and thin. It was, most likely, of the same tint as the old drawings of the same subjects, and would be better adapted for the filling up in various colours, as appears to have been the practice, than a black and harsh outline of ink. Fust and Schœffer, however, introduced, and their followers adopted, black ink, and were so skilful in compounding it that their works present a depth and richness of colour which excites the envy of the moderns; nor has it turned brown, or rendered the surrounding paper in the slightest degree dingy. From the above-mentioned colophons we have also the method of applying it to the types. This was by means of balls of skin stuffed with wool, in every respect the same as those used thirty years ago. The ink was laid in some thickness on a corner of a stone slab, and taken thence in small quantities and ground by a muller, and thence again taken by the balls and applied to the types. The types appear to have been disposed in cases very much the same as ours. The composing-stick differs somewhat, but cannot now be very clearly made out. The different operations of casting the type, composing, reading, and working, are mostly represented in the same apartment; but, it is probable, more for the sake of pictorial unity, than because such

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was really the custom. There must have been many workmen engaged in most of the old establishments; and they well knew the value of cleanliness, which is unattainable where all the operations are carried on together.

Introduction into England.

As the invention of printing has itself become matter of serious controversy amongst the learned of all countries, its introduction into England has not been suffered to pass without an attempt of the novelty-seekers to overturn the received opinion on the subject, and to give to another the laurel of a public benefactor, torn from him to whom the general voice had for two centuries allotted it. Fortunately, the quarrel is divested of one of the great difficulties of the continental, inasmuch as there does not appear to be any vestige of an art in any degree similar (such as block-printing) having been practised prior to the introduction of type-printing; the art, when it was brought over, being in a state somewhat approaching maturity. This controversy concerns the claims of William Caxton and Frederic Corsellis to the introduction of the knowledge of the art, and the printing of the first book, in this country.

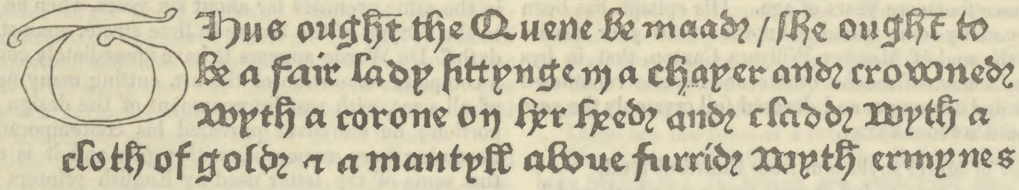
The general and original belief is that Caxton, who for thirty years resided in the Low Countries, under the reign of Charles the Bold, and who had taken every opportunity of learning the new art, and had availed himself of the capture of Mentz to secure one of the fugitive workmen of Fust and Schœffer, established a printing-office at Cologne, where he printed the French original and his own translation of the *Recuyell of the Historyes of Troy;* that whilst at Cologne he became acquainted with Wynkyn de Worde, Theoderick Rood, both foreigners, and Thomas Hunte his countryman, who all subsequently became printers in England; that he afterwards transferred his materials to England; that Wynkyn de Worde came over with him, and probably was the superintendent of his printing establishment; that his first press was established at Westminster, perhaps in one of the chapels attached to the abbey, and certainly under the protection of the abbot; and that he there produced the first book printed in England, the *Game of Chess*, which was completed on the last day of March 1474.

The correctness of these facts is not matter of dispute, all writers agreeing that Caxton did so set up his press at Westminster, and print his *Game of Chess* in 1474; but it has been asserted that Caxton was not the first printer, nor his book the first book printed, in this country. Neither does the controversy rest upon the contradictory statements of many writers, for all authors of the same and succeeding period agree in ascribing the honour to Caxton; and when, in 1642, a dispute arose between the Stationers' Company and certain persons who printed by virtue of a patent from the crown, concerning the validity of this patent, a committee was appointed, who heard evidence for and against the petitioners, and throughout the proceedings Caxton was acknowledged as incontestibly the first printer in England. Thus Caxton seemed to be established as the first English typographer, when, soon after the Restoration, a quarto volume of forty-one leaves was discovered in the library at Cambridge, bearing the title of *Exposicio Sancti Jeronymi in Simbolum Apostolorum ad Papam Laurentium*, and at the end, "Explicit Exposicio Sancti Jeronymi in Simbolo Apostolorum ad papam Laurentium, Oxonie Et finita, Anno Domini M.CCCC.LXVIII. *xvii.* die decembris." Upon the production of this book the claim for priority of printing was set up for Oxford. In the year 1644 Richard Atkyns, who then enjoyed a patent from the crown, and whose claims consequently brought him into collision with the Stationers' Company, and who was desirous of establishing the prerogative of the sovereign, published a thin quarto work, entitled *The Original and Growth of Printing, collected out of the History and the Records of the Kingdome; wherein is also demonstrated that Printing appertaineth to the Prerogative Royal, and is a Flower of the Crown of England.* The book was published "*by order and appointment of the Right Hon. Mr Secretary Morrice.*" In support of this proposition Atkyns asserted that he had received from an anonymous friend a copy of a manuscript discovered at Lambeth Palace, amongst the archiepiscopal archives. The following is an abstract of this document. "Thomas Bouchier, archbishop of Canterbury, earnestly moved the king, Henry VI. to use all possible means to procure a *printing* mold, to which the king willingly assented, and appropriated to the undertaking the sum of 1500 merks, of which sum Bouchier contributed 300. Mr Turnour, the king's master of the robes, was the person selected to manage the business; and he, taking with him Mr William Caxton, proceeded to Harlem in Holland, where John Guthenberg had recently invented the art, and was himself personally at work; their design being to give a considerable sum to any person who should draw away one of Guthenberg's workmen. With some difficulty they succeeded in purloining one of the under workmen, Frederic Corsellis; and it not being prudent to set him to work in London, he was sent under a guard to Oxford, and there closely watched until he had made good his promise of teaching the secrets of the art. Printing was therefore practised in England before France, Italy, or Germany, which claims priority of Harlem itself, though it is known to be otherwise, that city gaining the art from the brother of one of the workmen, who had learned it at home of his brother, and afterwards set up for himself at Mentz." The *Exposicio* is asserted by inference to be the work of Corsellis. That this document is a forgery may be safely assumed; because of the more than unsatisfactory manner in which it is said to have been obtained; because no one ever saw this copy; because no one, except the unknown, ever saw the original, for it is not amongst the archives nor in the library of Lambeth Palace, nor was it when the Earl of Pembroke made diligent search for it in 17(   ), nor was it found when the manuscripts, books, and muniments were moved into a new building; because Caxton himself, who took so important a share in the alleged abduction of the workman, states that twelve years afterwards he was diligently engaged in learning the art at Strasbourg, and repeatedly ascribes the invention to Gutenberg, "at Mogunce in Almayne;" because, when three years afterwards the Stationers' Company instituted legal proceedings against the University of Cambridge, to restrain them from printing, this document was rejected, as resting only on Atkyns' authority; because Archbishop Parker, in his account of Bourchier, mentions the invention of printing at Mentz, but makes no claim for his having introduced it into England, and Godwin, *de Præsulibus Angliæ*, says that Bourchier, during his primacy of thirty-two years, did nothing remarkable, save giving L.120 for poor scholars, and some books to the university, and that he minutely examined two registers of his proceedings during this term, without making any mention of his having found therein any record of so remarkable a transaction; because, since these transactions must have taken place before 1459, Henry VI. was at that time struggling fearfully for his throne and life, Edward IV. being crowned in that year; from internal evidence of the document itself, for, not to mention the weak evidence for the city of Harlem, it is quite certain that Gutenberg never printed there, and by Junius the theft is ascribed to John Fust, who certainly was a rich goldsmith of Mentz; whereupon Meerman, finding these statements at variance with possibility, boldly invents another theory, making the sufferers Koster's grandsons, who never printed, as far as is known, and the robber Corsellis himself; and, lastly, because six years elapsed between this asserted introduction and the publication of his *Exposicio*, and eleven years between this and any other publication from any Oxford press

Although these facts entirely confute the pretensions of Corsellis, there nevertheless remains the book itself, and unless some evidence can be produced, Oxford will still maintain the proud pre-eminence. Some of the most learned bibliographers entirely refuse their assent to the genuineness of the book. Middleton asserts that there must be an error of an x in the imprint, and produces many remarkable instances of similar typographical errors. This, however, is mere assertion; and as, in the Lambeth record, the best evidence is to be sought in the production itself, accordingly the work is printed with *cast* metal types, which are not proved to have been used by Koster at all, that art being invented by Gutenberg, Fust, and Schœffer at Mayence. The letter is of very elegant cut, the pages regular, and the whole work has the appearance of having been executed at a considerably advanced era of the art. Another and a good argument is, that the work has signatures, or marks for the binder at the foot of the page, such not having been used on the continent before 1472, by John Koethof at Cologne; and it is no refutation of this argument to say, as has been attempted by some, that many works executed by printers who did use signatures are without signatures; for the proof of a negative in one case is the poorest of all possible arguments of a positive in another. Let Caxton, therefore, be replaced in his old niche, the introducer of the art of printing into England.

Caxton.

William Caxton was born about the year 1412, in the Weald of Kent. His father was a wealthy merchant, trading in wool. He was brought up to the business of a mercer, and conducted himself so much to his master's satisfaction, that on his death he bequeathed him the then considerable sum of twenty marks. Caxton then proceeded, probably as the agent of the Mercers' Company, into the Low Countries. He must have been a man of some wealth and consideration, for in 1664 he and Richard Wethenhall were appointed by Edward IV. "ambassadors and special deputies" to continue and confirm a treaty of commerce between him and Philip duke of Burgundy; and, upon the marriage of Edward's sister Margaret with Charles duke of Burgundy, he was appointed to the household retinue of the princess, by whom he appears to have been treated with much familiarity and confidence; for at her instigation he first commenced his literary labours, and he mentions her as repeatedly commanding him to amend his English. His first work was a translation of the *Recuyell of the Historyes of Troye*, which he afterwards printed at Strasbourg, when his leisure had allowed him to turn his attention to the study of printing. The first production of his press is allowed to be the French *Recuyell* above mentioned, his second the *Oracion of John Russell on Charles Duke of Burgundy being created a Knight of the Garter*, which took place in 1469. Of his transactions between 1471 and 1474 there is no record; probably he was engaged in the diligent pursuit of the art, and preparing to transfer his materials to England, which he accomplished some time before 1477, when we find him printing in or near the Abbey of Westminster, of which Thomas Milling, bishop of Hereford, was at that time abbot. The first production of his English press was the *Game of Chess*, bearing date 1474, which work, however, some assert to have been printed by him at Cologne. The following is a specimen of this famous book, the initial letter being printed in red:



Thus ought the Quene be maad / ſhe ought to be a fair lady ſittynge in a chayer and crowned wyth a corone on her hed and cladd wyth a cloth of gold ⁊ a mantyll aboue furrid wyth ermynes

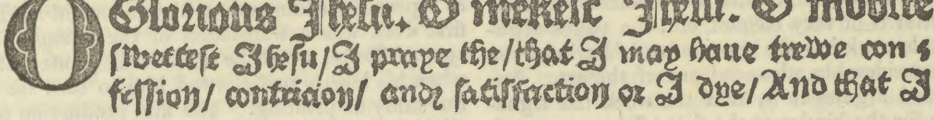
His next production was the *Boke of the hoole lyf of Jason*; but his first book bearing date and place in the colophon is the *Dictes and Sayings of Philosophres*, a translation from the French by the gallant Earl Rivers, "at Westmestre, the yere of our lord m. cccc. lxxvij." From this time he continued both to print and translate with great spirit. His "capital work" was a *Book of the noble Historyes of Kyng Arthur*, in 1485, the most beautiful production of his press.

There is but one copy of any of Caxton's works printed upon vellum; it is the *Doctrinal of Sapyence*. "Translated out of Frensshe in to Englysshe by wyllyam Caxton at Westmestre. Fynyshed the vij day of May the yere of our lord m.cccc.lxxix. Caxton me fieri fecit." This unique copy is in the library at Windsor, and it is in beautiful preservation. It is moreover doubly unique, for it contains an additional chapter, to be found in no other copy whatever, and which is entitled "Of the negligencies happening in the Masse and of the Remedies. Cap. lxiiij." It is a curious treatise of minute omissions and commissions likely to occur in the service of mass, with directions how to remedy such evils. Of their importance here are two specimens, "If by any negligence fyl (fall) any of the blood of the Sacrament on the *corporas*, or upon any of the vestments, then ought to cut off the piece on which it is fallen, and ought well to be washen, and that piece to be kept with the other relics." "And if the body of Jesu Christ, or any piece, fall upon the palé of the altar, or upon any of the vestments that ben blessed, the piece ought not to be cut off on which it is fallen, but it ought right well to be washen, and the washing to be given to the ministers for to drink, or else drink it himself." This singular treatise finishes with this grave confession, "This chapitre to fore I durst not sett in the booke, by cause it is not convenient ne appertaining that every lay man should know it et cetera." At the usual termination of this work is that colophon of Caxton which is given amongst the illustrations of this article in Plate CCCCXIV.; it is, however, considerably reduced.

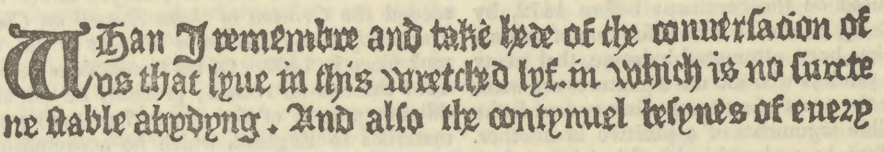
The Royal Library possesses another work of Caxton, which, as a *perfect* copy, is also unique. This is the "Subtyl Historyes and Fables of Esope. Translated out of Frenshe in to Englyshe by Wyllyam Caxton at Westmynstre In the yere of our lord m cccc lxxxiij Emprynted by the same the xxvj daye of Marche the yere of our lorde m cccc lxxxiiij And the fyrste yere of the regne of kyng Rycharde the thyrde." It consists of 142 leaves. Each fable is illustrated by a rude wood-cut, all of which are said to have been executed abroad, where similar editions of Æsop were frequently printed. They are, however, most probably copied; for there is nothing either in their design or execution that a most moderate artist might not perform; and this will equally apply to other wood-cuts interspersed in Caxton's works.

It has been said that the works of Caxton have been eagerly sought for by English bibliomaniacs. The most remarkable instances of this are the enormous prices given for some of them at the sale of the Duke of Roxburghe's library before mentioned. The *Chastysing of God's Children* was knocked down to Earl Spencer for L.146. The *Sessions Papers* were bought for the Society of Lincoln's Inn for L.378. The Duke of Devonshire gave L.351. 15s. for *The Mirrour of the World*, and L.180 for the *Kalendayr of the Shyppers*. Gower's *Confessio Amantis* produced L.366; *The Boke of Chyvalry*, L.336. The *Recuyell of the Historyes of Troye* gave rise to a startling contest. It was the identical copy presented by Caxton to Elizabeth Grey, queen of Edward IV. and sister of his patroness. "Sir Mark Sykes vigorously pushed on his courser till five hundred guineas were bidden; he then reined in the animal, and turned him gently on one side 'toward the green sward.' More hundreds are offered for the beautiful Elizabeth Grey's own copy. The hammer vibrates at nine hundred guineas. The sword of the marquess is in motion, and he makes another thrust—'One thousand pounds.' 'Let them be guineas,' said Mr Ridgway, and guineas they were. The marquess now recedes. He is determined upon a retreat; another such victory as the one he has just gained (the Valdarfar Boccaccio) must be destruction; and Mr Ridgway bears aloft the beauteous prize in question." (Dibdin.) At Mr Willett's sale *Tullius of Old Age* produced L.210, and became the property of the Duke of Devonshire.

The following are specimens of Caxton's *Pilgrimage of the Sowle*, and of the *Royal Book*:



O Glorious Jheſu. O mekeſt Jheſu. O mooſte
ſwetteſt Jheſu/ I praye the/ that I may haue trewe con-
feſſion/ contricion/ and ſatiſfaction or I dye/ And that I



When I remembre and take hede of the conuerſacion of
vs that lyue in this wretched lyf. in which is no ſurete
ne ſtable abydyng. And alſo the contynuel beſynes of euery

He must have been a man of wonderful perseverance and erudition, cultivated and enlarged by an extensive knowledge of books and the world. Of his industry and devotedness some idea may be formed, when Wynkyn de Worde, his successor, states, in his colophon to the *Vitæ Patrum*, that Caxton finished his translation of that work from French into English *on the last day of his life*. He died in 1494, being above fourscore years of age. His epitaph has been thus written by some friend unknown: "Of your charite pray for the soul of Mayster Willyam Caxton, that in hys tyme was a man of moche ornate and moche renommed wysdome and connynge, and decesed full crystenly the yere of our Lord MCCCCLXXXXI.

Moder of Merci shyld him from thorribul fynd,
And bryng hym to lyff eternal that neuer hath ynd."

The type used by Caxton is in design very inferior to that used upon the Continent even earlier than his period; but in the latter part of his life he very materially improved his founts, and some of his later productions are very elegantly cut. The design is peculiar to him, and is said to be in imitation of his own hand-writing; it bears, however, some resemblance to the types of Ulric Zell, from whom Caxton derived most of his instruction, and is something between *Secretary* and *Gothic*. He appears to have had two founts of *English*, three founts of *Great Primer*, one *Double Pica*, and one *Long Primer*.[1] He used very few ornamented initial letters, and those he did employ are very inferior in elegance to those of foreign printers. He preferred inserting a small capital letter within a large space, and leaving the interval to be filled up according to the taste of the illuminator, owing to which many excellent performances are destitute of these beautiful ornaments. Caxton's ink was not remarkable for depth of colour or richness; his paper was excellent; and he probably used presses of the same construction as the continental printers. His works are not very rare, but are highly prized by English collectors. Copies of one or more of his works are to be found in most collections of any pretension, and are well worthy of inspection. The number of his productions is sixty-two. Although Caxton was the first English printer, he was not the only one of his day, Wynkyn de Worde, Lettou and Machlinia, Hunte, Pynson, the Oxford printer whoever he may have been, and he of St Alban's, being his contemporaries.

Wynkyn de Worde

WYNKYN DE WORDE came, as we have already seen, from Germany with Caxton, and remained with him in the superintendence of his office until the day of his death, when he succeeded to the business. He was a native of Lorraine, and evidently a man of considerable information and taste, and of great spirit in the conduct of his affairs. After his succession to Caxton's business, he carried it on in the same premises for about six years, when he removed to the "Sygn of the Sonne in flete strete, against the condyth." De Worde appears to have immediately commenced a complete renovation of the art, cutting many new founts of all sizes, with vast improvement of the design and proportion; he moreover provided his contemporaries, then becoming very numerous, with type; and it is even said that some of the letter used by English printers less than a century ago are from his matrices, nay, that the punches are still in existence. He was the first (or Pynson) to introduce Roman letters into England, which he made use of amongst his Gothic to distinguish any thing remarkable, in the same manner as Italic is used in the present day. His works amount to the extraordinary number of four hundred and eight. "His books are, in general, distinguished by neatness and elegance, and are always free from professed immorality. The printer has liberally availed himself of such aid as could be procured from the sister art of engraving; although it must be confessed that by far the greater, if not the whole, number of wood engravings at this period are of foreign execution; nor is it without a smile that the typographical antiquary discovers the same cut introduced into works of a directly opposite nature."

In his *Instruction for Pilgrims to the Holy Land*, printed in 1523, the text of which is in Roman, and the marginal notes in Italics, he makes the first use in England of Greek, which is in moveable type; of Arabic and Hebrew, which are cut in wood; and the author complains that he is obliged to omit a third part, because the printer had no Hebrew types. Appended to the work are three Latin epistles, in which he makes use of Arabic.

His works are, of course, not so rare as those of his predecessor, but are nevertheless much sought after; and, when sold by the side of the Caxtons at the Duke of Roxburghe's sale, produced large prices. *Bartholomæus de Proprietatibus Rerum*, the first book printed on paper made in England, was bought by the Duke of Devonshire for L.70. 7s.

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[1] These are terms by which modern English printers distinguish the sizes of their type.

Chaucer's *Troyius and Cresseide*, L.43; Hawys' *Exemple of Vertu*, L.60; *Passetyme of Pleasure*, L.81; *Castell of Pleasure*, L.61; *The Moste Pyteful Hystorye of the Noble Appolyon, Kynge of Thyre*, L.110.

De Worde died about the year 1534. In his will, still in the Prerogative Office, dated 5th June 1534, he bequeaths many legacies of books to his friends and servants, with minute directions for payment of small creditors and forgiveness of debtors, betokening a conscientious and kindly disposition. His device is generally that of Caxton, with his own name added to the bottom; but he also used a much more complicated one, consisting of fleurs-de-lis, lions passant, portcullis, harts, roses, and other emblazonments of the later Plantagenets and the Tudors. A fac-simile of the former will be found in Plate CCCCXIV.

Lettou.

JOHN LETTOU and WILLIAM MACHLINIA printed separately and jointly before the death of Caxton, but were very inferior to him in every respect; their type being most especially barbarous. Their works are not very numerous, and are principally upon legal subjects; they printed the first edition of Lyttleton's Tenures.

Pynson.

RICHARD PYNSON was a Norman by birth, and studied the art of printing under his "worshipful master William Caxton." It would seem that he was an earlier printer than Wynkyn de Worde, having established an office before the death of Caxton. His first work is of date 1493, and was printed "*at the Temple-bar of London.*" He enjoyed high patronage, and was appointed by Henry VII. to be his printer before 1503. He is perhaps inferior to De Worde as a typographer, his first types being extremely rude. He afterwards used a fount of De Worde's, and another peculiar to himself in this country, probably imported from France. Some of his larger works, Fabian's Chronicle, Lord Berner's translation of Froissart (which are the first editions of these important additions to English literature), and some of his law-works, are very fine specimens of the art. His device was a curious compound of R and P, on a shield which is sometimes supported by two naked figures.

Early English printers.

Of Julian Notary, William Faques, Henry Pepwell, and others, it is unnecessary even to mention their names, inasmuch as they add little that is interesting to the history of English typography.

Grafton.

RICHARD GRAFTON, however, claims especial notice. He was by trade a grocer, although of good family. Of his education nothing appears; but he was one of the most voluminous authors of his time, having, by his own account, written a considerable portion of Hall's Chronicles, an Abridgment of the Chronicles of England, and a Manual of the same, a Chronicle at Large, and other books of historical character, under what circumstances is not known. In 1537 Grafton published Thomas Mathew's translation of the Bible, which was printed abroad, but where is not satisfactorily ascertained; and in 1538 the Testament translated by Miles Coverdale, which was printed at Paris by Francis Regnault. At this time it would not appear that English printers were in high estimation; for Lord Cromwell, desirous of having the Bible in the English language, thought it necessary to procure from Henry VIII. letters to the king of France for license to print it at Paris, and urged Bonner to tender his earnest assistance. Bonner entered upon the undertaking with such zeal, that in recompense he was soon afterwards appointed to the bishopric of Hereford. Miles Coverdale had charge of the correctness (see his letter, Gent.'s Mag. 1791), and Richard Grafton and Edward Whitchurch were the *proprietors;* but under what arrangement does not appear. When the work was on the point of completion, the Inquisitors of the Faith interfered, seized the sheets, and Grafton, Whitchurch, and Coverdale, were compelled to make precipitate flight. The avarice of the lieutenant-criminal induced him to sell the sheets for waste paper instead of destroying them, and they were in part repurchased. The Testament was intrusted to Francis Regnault, whose brother used the tasteful colophon which will be found in Plate CCCCXIV. Under the protection of Cromwell they next, after many difficulties, obtained their types and other materials from Paris, and the Bible was completed at London in 1539. "Thus they became printers themselves, which before this affair they never intended." The edition consisted of 2500 copies. Cromwell next procured for them a privilege (not an exclusive one, however) for printing the Scriptures for five years. Very shortly after the death of Lord Cromwell, Grafton was imprisoned for printing Mathew's Bible and the Great Bible, his former friend Bonner much exaggerating the case against him. The prosecution, however, was not followed up; but in a short time he was, with Whitchurch, appointed printer to Prince Edward, with special patents for printing all church-service books and primers. The document is curious. It recites that such "bookes had been prynted by strangiers in other and strange countreys, partely to the great losse and hynderance of our subjects, who both have the sufficient arte, feate and treade of prynting, and partely to the setting forthe the bysshopp of Rome's usurped auctoritie, and keping the same in contynuall memorye;" and that, therefore, of his "grace especiall, he had granted and geven privilege to our wel-biloved subjects Richard Grafton and Edward Whitchurch, citezeins of London," exclusive liberty to print all such books for seven years, upon pain of forfeiture of all such books printed elsewhere.

One Richard Grafton, supposed to be the above, was member of parliament for the city of London in 1553–54, and also in 1556–57, and in 1562 was member for Coventry. He is supposed to have died about 1572, and not in very affluent circumstances. He used a punning, or, as the heralds would call it, a canting device, of a young tree or *graft* growing out of a *tun*. His works are distinguished for their beauty, and are very numerous and costly. He was one of the most careful and meritorious of English printers.

These are the titles of a few of his early Bibles, &c.

The Byble, 1537, folio. "The Byble, which is all the holy Scripture: In whych are contayned the Olde and Newe Testament truly and purely translated into Englysh by Thomas Mathew. Esaye 1 ☞ Hearcken to ye heauens, and thou earth geaue eare: For the Lorde speaketh. M.D.XXXVII." The title of the New Testament is, "The newe Testament of our sauyor Jesu Christ, newly and dylygently translated into Englyshe, with Annotacions in the Mergent to help the Reader to the vnderstandyng of the Texte." This was printed in France.

The New Testament, Latin and English. 1538. Octavo. "The new testament both in Latin and English after the vulgare texte; which is red in the churche. Translated and corrected by Myles Couerdale: and prynted in Paris, by Fraunces Regnault. M. CCCCC. XXXVIII in Nouembre. Prynted for Richard Grafton and Edward Whitchurch. cytezens of London. Cum gratia & priuilegio regis."

The Byble in Englysshe. 1539. Folio. "The Byble in Englyshe, that is to saye the content of all the holy Scrypture, bothe of y^e^ olde, and newe testament, truly translated after the veryte of the Hebrue and Greke textes, by y^e^ dylygent studye of dyuerse excellent learned men, expert in the forsayde tongues. *Prynted by Rychard Grafton, and Edward Whitchurche. Cum priuilegio—solum.* 1539." This is a very superb book, and is the one which was commenced at Paris and finished at London under the circumstances before related.

NEWE TESTAMENT IN ENGLYSSHE. 1540. Quarto. "Translated after the texte of Master Erasmus of Roterodame."

THE PRYMER. English and Latin. 1540. Octavo.

THE BYBLE IN ENGLYSHE. 1540. Folio. A noble volume, called, from the preface, Cranmer's Byble.

History.

The Byble in Englyshe. 1541. Folio. "The Byble in Englyshe of the largest and greatest volume, auctorised and appoynted by the commaundement of oure moost redoubted prynce and soueraygne Lorde, Kynge Henrye the VIII, supreme head of this his churche and realme of Englande: to be frequented and vsed in euery Churche within this his sayd realme, accordyng to the tenourc of hys former Jniunctions geuen in that behalfe. Ouersene and perused at the cōmaundemēt of the kynges hyghnes, by the ryght reuerend fathers in God Cuthbert byshop of Duresme, and Nicholas, bisshop of Rochester." The lines of the title are printed alternately red and black.

Such, with many other manuals, primers, &c. were the productions of this most eminent British typographer.

John Day.

John Day was a printer of much eminence; and his works are numerous, beautiful, and useful.

Isaac Jaggard, Edward Blount, &c.

The first complete edition of Shakspeare's Plays was printed by Isaac Jaggard and Edward Blount, in folio, in 1623. Of his single plays, the earliest is "The first part of the Contention betwixt the two famous Houses of Yorke and Lancaster," which was printed by "Thomas Creed for Thomas Millington, and are to be sold at his shop, under Saint Peter's Church, Cornwall" (Cornhill), in 1594. These plays were printed by various typographers, amongst whom appear the names of George Eld, Valentine Simmes, R. Young, John Robson, and others who only give their initials.

Peter Parker.

The first edition of Milton's Paradise Lost was printed in quarto by Peter Parker in the year 1667; the Paradise Regained in 1671.

During the troublesome times that preceded the great rebellion, the Puritans, jealously watched and persecuted, introduced the anomaly of ambulatory presses, which were constantly removed from town to town to escape the vigilance of the Star-Chamber. At these presses many of Milton's controversial pamphlets were printed; and it is even said that the identical press at which the Areopagitica was printed is still in existence, and was lately in the possession of Mr Valpy, the well-known printer of the Variorum Classics.

It is a very pleasing reflection, that the earlier practitioners of the art did, by their uniform good character and religious turn, tend much to render their profession productive of a highly moral class of literature, and to raise it in the estimation of all men. Had they been less respectable, had they turned their attention to the many ribald and tasteless writings of those times, the effect of the new art would have been to degrade literature and lower morals, to delay the spread of knowledge, and to give a depression to the character of the art and its practitioners, from which possibly they might never have recovered. These excellent and learned men appear to have received their temporal reward, in public estimation, sufficient wealth, and a length of years beyond the ordinary term of mortality.

Oxford.

Setting aside the claim of Corsellis, printing was first practised at Oxford by Theoderic Rood and Thomas Hunte from 1480 to 1485. In Rymer, vol. xv. is a grant by Queen Elizabeth to Thomas Cooper, clerk of Oxford, for the exclusive printing of his Latin Dictionary. In 1585 a printing press was established at the expense of the Earl of Leicester, chancellor of the university. Joseph Barnes was appointed printer to the university in 1585.

Cambrid

At Cambridge John Siberch printed in 1521, when Erasmus resided there, and probably executed some of his books. Thomas Thomas, M. A. was the first printer to the university in 1584.

St Alban

At St Alban's printing was very early practised, certainly in the year 1480. It would appear that the printer was a schoolmaster. It has been asserted, but without shadow of argument, that printing was introduced here many years before Caxton.

Early Sco tish prin ers.

Printing was not introduced into Scotland till thirty years after Caxton had set up his press at Westminster. Under the patronage of James IV., who was a zealous encourager of learning and the useful arts, Walter Chepman and Andro Myllar established the first printing press at Edinburgh, as appears by a royal privilege granted to them in 1507.[1]

The only publications known to have issued from the press of Myllar and Chepman are a collection of pamphlets, chiefly metrical romances and ballads, in 1508, of which an imperfect copy is preserved in the Advocates' Library;[2] and the Scottish Service Book, including the Legends of the Scottish Saints, commonly called the Breviary of Aberdeen, in 1509.[3]

It is difficult to account for the discontinuance of printing in Scotland for about twenty years after this time: probably the disastrous events at the close of the reign of James IV. may have contributed to render it an unprofitable trade; but in its revival by Davidson there was no deterioration, either in the magnitude and importance of the works attempted, or in the mode in which the mechanical part was executed. It was probably about the year 1536 that he printed, in a black-letter folio, "The History and Croniklis of Scotland, compilit and newly correckit be the Reuerend and Noble Clerke Maister Hector Boece. Translatit laitly be Maister Johne Bellenden. Imprentit in Edinburgh be Thomas Davidson, dwelling fornent the Frere Wynd;" and in 1540 he printed the whole works of Sir David Lindsay.

Davidson was succeeded by Lekprevik, Vautrollier, and others; but none were distinguished as printers till the time of Ruddiman.

A mere catalogue of printers would afford little amusement, and less instruction; especially since the productions of the English press, save in the works of the printers above named, not only exhibited no advance, but even much deterioration, in most requisites of good printing. Indeed, to so low a point had the art fallen, and so little spirit was exhibited by English typographers, that the regeneration was left to an alien, whose perception of the inferiority and capacity of improvement at once raised the art to the level of the finest productions of Bodoni and Barbou.

Baskerville, Bulmer, &c.

This was John Baskerville, a japanner of Birmingham, who, having realized a considerable fortune, turned his attention to cutting punches for type, and succeeded in producing a series of founts of remarkable beauty, so excellently proportioned, and standing so well, that the best of modern type-founders (and this seems the Augustan age of type-founding) have done no more than vary the proportions and refine the more delicate lines and strokes. Added to this, his press-work is of most excellent quality; his paper the choicest that could be procured; and his ink has a richness of tone, the mode of producing which has died with him. The works of Baskerville are amongst the choicest that can adorn a library. He died in 1775. His types and punches were purchased to print the splendid edition of Voltaire's works at Paris. He was worthily succeeded by BULMER, whose magnificent Shakspeare and MILTON are amongst the most superb books ever issued from the press, and, with Macklin's Bible and Ritchie's, Bensly's Hume, and other works, may be fearlessly produced to win for this country the palm of fine printing; whilst in Scotland THOMAS RUDDIMAN, and the two FOULIS, may challenge the prize of classical typography from Aldus and the Stephani. Indeed the larger Greek types of the Foulis are without parallel for grandeur; their press-work is beautiful, and their correctness beyond all praise.

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[1] "James, &c. To al and sindrj our officiaris liegis and subdittis quham it efferis, quhais knawlage thir our lettres salcum, greting; Wit ye that forsamekill as our lovittis servitouris Walter Chepman and Andro Millar, burgessis of our burgh of Edinburgh, has at our instance and request, for our plesour, the honour and proffit of our Realme and liegis, takin on thame to furnis and bring hame ane prent, with all stuff belangand tharto, and expert men to use the samyne, for imprenting within our Realme of the bukis of our Lawis, actis of parliament, croniclis, mess bukis, and portuus efter the use of our Realme, with addicions and legendis of Scottis sanctis, now gaderit to be ekit tharto, and al utheris bukis that salbe sene necessar, and to sel the sammyn for competent pricis, be our avis and discrecioun thair labouris and expens being considerit," &c.

"Geven under our prive Sel at Edinburgh the xv day of September, and of our Regne the xx^{ti} yer."

[2] These pamphlets were reprinted in a handsome quarto volume, edited by Mr David Laing. The preface contains much accurate information regarding early printing in Scotland.

[3] Of this Service Book, which forms two volumes octavo, handsomely printed with red and black letter, in the years 1509 and 1510, a beautiful copy is preserved in the University Library of Edinburgh. As the name and device of Walter Chepman occur in the work, without any mention being made of his partner, we are led to the conclusion that Andro Myllar, if then alive, had relinquished his share in the concern.

Modern printers, with all their faults, are not degenerate successors of these worthies. The works from present offices that make pretensions to fine printing need not be ashamed of comparison with these *chef-d'œuvres;* whilst, from the vast improvements in the mechanism of the art in all its branches, paper, presses, ink, type, and other adjuncts, the average of the printing of the present day is infinitely superior to that of the last century. But in what relates to practical skill, correctness, taste, and diligence, we cannot hope to excel, though we may perhaps equal, these departed masters.

PRACTICAL PRINTING.

See Plate CCCCXV. The first operation when the new fount[1] has entered the doors of the printing-office, is to *lay* it in the *cases.* These are always in pairs, the *upper case* being divided into equal spaces or *boxes;* the part on the left of the broader division being appropriated to CAPITAL letters, figures, accented letters, particular *sorts,* &c.; that on the right to SMALL CAPITALS and miscellaneous characters. The letters and figures are arranged in alphabetical and numerical order, from left to right. The *lower case* is divided into unequal portions, according to the average occurrence of the particular letters; for the compositor (the workman whose duty it is to lay the fount, and afterwards to place together or *compose* the separate types into words) never looks at the face of the letter he picks up, but unhesitatingly plunges his fingers into any box, being sure that the letter he picks out thence is the one to which that box is appropriated, and consequently the one he requires. As there is no external mark or guide attached to the different boxes to denote the letters they contain, a stranger is not a little surprised and mystified at the eccentric movements of the workman's hand. Accordingly, it will be observed, upon looking to the engraving, that the letter e has a box one half larger than any other, c, d, m, n, h, u, t, i, s, o, a, r, twice the size of b, l, v, k, f, g, y, p, or w, and four times the size of z, x, j, q, or the [] crotchets, full points, &c. These boxes are not arranged in alphabetical or any other order, but as experience has shown how the case may be most conveniently divided into the requisite proportions. There are also other pairs of cases similarly arranged for the *italic* letters. The fount is therefore *laid* or distributed in these boxes, when the following are found to be some of the proportions of the letters in a fount of pica of 800 lbs. weight:

Capitals, of each from 400 to 600,
Small capitals, from 150 to 300,

a	8,500,	b	1,600,	j	400,	z	200,
e	12,000,	c	3,000,	k	800,	&	200,
i	8,000,	d	4,000,	m	3,000,	,	4,500,
o	8,000,	f	2,500,	n	8,000,	.	2,000,
u	3,400,	h	6,400,	q	500,	&	200,

the whole fount comprehending the number of 150,000 letters, spaces, and figures.

The compositor having placed his copy upon a little-used part of the upper case, and having received the necessary directions, takes up an instrument called a *composing-stick* (which, as well as the way of holding it and its use, will be better understood by reference to the drawing than by description, see Plate CCCCXV.), and sliding that inner moveable portion fastened by a screw, wider or closer according to the desired width of the page, cuts to the exact size a piece of brass rule, called the *setting-rule,* which enables the letters to slip down without any obstruction from the screw-holes of the stick, or the nicks by which one fount is distinguished from another. He then reads the first few words of his copy, takes first a capital letter from the upper case, the succeeding letters from the lower case, and at the conclusion of the word a *space,* which is merely the shank of a letter without any face, and not so high as a letter by about one-fourth part. This therefore separates each word by a space, which cannot appear upon the paper, because the ink cannot be distributed upon it except by mismanagement, in which case it is a fearful blotch upon a fair page, and must have been observed by most readers. He then proceeds with his next word, which will probably consist of lower-case letters only, and so proceeds until he has arrived at the end of his line. It is most likely, however, that the words he has occasion to compose, with the necessary spaces, will not fill up the exact width of the line, and that there will be sometimes too much, sometimes too little, room for getting in the next or part of the next word. In this case he has to consider whether it will be better to crowd the line and get in the next syllable, or make the line more open and take it over to the next line; his care being that his matter, when composed, shall not look too white or too dark. Having decided, he takes out the spaces he has inserted, and puts in their stead others of greater or less width, as the case may require, in such a manner that on the face of the line being touched it shall not feel loose, or that it shall not require any particular pressure to force down the last letter into its proper place. This being accomplished in an artist-like manner, he takes out his setting-rule, and places it in front of his line, and with a gentle pressure of the thumb forces both back into the composing-stick; he then proceeds in a similar manner with other lines, until his stick is very nearly full, when, placing it upon the *frame* on which the cases are, his setting-rule being in front, he lifts his lines out of the stick in order to place them upon a proper instrument, called a *galley.* If, however, the matter is to be *leaded,* that is, if the lines of types are to be more apart than usual, the process is a little different. The compositor then has before him a quantity of pieces of metal called *leads,* of the exact width of the page, only one fourth, one sixth, or one eighth as wide as the type, and not higher than spaces. After composing a line, before moving his setting-rule, he takes one or more of these and places it before the line, then places the setting-rule, and so proceeds. Having thus gone on until a considerable quantity of matter is composed, the compositor next proceeds to make it up into pages, and then into sheets. First, taking by portions as many lines of his matter as are to be contained in a page, he adds thereto at the bottom a line of quadrats, which are the same as spaces, but much larger, being three, four, five, or six times as long as they are broad, and places at the top the folio of the page and the *running head*, or line which indicates the title of the work or the subject of the page or chapter, and then adds such leads or other things as may be necessary, taking care that in the first page he places the *signature* (a letter of the alphabet, intended for a guide to the binder), because by keeping this always outside, and the second signature on the next leaf, he cannot fold the sheet wrong. He next ties it tightly round with page-cord, and places it upon a piece of coarse paper. Having made up as many pages as the sheet consists of, viz. four if folio, eight if 4to, sixteen if 8vo, he next lays them down upon the *imposing-stone* (a large slab of marble let into a frame) in the necessary order. This is, to a stranger, a very curious arrangement; they appear to him to be placed at random, without any design or fixed rule, and as they are necessarily laid down in two divisions, one for each side of the sheet, one is of consequence the very reverse of the other. He may very easily instruct himself, however; for if he take a sheet of paper, and fold it into any required size, marking the folios with a pencil, and then open it without cutting, he will find they fall in curious irregularity. The pages are laid down on the stone reverse of the arrangement they have on the paper; for it must be remembered that every type and every page is like a seal, the reverse of the impression it leaves; consequently, were the pages laid down as on a marked paper, viz. the first page on the right hand, it would, in type, be at the extreme left, and so on. The following schemes of the *laying down* and *imposition* of a sheet of 4to, 8vo, and 12mo, will give some idea of the apparent confusion of this process.

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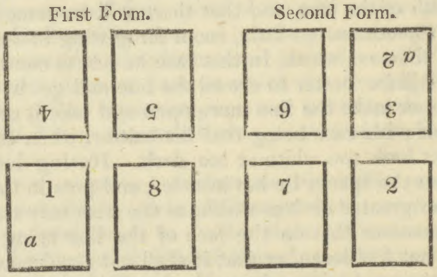
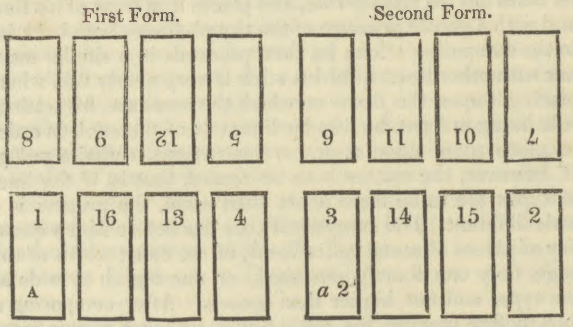
[1] A fount is any weight of type consisting of every letter, space, quadrat, &c. in certain proportions, instances of which are given below. See TYPE-FOUNDING.

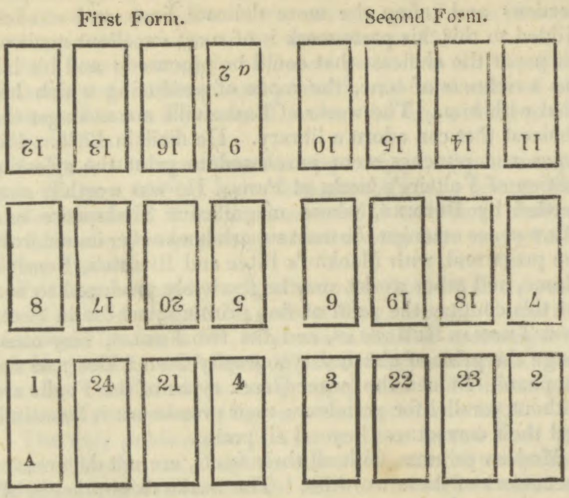
Imposition of a Sheet of 4to.



Imposition of a Sheet of 8vo.



Imposition of a Sheet of 12mo.



The pages being properly disposed upon the imposing-stone, the compositor next takes a *chase* (a frame of iron divided by cross bars into compartments, the inner angles of which are made rectangular with much care) and places it over them, and then having ascertained the size of the paper to be used, adjusts pieces of wood or metal, called furniture, between them. Within the chase, but next to the pages, he now places other pieces of iron called *side* and *foot sticks*, which are rather wider at one end than the other, and between these and the chase small pieces of wood, which decrease in width in the same proportion as the side-stick, and which are called *quoins*. With a *shooting-stick* (which formidably-named weapon is merely a piece of hard wood, a foot in length, an inch and a half in width, and half an inch in thickness) and a mallet he forces the quoins towards the thicker ends of the side and foot sticks, which consequently act as gradual and most powerful wedges, forcing the separate pieces of type to become a compact and almost united body, so that, every side of the pages being again and again *locked up*, the whole mass, consisting of many thousand letters, may be lifted unbroken from the stone. This united mass is called a *form;* that one which contains the first page being called the *outer form*, the other the *inner*.

The compositor is paid by the number of thousands of letters he composes,[1] which is thus ascertained. The letter m, being on a shank which is perfectly square, is taken as the standard; he ascertains how many ms the page is in length, including the running head and the white line at the bottom; that is, in fact, how many lines of the particular type used there would be in a page of the given size, supposing it were all solid type; next, how many ms it is in width, that is, how many times the letter m would be repeated in a line of the given length were it to consist of nothing but ms. This latter sum is then doubled, because experience shows that the average width of the letters is one half of the depth, or one half of that of the letter m.

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[1] In 1804, after a protracted litigation before the Court of Session, the journeymen compositors of Edinburgh succeeded in obtaining the sanction of the Court for an advance of one penny per thousand letters, or, upon an average, about one fourth on the prices of their work. The grounds upon which the Court rested this decision were, that the wages were much too low; that they had remained for forty years unaltered, whilst the price of the necessaries of life had very much increased; that it was proper to avoid a rise of wages which might lead to idleness, but equally necessary to place the workmen upon a respectable footing, so as to enable them to do their work properly, and also to encourage them in cultivating and acquiring that degree of literature by which the public must infallibly be benefited; and that the fair criterion was, to make the wages of Edinburgh bear the same proportion to those of London which they did in the year 1785, before the London prices were raised.

That a court of law, whose province it is, not to legislate, but to apply and enforce existing statutes, should have entertained a question regarding the price of labour, for the regulation of which there not only existed no law, but which had never been deemed a fit subject for legislative interference, appears to be a very singular incident in the history of judicial procedure. The prices thus fixed, however (namely, 4½d. per 1000 for book-work, with an additional halfpenny if nonpareil, and a penny if pearl, and 5½d. for law-papers and jobs), being regarded as not unreasonable, have ever since been adhered to by every respectable establishment in Edinburgh.

The length of the page is then multiplied by the product of this doubled width, then by the number of pages in the sheet, and the result will give the average number of letters in the sheet. This will be much better understood by the following *casting up* of a sheet of 8vo in pica.

Number of ms long....................	47
... ms wide, 24 × 2.........	48
	376
	188
	2256
Number of pages in a sheet of 8vo......	16
	13536
	2256
	36096

The compositor therefore is paid for composing 36,000 letters; for odd figures are dropped, unless they exceed 500, when they are paid for as if they completed another 1000. If the sheet be of solid type, and of ordinary size, the price paid in London is sixpence per 1000 letters; if the small type called minion, sixpence farthing; if nonparcil, sevenpence; if pearl, eightpence. If, however, the type be leaded, the price is a farthing per 1000 less; and if the work be composed from print copy, the price is three farthings per 1000 less than it would be paid if the copy were manuscript. Works in foreign languages are paid one halfpenny per 1000 more in the type of ordinary size, three farthings per 1000 more in the smaller. Greek with leads and without accents is eightpence halfpenny per 1000; without leads or accents, eightpence three farthings; with accents, tenpence farthing. Hebrew, Arabic, Syriac, &c. are paid double. The compositor, it appears, must therefore pick up 72,000 letters before he can receive an ordinary week's wages, must moreover correct all the blunders mischance or carelessness may have occasioned; and must make up his matter into pages and impose them, with great expenditure of time in many other particulars; but, as is hereafter described, he must have previously placed every one of these 72,000 into the appropriate boxes whence he has withdrawn them in composition. Now it is usually reckoned that this latter operation, called *distributing*, occupies one fourth of a compositor's time, and the other operations another fourth; he has therefore only one half of his time for composition; consequently he must pick up letters at the rate of 144,000 per week, 24,000 per day, or 2000 per hour. His hand has in picking up each letter to traverse a considerable space, say six inches, and back again, to his composing-stick. His rapidity of motion is therefore wonderful, and the exertion is so long continued, that the business, although apparently a light one, is in fact extremely laborious. The number of thousands of letters in a sheet necessarily varies with the size of the type, width and length of the page, and the number of the pages. The casting up above given is a solid pica sheet of demy octavo, of moderate page; a similar sheet of brevier would contain 81,000 letters, and the cost of composing it would be L.2. 0s. 6d. Single tables, forming one uninterrupted mass of type, will sometimes contain 250,000 letters; and the labour of the compositor being very great in getting up tables, he is paid double. Consequently the cost of composing such a table in pearl or diamond (see the 13th of Bell's Chronological Tables, 4th edit.) would be not less than L.16. 13s. 6d., without extra charges. Yet this infinity of types, by the power of the wedge-formed side-sticks and quoins, is formed into so solid a mass as to be moved without much danger of disruption.

The sheet being now imposed, an impression is taken, called a proof, which is carried down to the reader, who, having folded the proof in the necessary manner, first looks over the signatures, next ascertains whether the sheet commences with the right signature and folio, and then looks to the following folios. He now looks over the running heads, inspects the proof to see that it has been imposed in the proper furniture, that the chapters are numbered rightly, and that the other directions have been correctly attended to, marking whatever he finds wrong. Having carefully done this, he places the proof before him, with the copy at his left hand, and proceeds to read the proof over with the greatest minuteness, referring incessantly to the copy that no word may escape him, correcting the capitals or italics, or any other peculiarities, noting continually whether every portion of the composition has been executed in a workman-like manner; and having fully satisfied himself upon all technical points, he calls his reading-boy, who, taking the copy, reads in a clear voice, but with great rapidity and the least possible attention to sound, sense, pauses, or cadences, the precise words placed before him, inserting, without pause or embarrassment, from the most crabbed or intricate copy, every interlineation, note, or side-note. The gabble of these boys in a reading-room, where there are three or four reading, is most amusing, a stranger hearing the utmost confusion of tongues, strange unconnected sentences, and most monotonous tones; the readers plodding at their several tasks with the most iron composure, not in the least disturbed by the Babel around them. They follow carefully every word, marking every error, or pausing to assist in deciphering every unknown or foreign word. This first reading is strictly confined to making the proof an exact copy of the manuscript, and ascertaining the competency of the compositor, consequently first readers are generally intelligent and well-educated compositors, whose practical knowledge enables them to detect the most trivial technical deficiencies. Having thus a second time perused the proof, and carefully marked upon the copy the commencement, signature, and folio of the succeeding sheet, he sends it by his reading-boy to the composing-room to be corrected by the workmen who have taken share in the composition. These immediately divide the proof amongst them, and each, taking that portion of it which contains the matter he had composed, and going to his cases, gathers the letters marked as corrections in the margin, together with a quantity of spaces of all sizes, and returns to the forms, which in the meanwhile one of them has *laid up* on the imposing-stones and unlocked. He then with a blunt bodkin lifts up each line in which a correction is required, draws out the wrong letter and inserts the right one, adjusting the spaces in such a way as to compensate for the increased or diminished size of the letter substituted, overrunning carefully several lines should any word have been added or struck out, so that the spacing may be uniform, and the corrected matter exhibit no proof whatever of any alteration having been necessary. This is an operation requiring much practice and skill; and here is shown the value of attention in the preliminary operations. Should the types have been carelessly laid or improperly distributed, should the workman have been careless in composition, capitalling, or spacing, he will consume as much time in amending his errors as in composing his matter, to the great detriment of his work, the injury and inconvenience of his employer and his companions, and great delay in every part of the printing-office. Thus every compositor having taken his share, another proof is pulled, which, with the original proof, is taken to the same first reader, who compares the one with the other, and ascertains that his marks have been carefully attended to, in default of which, he again sends it up to be corrected; but should he find his revision satisfactory, he sends the second proof with the copy to the second reader, by whom it undergoes the same careful inspection; but this time, most technical objections being rectified, the reader observes whether the author's language be good and intelligible; if not, he makes such queries on the margin as his experience may suggest; and having again followed his reading-boy, he sends it up to the compositor, where it again undergoes correction, and a proof being very carefully pulled, it is sent down to the same reader, who revises his marks and transfers the queries. The proof is then sent, generally with the copy, to the author for his perusal, and he having made such alterations as he thinks necessary, sends it back to the printing-office for correction. With the proper attention to these marks the printer's responsibility as to correctness ceases, and the sheet is now ready for press.

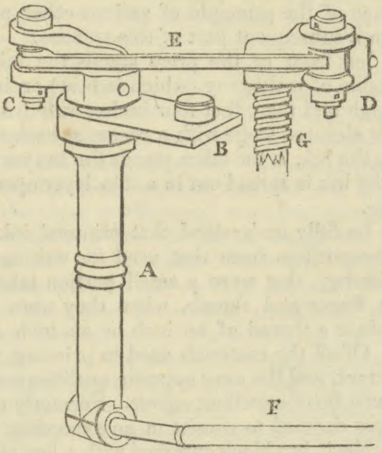
It need scarcely be remarked, that "correctness of the press" is a very material feature in every work, and more especially in those of a scientific nature. When the attention and the mind are devoted to the train of some close argument, or passage of surpassing beauty, it is surprising how easily an error of the press, even although it may not injure the sense, and may be as evident "as the sun at noon," will destroy the charm, and break the "thread of the discourse;" and even in works of ordinary reading they are exceedingly offensive. Many curious anecdotes are related of the methods which the earlier printers adopted to attain correctness. It was the glory of the early literati to take charge of the accuracy of new works; and, in return, the value and sale of each edition varied with the skill and reputation of the corrector. Of these Erasmus is an illustrious proof. Many of the first printers were led to the practice of the art by their love of learning, and their anxiety to promote it by the production of classic authors. Hence several are better known in the world of learning than in the circle of bibliographers; as the editors and correctors of valuable works, than as the careful or beautiful printers of them. Aldus, it is true, has so admirably succeeded in both characters, that he has fully established his double fame; but whether he most valued himself upon his learning or his skill may be doubted. It would appear from his letters that he considered it as his chiefest duty to correct every sheet that passed through his press. In all his bustle in preparing every material in use in his art, in all his occupations public and private, this important duty was never neglected. He tells us, "that he has hardly time to inspect, much less to correct, the sheets which are executed in his office; that his days and his nights are devoted to the preparation of fit materials; and that he can scarcely take food or strengthen his stomach, owing to the multiplicity and pressure of business; meanwhile," adds he, "with both hands occupied, and surrounded by pressmen who are clamorous for work, there is scarcely time even to blow one's nose;" nor did his son or grandson depart from his ways, but did themselves insure the correctness of their works, even when the latter had risen to wealth and eminence, and enjoyed the laborious dignity of a professor's chair. The beautiful Greek works of the Stephani are especially valued for their correctness. Stephens corrected his own press with intense labour and minuteness, and is reported to have adopted a singular plan for obtaining perfect similarity to the copy, by employing females who had not the slightest knowledge of the Greek characters or language to compare every letter of the proof with the manuscript; a labour so intense as to be almost incredible. He is moreover said to have hung up proofs on the doors of his printing-office, and to have amply rewarded any who could detect inaccuracies therein. Coverdale, it will be recollected, corrected the first English Bible and Testament, and received a bishopric as his reward.

The experience of every printer will furnish a host of laughable errors; and indeed these defects have been deemed of such importance as to deserve preservation. (D'Israeli's *Curiosities of Literature.*) The omission of the word *not* from the seventh commandment, in an edition of the Bible, printed by the Stationers' Company, is well known; and the company richly deserved the severe fine they incurred for spreading the immoral command, "Thou shalt commit adultery." The Bible so misprinted has received the name of the "Adultery Bible;" and a copy is preserved in the British Museum, the edition having been carefully suppressed. There is another Bible known as the "Vinegar Bible," from a misprint in the 20th chapter of St Luke, where "Parable of the Vinegar" is printed for "Parable of the Vineyard;" this proceeded from the Clarendon press. In the reign of Charles I. a very curious traffic in Bibles, &c. arose; they were printed by any one who chose, and imported in vast numbers from abroad. It will readily be imagined that these were made for *sale*, not for *use*, and that they abounded with egregious errors; but, what is worse than this, they were full of mistranslations and interpolations, and the omissions were fearful. All these were done as much by design as by accident, the Romanists and sectaries taking the opportunity of advancing their own tenets by interpolating and altering texts to suit their views. These monstrous anomalies produced, however, some good; they occasioned the necessity of the authorized version now in use, and printed under such authority as insures perfect fidelity, whilst there is sufficient competition to make it impossible that the Word of God can ever become a sealed book to the humblest and poorest Christian. Some of the blunders in these editions are sufficiently absurd to overcome the repugnance which must naturally be felt at such license. Thus, in Luke xxi. 28, *condemnation* has been misprinted for *redemption*. In Field's Bible of 1653, called the Pearl Bible, Rom. vi. 13, we find "Neither yield ye your members as instruments of *righteousness* unto sin," for *unrighteousness;* and 1 Cor. vi. 9, "Know ye not that the unrighteous *shall inherit* the kingdom of God?" for *shall not inherit.* It is said that these corruptions are in great measure owing to Field's cupidity, and that he received a bribe of L.1500 from the Independents to alter the text in Acts vi. 3, to sanction the right of the people to appoint their own pastors, "Wherefore, brethren, look ye out among you seven men of honest report, full of the Holy Ghost and wisdom, whom *ye* may appoint over this business," instead of *we.* This Bible is notorious, and, strange to say, valued, for its gross incorrectness. It is asserted that no less than six thousand errors of greater or less magnitude have been noted in it. But the most extraordinary example of carelessness is presented by the Vulgate the printing of which was sedulously superintended by no less an authority than Sextus V., a curious example of the infallibility of the pope. To the astonishment of the world, it swarmed with errors; and a whimsical attempt was made to remedy the defects, by pasting printed slips of paper over the erroneous passages. As this, however, was exceedingly laughable, the papal authority was exerted to the utmost to call in the edition, and with such effect, that it soon became very scarce, and a copy of it has produced the disproportionate sum of sixty guineas. To add to the absurdity, the volume contains a bull from the pope anathematising and excommunicating all printers who, in reprinting it, should make any alteration in the text. The monkish editor of *The Anatomy of the Mass*, printed in 1561, a work consisting of 172 pages of text and fifteen pages of errata, very amusingly accounts for these mistakes by attributing them to the artifice of Satan, who caused the printers to commit such numerous blunders; but he does not inform us whether it was really the archangel fallen, or only his minor satellite, the printer's devil. The editor of an Ethiopic version of St Paul's Epistles innocently confesses, in palliation of his errors, "that they who printed the work could not read, and we could not print: they helped us and we helped them, as the blind helps the blind."

The sheet being printed off in the way hereafter to be described, and the forms returned by the pressmen to the composing-room, and very carefully washed with lye, and rinsed with water, the compositor lays up the forms on a letter-board, and there unlocks them. Each compositor employed on the work then takes a share of the letter, and, wetting the face of it plentifully with a sponge, which causes the types to adhere sufficiently to prevent accidents, yet not so much as to retard the workman, takes up a portion on his setting-rule, with the nick upwards, and the face turned towards him; he then takes between his fingers and thumb a few letters, gives a rapid glance at the face to see what letters they are, and then passing his hand rapidly over the cases, drops each into its appropriate box. In this operation the greatest attention is necessary, for it must be remembered, that every letter dropped into a wrong box in distributing is sure to cause an error in composing; for the workman, as before stated, never looks at the letter he takes up, relying upon the correctness of the distribution. Compositors, therefore, should be especially careful, when learning their business, not to sacrifice certainty to swiftness; for in this instance most especially is it found that too much haste is little speed. If the rapidity of motion in composition strikes the stranger with wonder, what must that of distribution occasion? Most compositors distribute four times as rapidly as they compose; if, therefore, he pick up two thousand letters in an hour, he would distribute eight or ten thousand, or about three per second. His letter being properly distributed, he again proceeds to compose in the manner before described, until the work is finished. The number of times the letter is returned must depend upon the size of the fount. A thousand pounds weight of types would get up five or six sheets, and, therefore, in a fair octavo volume, the letter would be returned five or six times.

The Press is the machine whereby impressions are obtained of the type, when set up by the compositor as above described. On the skill and care of the pressmen depend the beauty of the work. If the press-work be not good, all the labour of the compositor is thrown away; his work makes no respectable appearance, and the master gets no credit.

It has already been mentioned, that very little alteration had been made in the printing press from the time of the first printers to that of Blaew of Amsterdam, about 1620. Blaew's improvements, although of immense advantage, only consisted in alterations in the details, and not in the principle. Blaew's presses have in their turn been superseded by those of Lord Stanhope; and very few are in existence, in England at least, save in old offices, where they are used as proof-presses, or kept merely as curiosities. A description of a bygone piece of mechanism would be of little utility; to show, however, Lord Stanhope's ingenious invention, it is necessary to make the reader understand the original construction. As a great part of the old press is retained in the new, one description will serve for both; premising that the old presses, as well as those first fitted with the Stanhope power, were of wood, but that very soon the latter were constructed of iron, and that, in consequence, the general appearance of the press was much altered. A press then consisted of two upright pieces of immense strength, which rose perpendicularly from the floor to the height of six feet and a half, and were connected with cross pieces. From about the middle of each of these a slide, called a rib, projected at right angles, and perfectly parallel to each other; a spindle with a powerful screw, kept in its place by these cross pieces, worked in a box called a hose, by means of a bar or lever inserted in it; the toe of the spindle worked in a sort of cup fixed upon a large solid block of mahogany, having the face planed perfectly smooth, and called the platten. It will be evident, that when the bar is pulled down, the spindle will descend in proportion to the worm of its screw, and force down the platten to precisely the same degree, and with great power. A table was made to run in and out upon the above-mentioned ribs; upon this was the form of type; when run in, it was exactly under the platten, and having been previously inked, and the paper laid on it, the bar was pulled over, the spindle, platten, &c. descended, and the consequence was a very powerful pressure of the paper between the platten and the type, causing the latter to give a perfect fac-simile of its surface upon the paper. Lord Stanhope's invention consists in an improved application of the power to the spindle and screw, whereby the power is multiplied many times. This will be best understood by describing an iron press of the modern construction. Upon reference to the engraving, this will be found to consist of a very heavy mass of iron, called the staple *aa*, the outline of which somewhat resembles that of a vase. It is united at the top and bottom, but the neck and body are open. The upper part is called the *nut b*, and answers the purpose of the head in the old press, as it is in fact a box with a female screw, in which the screw of the spindle *c* works; the lower portion of the open part described as the neck is occupied with a piston and cup *d*, *d*, in and on which the toe of the spindle works. On the nearer side of the staple is a vertical pillar or *arbor e*, the lower end of which is inserted into the staple at the top of the shoulder; the upper end passes through a top-plate *f*, which being screwed on by the upper part of the staple, holds it firmly. The extreme upper end of the arbor being hexagonal, receives a head *g*, which is in fact a lever of some inches length; this head is connected by a *coupling bar h*, to a similar lever or head *i*, into which the upper end of the spindle is inserted.



A, the arbor. B, the top-plate. C, the arbor-head. D, the spindle-head. E, the coupling-bar F, the bar or lever. G, the spindle and screw.

The bar or lever *k*, by which the power is applied by the workman, is inserted into the arbor, and not into the spindle, by which ingenious contrivance, 1st, the lever is in length the whole width of the press, instead of half, and is, moreover, in a much better situation for the application of the pressman's strength; 2d, there is the additional lever of the arbor-head; 3d, the additional lever of the spindle-head; and, lastly, the screw itself may be so enlarged in diameter as to have immense increased power. The platten is screwed on to the under surface of the piston; the table *m* has slides underneath, which move *in* the ribs *n*, *n*, instead of *upon* them, and is run in and out by means of girths affixed to each end, and passing round a drum or wheel *o*. As the platten is of considerable weight, the workman would have to waste much strength in raising the platten from the form after the impression has been given, were not a balance-weight *p* suspended upon a lever and hook at the back of the press, which counterbalances the weight of the platten, raises it from the form, and brings the bar-handle back again, ready for another pull. These are the principal parts of the machinery whereby the impression is given, and are sufficient for the general reader, with the aid of the engraving in Plate CCCCXV. For the printer there are yet other appliances. At the right-hand end of the table is an iron frame *q*, moving freely upon pivots, so as to fall upon the table, or rise until stopped by what is called the gallows *r;* this is covered with parchment very tightly stretched, and is then called the tympan; upon the tympan blankets are placed, which are covered by an inner tympan, and fastened by hooks; the whole forming a solid yet elastic and yielding surface, admirably fitted for impressing the paper upon the type (for this is its use), inasmuch as the surface of the parchment is soft and without grain, and readily receives the impression of the type, while the blankets give freely to every projection, without retaining any indentation. To protect those portions of the paper which are not destined to be coloured from ink or soil, there is at the upper end of the tympan another iron frame, of much lighter make, and also moving upon pivots, so as to fall upon the face of the tympan. This is covered with a sheet of coarse paper, and the exact size and form of the pages are carefully cut out therefrom, the parts left being an excellent protection of the paper under them. This is called a frisket.

Such is the ordinary Stanhope press. Since this was introduced many excellent presses have been invented, and very extensively introduced; but this is so simple, so easily kept in order, and so powerful, that it has never been excelled; and being very intelligible, has been chosen for the illustration. The manner of working is the same in all. A notice of the principle of various other presses will be found in a subsequent part of this treatise.

On the left front of the press stands the inking table. This is a table of mahogany (which is best) or iron, about four feet high and three feet four inches wide; at the back is a slightly elevated stage with a recess at each end, in one of which is the ink, in the other stands the brayer or muller, by which the ink is spread out in a thin layer upon the front of the stage.

Printers' ink.

It must be fully understood that printers' ink is a very different composition from that used for writing. It is of such consistency, that were a small portion taken up between the finger and thumb, when they were opened it would produce a thread of an inch or an inch and a half in length. Of all the materials used in printing, this is the most important, and the most opposite qualities are required in it. It must be of excellent colour. Formerly excellence of colour was deemed to consist in an exceeding dark hue, not exactly black, but black enriched with a hue of the darkest blue or purple. This gave indescribable effect to the works for which it was used, a richness, a gorgeousness, which it is impossible to describe; but the works of Baskerville and Bulmer, especially the Milton of the latter, afford the best specimens. *Now* we hold perfection to consist in the intensest black, and all the resources of chemistry and the arts have been sought to attain this end. It must stand for ever; but here we have miserably failed. Compare the productions of the old printers with those of twenty years back. What a difference! The works of the Aldi and Elzevirs, of Plantinus, Caxton, Pynson, and Grafton, preserve their colour as intense as the day they were printed; there is no yellowness or brownness, no foxiness, whilst the books of those of 1810-20 are wretchedly discoloured. Where fine printing, however, has been required *and paid for*, the modern ink is no whit inferior to the ancient. Witness the before-mentioned works of Bulmer, Macklin, Ritchie, Bowyer, Baskerville, and others; but certain it is that the ink in general use twenty years ago was of very inferior quality. It must be perfectly mixed, and ground until it is absolutely impalpable, otherwise it will speedily clog the types and inking apparatus; it must adhere to the paper, and not to the type, or it will tear off the face of the former, and clog up the latter; it must be sufficiently thick; it must keep perfectly undried when in large masses, and dry very quickly when it is distributed in thin surface. No printers of the present day make their own ink, although some add ingredients which they believe to improve the colour or quality. It is an especial business, and, by the aid of machinery, capital, and exclusive attention to the manufacture, the ink now supplied is admirable in the qualities of thorough mixing and grinding, drying, blackness, &c.; but whether it will stand the test of time, time alone can show. It is an expensive article, the commonest book-ink being one shilling and sixpence per pound, whilst the usual qualities are two shillings and sixpence, three shillings, and four shillings per pound; those used for superior work are five shillings and six shillings, and those for cuts as high as ten shillings, though it is questionable whether, at the latter price, the consumer is not paying for a mere name.

Every manufacturer has, of course, his own secrets, both of ingredient and process. The universal ingredient is the finest possible lamp-black; the great secret probably consists in the manner in which, and the material from which, this is made. There are vast buildings appropriated to the sole purpose of burning oil, naphtha, spirits, coal-gas, &c. to produce this black, which is collected from the sides, ceilings, &c. of the buildings. It is brought from Germany and many other countries; and no expense is spared to get the most superior quality. The next most important article is nut or linseed oil boiled and burnt into a varnish; then oil of turpentine, &c. The following receipts have been given. The first is the method used by Baskerville and Bulmer, and nothing can be better than the results.

1. Fine old linseed oil boiled to a thick varnish, and cooled in small quantities, three gallons; a small quantity of black or amber rosin dissolved therein; the mixture then stands for some months, that all impurities may be deposited; after which it is mixed with the finest lamp-black, and carefully ground for use.

2. One hundred pounds of nut or linseed oil are reduced by boiling and burning one tenth or one eighth of its bulk, and to the thickness of a syrup; two pounds of coarse bread and several onions being thrown in to purify it from grease. Thirty or thirty-five pounds of turpentine are boiled apart, until, on cooling it on paper, it breaks clean, without pulverising. The former is poured nearly cold into the latter, and well mixed. The compound is then boiled again. Lamp-black is next thoroughly mixed with it, in quantity according to the ink required, and being well ground, the ink is then ready for use. Some add indigo, some Prussian blue, which considerably improves the colour; but these inks are so difficult to work, and so clog up the type, that the *improvement* is better let alone. The turpentine is added to give greater varnish, and improve the drying quality; but if the oil be old and fine, the quantity required is proportionally less.

3. Mr Savage, an admirable artist, denies that any ink can be depended on, of the varnish of which oil is the basis; he therefore gives the following receipt:—Balsam capivi, 9 oz.; best lamp-black, 3 oz.; Prussian blue, $1\frac{1}{2}$ oz.; Indian red, $\frac{3}{4}$ oz.; turpentine soap dried, 3 oz. This ink is of beautiful colour, but appears to work foul. There can be no doubt, however, that the best and cheapest plan is always to purchase what is required of a proper ink-maker.

Press.

At the right front of the press stand the *bank* and *horse*. The bank is a deal table of some size; the horse is an inclined plane which stands upon the bank; upon it is laid the white paper prepared for working, which, when worked, is brought from the press to the bank. There are two pressmen to each press, one of whom attends to the inking only, to ascertain the excellence of which he turns, whenever he has a moment to spare, to the worked sheets upon the bank, glancing his eye rapidly over each to see that every part is of its proper colour, and that no picks, or other impressions, mar the work; the other attends only to the press, and gives the impression. These men are paid by every two hundred and fifty impressions, or by the *token*. Thus, if the number be five hundred, and the price fourpence-halfpenny per token, each man receives ninepence for the five hundred impressions of each form, and the cost therefore is,

First form, two men, two token, at 4½d.........1s. 6d.
Second form, do. do. do. ....1s. 6d.
3s. 0d.

The price necessarily varies with the size of the type and of the form; with the quality of the paper and of the ink; with the number, and the care required. Common work is fourpence-halfpenny, good sixpence, superior sevenpence, the very best eightpence, ninepence, or even twelvepence per token.

The pressmen, having received the forms after the final correction, lay the inner form, or that one which contains the second page, upon the table of the press, and secure it in the centre by quoins; one of them, in the meanwhile, pastes a stout sheet of paper upon the frisket frame, and then secures it upon the tympan. They then ink the form, and take an impression upon the frisket, and cut away all the printed part, which therefore leaves so much of it as is necessary to protect the paper from soil. The puller now carefully folds a sheet of the paper according to the crosses of the chase, and laying it upon the form, opens it carefully, by which the paper is made to lie evenly upon the form, with the same margin with which it is to be afterwards worked. Having wetted the tympan, the pressman closes it down upon the form, and takes an impression, when the paper will be found to adhere to the tympan, and thus become a guide whereby to lay all the subsequent sheets, and therefore much care should be taken to lay it properly. They now choose their points, which are thin iron arms, having a short point projecting from the end, and made to screw on to the tympan-frame, which must be done in such a manner as that the points may fall in grooves in the cross of the chase; because if they did not, they would be battered and broken upon it at the first pull.

The puller now brings his paper from the wetting-room; for before any good impression can be taken the paper must have been damped, by rapidly passing it, one fourth or one fifth of a quire at a time, through water, and then allowing it to soak for two or three days, until it is evenly and thoroughly damp; and, laying a ream upon the horse, he takes a sheet, and placing it carefully over the tympan-sheet, closes the frisket over it, shuts both tympan and frisket down upon the form, which in the meanwhile his companion has inked (a process that will be described below), runs the table in under the platten, pulls the handle of the bar or lever over by his full weight, until brought up by the stop, at which moment the platten descends and gives a powerful impression to the tympan, &c. upon the form, producing upon the paper a perfect fac-simile in reverse of the surface of the latter. The pressman now gradually releases his hold, the balance-weight raises the platten, the bar returns to its first position, the table is run out, the tympan and frisket are raised by the workman, and the frisket thrown up to the catch. The sheet is taken off the points, which the impression has caused to pierce through it, and carefully examined to ascertain that the impression is just and even, which is the great test of the workman's skill, and the excellence of the press. Invariably the first impression is defective; the parchment may have been thicker in some parts than in others, the blankets worn, or one of two founts of type may not have been of equal height, in which respect "the estimation of a hair" would be a monstrous fault, the thinnest possible tissue paper being quite sufficient for remedy. The pressman proceeds to overlay, that is, to paste upon his tympan-sheets portions of paper of the exact size of the defects, thicker or thinner as may be required; or if the defect be great, he places a part of a sheet of paper within his tympans. If there be any small portion of undue prominence, or that "comes off hard," he rubs away a portion of the tympan-sheet with wet fingers, or cuts it away altogether. Having, as he supposes, remedied all blemishes, he takes another impression, which he again examines with equal closeness, and carefully removes every remaining defect by the same method; having at length satisfied himself, and his master or overseer, the work is proceeded with, the inker taking even portions of ink well distributed, and covering the form equally, the puller taking a sheet, and laying it on the tympan as before. They thus proceed until the whole number of the white paper is worked off. The form is now lifted from the table, and carefully washed with a very strong lye. The outer form is then laid on and made ready.

This varies a little from the mode previously described. It has been stated that the points penetrate the paper at the first impression. These holes and points are the guides whereby perfect register is obtained; that is, whereby not only the pages, but the lines, are made to fall exactly upon the back of each other, a deficiency in which is a great fault in good book-work. The form, therefore, having been placed in precisely the same place as the previous one occupied, one of the sheets which have been printed on one side is taken and placed with the face inwards, in such manner that the points pass through the same holes, but of course the opposite way, and an impression is taken. If the pages do not back, the points are shifted until they do; or if the defect be in the form, such alterations are made in it as may be necessary. The impression is then brought up as before, and when all is ready, a thin sheet of white paper, called the *set-off* sheet, is placed over the tympan-sheet and upon the points. It must be remembered that one side has been worked, that the ink has not yet dried, that the paper is still damp; therefore at every impression some portion of the ink will be transferred to, or impressed upon, the set-off sheet. When this has taken place in many impressions, the effect will be doubled; for not only will some of the ink of the print be transferred to the set-off sheet, but some, a very slight portion, of the set-off will be re-transferred to the sheet working, producing a most unpleasing dirty appearance, very mystifying to the eyes, and utterly destructive of beauty. The puller, therefore, after a few impressions, moves the set-off sheet slightly, and when it has become very dirty, discards it, and replaces it with another. The pressman should be very attentive to this; and the master should not grudge ample supplies of set-off paper, for it is not destroyed, but is very useful afterwards in other departments as waste paper. The form is now lifted and carefully washed with lye, and the two are sent to the composing-room, where they are again carefully washed and rinsed, and are then ready for distribution. Two good pressmen are supposed to do about one token, or 250 impressions, per hour, of fair work. This, however, must depend entirely upon the quality of the work required; with small type, stiff ink, and many rules, the work is more slow, and paid for accordingly. The finest work is seldom paid for by the token, the pressmen being placed upon weekly wages, and allowed as much time as they require, the rapidity being at the discretion of the overseer. Frequently they are limited to a certain number per hour, often as few as fifty, the most careful inspection being given to every sheet by both pressmen, and continual attention by the press-overseer and other chief persons in the establishment. In such work the very best materials are employed. Instead of parchment, the tympans are covered with fine calico, and even silk; instead of blankets the finest broad cloth, picked blotting-paper for the thick overlays, the thinnest tissue-paper for the finer. It will readily be understood, that in all operations of the press-room, where everything depends upon the skill of the workmen, there are infinite minutiæ, which it would be tedious, if it were even possible, to enumerate. Seven years apprenticeship are not more than sufficient to educate a good pressman. It is the accumulated labour of a life to make a first-rate one; and, after all, excellence depends upon the native talent and ingenuity of the man himself.

The ink is distributed over the type either by balls or by rollers. The rollers are of modern use; the balls were, until a recent invention, sheep-skins with the hair taken off with lime, made into a ball with wool, gathered at all corners, and nailed upon a wooden handle. One of these was held in each hand; and a small portion of ink being taken, they were well beaten upon the inking-table, and then upon each other, until the ink was so evenly distributed over the whole surface, that if touched gently with the finger, the prominent lines of the skin would be perfectly blackened, whilst the channels would be left perfectly clean. The balls were then beaten over every part of the type, so that the whole surface should be evenly covered; an operation requiring much skill and practice. The skins were prepared and softened by the nastiest processes imaginable, which converted a press-room into a stinking cloaca. Thanks, however, to the observation and ingenuity of Mr Donkin and Mr E. Cooper, this has been entirely done away, and a press-room now almost regales the nose with a warm scent of ink and paper, anything but unpleasant. This invention has been of the greatest consequence to printing. The printing machine is popularly said to be the great engine of modern literature; and so it is; but without this, printing machines were mere old iron and brass. For many years the workmen in the potteries had used a composition of glue and treacle for applying colours to their ware. Mr Donkin observed that this composition possessed every requisite for the use of the printing-office, and he immediately proceeded to form balls of canvass, with a facing of composition. They answered admirably, proved beautifully soft, distributed beautifully, kept clean, and were easily washed and purified if soiled. Some opposition was offered by the workmen; but their advantages proved so great that they were readily adopted by the masters, and speedily drove away for ever the nasty skins. The next step, however, was more important still. Mr Donkin bethought him, that if he could cast rollers of composition, without seam and perfectly cylindrical, it could not fail to be of infinite utility to machine-printing. It remained, however, for Mr Cooper to suggest the substitution of them for balls at the common press. In this he succeeded; but it is astonishing how much difficulty there was in persuading the men to lay aside their old habits. They could not conceive that a straightforward rolling would answer the purpose of their laborious and careful beating. The rollers were nicknamed "rolling-pins," but they made their way, and are now in general use. They consist of a wooden cylinder, with a thick coating of composition cast perfectly true; through the middle of the cylinder passes an iron rod attached to a curved bar passing over the roller, upon which are two handles; and the roller revolves freely upon the rod. The pressman having brayed out a narrow line of ink upon the raised stage of the inking-table (or upon a distributing roller which runs the whole length of the table, and, being turned, presents a line of ink to the inking-roller), takes a portion of this upon the composition, and distributes it carefully upon the table until the entire face is evenly covered, and then rolls the form, taking care that the whole surface receives its due proportion. If he does this lightly and steadily there is no fear of the result; he cannot in rolling overlook any part; but it nevertheless requires some judgment. If there be any heavy titles or large type, he must roll that portion several times; if there be blank pages, he must take care that the roller does not sink, and so leave the pages in line with it slightly touched. The chiefest judgment, however, is displayed in choosing the exact quantity of ink required for the form. If the type be small, the quantity taken must be small; it must be very carefully distributed, and the form rolled many times; for if the quantity be too great the type will become clogged, and if too little, the colour will become faint. The pressman must from time to time examine the sheets as they are printed, turning up the corners of the sheets that he may see whether the colour corresponds to that of the side first worked, and detecting with quick eye every defect; and he must be particularly careful that for every sheet of the same work he take the very same quantity of ink, that the book when bound may present an even and beautiful colour, every bold line being perfectly covered, and yet every fine stroke clear and distinct. This can only be effected by careful distribution and repeated rolling, with exact judgment as to the quantity of colour to be taken.

Warehous

The sheet having been thus worked off, the printed paper is taken away by the warehouseman, and hung by the boys upon poles stretched under the ceiling, by means of a peel, which is a handle with a broad end, upon which a quire or two is hung at a time, thence transferred to the poles, and distributed in portions of four or five sheets. Here they hang a day or two, until the ink and paper are perfectly dry. This should be a gradual process, for if by artificial heat the drying is hurried, a skin will be formed upon the surface of the ink, which will prevent that underneath from drying; the work will look very well until it is pressed or bound, when the skin breaks, the ink spreads, and the sharpness of the letter is entirely destroyed. When perfectly dry they are taken down and laid in heaps upon the gathering board, each signature separately; thus, first, a heap, say 1000, of B, then C, D, E, F, and, lastly, the title-sheet A. The boys then take one sheet from each heap; consequently, when they have got to the last signature, each boy has one complete copy of the work. These are laid upon one another in such a manner that each book is perfectly distinct. The warehouseman then takes a collator (a needle inserted in a handle) and goes over the whole with great rapidity, ascertaining that no sheet has been carelessly omitted, and that no two of the same sheet have been taken. The books are then folded down the middle, counted out in tens, thirteens, or twenty-fives, and tied up in fifties. The process of printing is thus complete, and the work is ready for the binder.

Pressing.

Works of finer description, indeed most works of the present day, are submitted to another process after they have been taken down from the poles, viz. hot or cold pressing, which very much improves their appearance. In cold pressing the sheets are placed one by one between glazed boards, or sheets of coarse material pressed until there is a perfect glaze upon both surfaces. The heaps are then placed in an hydraulic press, with cold iron plates at small distances, and the whole is subjected to considerable pressure for some hours; they are then taken out and the sheets extracted from the boards, when the indentations consequent upon the working will have been all pressed out, the roughnesses of the paper smoothed out, a slight gloss given to the ink, and the whole will present a very agreeable smoothness to the eye and the touch. Hot-pressing is used when the paper is very stout and the ink strong. The sole difference is, that the iron plates are heated until they can hardly be touched. The effect is much greater than that of cold pressing; the whole surface of the paper is perfectly glazed, and the ink absolutely shines; but the effect is not so agreeable to the eye; it is too glossy. As these processes also make the books lie perfectly flat, they render great beating by the binder unnecessary, doing away with the danger of such beating causing the ink to set off upon the opposite pages, which danger, should it from circumstances prove necessary to beat the book much, is considerably diminish-

Warehouse.

ed, as the pressing sets the ink very effectually. The glazed boards must be often cleaned by rubbing with waste paper, or they will dirty the sheets placed between them. Every printing-office of credit should have an hydraulic press and boards; for it is incredible how much smartness pressing gives to the work, and how greatly the warehouse work is facilitated by the readiness with which the hydraulic is pumped up, and by its great power. A press of eight-inch ram will be found sufficient for most purposes; but where much hot and cold pressing are required, one of nine-inch ram will prove cheapest, because, from its immense power, a few hours are sufficient to give the requisite surface, and the press may therefore be filled twice a day.

Of casual variations in printing. Wood-cuts.

Wood-blocks are very often worked with the common type. The block, having been carefully reduced by the engraver to the exact height of the type, is placed in the composing-stick, and justified to the width of the page; it is then made up along with the other matter in its proper place. When laid upon the press for working, and an impression of the form has been taken, the pressman examines with great minuteness whether it stands well with the type; if not, the form is unlocked, and paper placed under it if it be too low, or under any corner that may be lower than the rest; if the block be too high it must be scraped or filed at the bottom. Anciently the artist in wood contented himself with producing his lights and shades by cutting his lines in greater or less degrees of fineness upon a plane, leaving to the printer the task of producing the required effects by a tedious process of overlaying; but since the introduction of machines, in which such method is impracticable, from the nature of the impression, and from the immense loss consequent upon the machine standings till whilst the cut is in preparation, several eminent engravers have turned their attention to the subject, and have succeeded in a method of so cutting away the block that it is put into the printer's hands in a great measure prepared. Notwithstanding this vast improvement, the pressman has much to do; he is to a certain extent an artist, and must have a good eye for perspective, and for the proper adjustment of tints. These effects he produces by careful and skilful overlaying. The cut may then be worked with the type without any other care than that of keeping it clear from clogging or picks. When done with, it must be very carefully cleaned with spirits of turpentine and a brush.

The working of wood-cuts by themselves as illustrations of works, differs from type-printing in no other respect than the superior materials and skill required. The wood-cut must be imposed in a chase, and locked up upon the table of the press, which is generally a smaller one than that used for ordinary printing, of most excellent construction, and in good order. The tympans are often of silk or cambric.

Composition balls and rollers

There are in London, and probably in the larger provincial cities, parties who make an especial business of the manufacture of composition balls and rollers, which they supply to printers upon payment of a rent. The skill and experience of these persons enable them, as must be the case in every instance where a manufacture engages exclusive attention, to supply a much better and cheaper article than could be manufactured by any individual whose engagements are varied; consequently there are not many printers, either in town or country, who do not avail themselves of these opportunities. The rent is paid for each roller required, and by the quarter; that is to say, if a printer employs six presses, and consequently six rollers, he pays for six rollers, the manufacturer engaging to supply him with as many changes as he may require from their getting out of order or being injured; in fact, to keep him supplied with six rollers in good condition. The rent for a common press-roller is the moderate sum of six shillings per quarter; they are sent into the country in boxes fitted for the purpose. There are, of course, situations in which it is not easy to obtain a regular supply of the necessary article, and in this case the printer may very easily make them for himself; but the expense of the utensils is so great as to exceed the usual rent for years. They consist of the following: For rollers, a hollow cylinder of brass, the bore of which must be most accurately turned and well polished; this mould consists of two semi-cylinders closely fitted and brought into contact by screws along the sides and collars at the end, and a head is made to fit into the lower end. The core, a wooden cylinder, upon which the composition is cast, is held in the centre of the bore by means of a star, through the radii of which the composition flows. For balls are required a concave mirror of about half an inch cavity, and a board of the same size, and of a quarter of an inch in convexity. A kettle for melting and mixing the composition is also required. This is made double like a glue-pot, fitting exceedingly close, and with a small orifice for the escape of the steam from the hot water between the two; and the inner vessel should have a large lip. The recipes for making the composition vary, and this appears to arise from the different circumstances under which it is made. The ingredients are but three, and these easily purchaseable, viz. fine glue, treacle, not that procured from the bakers, which is adulterated, but the best from the sugar-refiners, and a small quantity of carbonate of barytes, called in commerce Paris white. The first two are quite sufficient with a little skill. The following are good recipes.

Rollers.

1. Two pounds of glue to one pound of treacle.
2. Two pounds of glue to three pounds of treacle.
3. One pound of glue to three pounds of treacle and a quarter of a pound of Paris white.

Soak the glue in water until it is soft; then place it in the inner vessel, and boil quickly, until the glue is thoroughly dissolved; add the treacle, mixing it well, and let it boil for an hour or more; then sift in the Paris white, but do not stir it violently, or the mixture will be full of air-bubbles, which are destructive to the roller or ball. Rub the mould slightly with a rag dipped in thin oil, taking care that no globules and streaks remain upon the surface. When the mixture is ready, pour it gently between the radii of the star, so that no air be detained within the cylinder until the mould be filled; allow it to set, and then take it from the mould, cutting off the superfluous portion with a string. When the roller has been hung up twenty-four hours it will be fit for use. In making balls, having oiled the mirror, pour the composition upon the centre, and having allowed it to spread itself, lay over it a piece of coarse canvass, place the board upon it, and lay weights upon it to press it down; it will consequently be found that the composition face of the ball will be slightly thicker in the centre than at the edges, which, besides being a convenience in the working, will allow it to be *knocked up* with much facility, which is done in the ordinary manner. These balls and rollers are very easily kept in order; if they are too soft, cold water will harden them; if too hard, warm water will soften them. When not in use they should be covered with refuse ink, and hung up in a room of even temperature, and carefully scraped with a palette-knife before use. They should not be cleaned with spirits of turpentine, as that will give them a hard surface. These rollers will be fit for use for a long while if attention be paid to them; and when spoiled, the composition may be repeatedly melted down, and, with an addition of new materials, will make as good rollers as before. When the proper apparatus is wanting, small balls for wood-cuts or single pages may be made upon an earthen palette, or even upon a smooth dinner-plate.

Stereotyping.

Stereotyping is a mode of making perfect fac-similes in type-metal of the face of pages composed of moveable types.

Stereotyping.

Letter-press printing being a very expensive process, the price of books consequently high, and the heaviest expense consisting in the composition, the printers of the Continent very soon set up the entire of such small works as were in constant demand, and thus were enabled to sell them at little more than the cost of paper and press-work. Some works of very great extent, especially Bibles and prayer-books, were kept standing by the privileged printers. This, however, was exceedingly expensive, as the cost of type would be enormous; the forms would occupy vast store-rooms, and be liable to continual damage, both from the accidental dropping of letters, from batters, and other accidents to which they would be unavoidably liable. Some method, therefore, by which all or some of these disadvantages might be remedied, was sought after with great anxiety. About the beginning of the eighteenth century, Van der Mey, in Holland, sought to avoid this liability to accidents, by immersing the bottom of his pages in melted lead or solder, and thus rendering them solid masses: "c'est une réunion des caractères ordinaires par le pied, avec de la matière fondue, de l'épaisseur d'environ trois mains de papier à écrire;" therefore the mass together would be of somewhat less than the height of our type. It is not very easy to guess how they contrived to make the backs of these blocks of such evenness as to produce anything like a good impression; but Dibdin says that the book is very handsome. The same process was followed by a Jew of Amsterdam, in printing an English Bible; but he was utterly ruined by his speculation.

Some time before the year 1735, there is sufficient evidence that the French used casts of the calendars placed before church-books. These plates are thus described by Camus: "It (one of the plates) is formed of copper, and is three inches and a half long by two inches broad and one seventh of an inch thick. From the roughness of the casting, it has evidently been made in a mould formed of sand or clay." After the plate had been cast, the back of it had been dressed with a file, in order that it might bear equally upon a block of wood to which it had been attached.

Who really invented the art of stereotyping as at present practised (and, after all, he who finds out the efficient *modus operandi* is the inventor of the art, though he may not be of the principle), is, like the inventor of the parent art, a matter of some controversy, which has been carried on with more vigour than the subject merited. It seems however most probable, when all assertions are weighed, that William Ged, a goldsmith of Edinburgh, deserves the credit; thus exhibiting a singular coincidence with Fust. According to his statement, being in 1725 in company with a printer, they lamented the want of a good letter-founder in Scotland; and the printer asked him whether he could do anything to remedy the defect. He immediately answered, that it would be more easy to cast plates from pages when composed in moveable type; and he undertook to produce, and very shortly did so, a specimen of his new plan, and not long afterwards made arrangements with a capitalist to advance the requisite funds. The latter failing to perform his part, Ged made a similar contract with a London stationer, in conjunction with whom he made many attempts; but being repeatedly thwarted, he parted from his partner, and made proposals to the universities and the king's printers to stereotype Bibles and prayer-books. These all entered into the scheme with some eagerness, and some works were produced quite equal to the ordinary printing of the day. Nevertheless, so much ignorance and prejudice prevailed amongst the workmen, and others interested, as they imagined, in the old system, that the undertaking was soon abandoned, and Ged entered into several subsequent arrangements, in which he was equally unsuccessful; a type-founder, in particular, causing such obstructions that the art made no progress. Ged died, therefore, before he had met with any encouragement; nor did his son succeed better, although, as the practicability was made more manifest, the very parties who had rejected his plans subsequently made extensive use of his plates. What was Ged's method of stereotyping is unknown, as he kept it private; nor did his partners fully participate in the secret.

Fifty years afterwards, Mr Tilloch made a similar invention; but, from private circumstances, the design was laid aside, not however before several volumes had been printed from his stereotype plates at the press of Mr Foulis. Some years after this Lord Stanhope engaged an ingenious London printer, Mr Wilson, to prosecute the invention; and after many trials, the noble lord's ingenuity succeeded in bringing the art into perfect use.

Mode of stereotyping.

When a work is expressly intended for stereotyping, the type used should be somewhat different from that commonly employed. The letter should be cast without any shoulder, but should rise in a straight line from the foot; the spaces, quadrats, and leads should be of the same height as the stem of the letter, because the less the cavities in the page, the less chance there is of any of the mould breaking off and remaining in the form. The page having been composed in the ordinary manner, and very carefully corrected, is imposed in a small chase with metal furniture, and the whole is placed within a moulding frame, somewhat less than half an inch higher than the type. The surface of the type is then rubbed with a soft brush holding a small quantity of very thin oil.

The plaster of which the mould is formed is the common material of which statues and busts are cast; it should be of two degrees of fineness, and may be easily purchased ready prepared. These having been carefully mixed, a small portion of the finer quality is gently poured upon the surface of the page, and softly worked in with a brush, care being taken that every portion is fully covered, and that no air-bubbles remain in any part of the letters. Immediately a larger quantity of the coarser plaster is poured on and spread over the previous layer without disturbing it; a straight-edge is then passed over the moulding-frame, clearing away the superfluous plaster, and leaving that within the frame of uniform thickness. It is then left to set. When sufficiently dry, the moulding frame is raised, and the mould with it; the mould is then dressed, and placed in an oven until it be perfectly dry, and raised to an adequate temperature for the casting. The oil with which the page is rubbed prevents the plaster from adhering to the type.

The melting-pot is a square vessel of iron about two inches and a half deep, having a separate lid, of which the four corners are cut off, the inner face being carefully turned, the outer face turned hollow towards the centre. A floating plate, of which the upper surface is turned, is placed at the bottom of the pot. Over the melting-pit is a crane with a rack, upon which a pair of nippers are made to run. These lay hold of ears upon the melting-pot, closing with its weight, and opening when relieved. The metal does not differ from type-metal, and must be sufficiently fluxed to flow easily, but not made too hot, or it will prove brittle. The melting-pot having been heated in the same oven with the mould, and consequently to the same temperature, the latter is placed within it, the face being turned down upon the floating-plate. A bar or other piece of iron is screwed down upon that part of the lid which is turned hollow; and the whole being suspended by the rack and crane, is swung over the melting-pit, and gradually let down into the metal, which flows gently into the pot through the openings left at the corners. The metal flowing slowly in gradually expels all the air; the mould immediately rises to the inner surface of the lid; the floating-plate, being specifically lighter than the metal, rises also to the edge of the mould; consequently the metal which has run in between is of the exact thickness of the depth of the mould, the upper surface being the field upon which are the casts of the type, the under surface the smooth face of the floating-plate, and the rest of the melting-pot being filled with metal. The pot is allowed to remain immersed ten minutes or a quarter of an hour, that is, until the air is supposed to be perfectly expelled. The pot is then drawn up, and swung to a board resting upon a trough of water, and there allowed to cool. The cooling is a process requiring much care and attention. It is obvious, that unless the whole mass cool equally, the plate will be warped, and consequently spoiled; it is equally clear that the heat will more readily radiate at the corners, and consequently that the centre will remain fluid after the other parts are set, and that the contraction must be unequal. This is provided against by the lid having been turned hollow in the centre, and it will therefore allow the metal under it to cool more rapidly. The mass having been turned out from the pot, the metal under the plate is separated by a smart blow or two of the mallet; the floating-plate will be readily disengaged, and the mould be removed from the cast. Some defects will invariably be found in the new plate; but these are removed by the picker, who goes carefully over it, clearing away the picks from the face of the letter, and deepening the larger white lines with a graver, that they may not blacken in working at press; for it must be remembered, that the quadrats and spaces used in stereotyping are higher than those in moveable-type printing. If the face of the plate has cooled evenly, and it is in other respects a successful cast, it is placed, the face inwards, in a turning lathe, and the back rendered a plane parallel to the face; the margins are then squared, and the edges flanched. The plate is now ready for use.

A great improvement in the stereotype art was a few years ago introduced by Mr Thomas Allan, printer in Edinburgh, into his establishment, by which a number of plates are cast at once, whilst the risk of broken casts is considerably lessened. This is effected by means of a pot sufficiently deep to contain moulds placed in a perpendicular position. The pot is an oblong square cast-iron box, widening towards the mouth, and having placed inside, at each end, a wedge-like block, of which one face is parallel to the side, while the other is perfectly vertical. On the vertical side are perpendicular grooves, at distances rather greater than the thickness of the stereotype moulds. Into these grooves are inserted plates of malleable iron, by which the interior of the box or pot is partitioned into spaces sufficiently wide to admit with ease the plaster moulds. The moulds, when baked, being inserted into these spaces, a cross bar of metal is placed over the top, instead of a cover, which serves to prevent the moulds from being raised by the liquid metal flowing beneath them; and it is then suspended upon the crane, and dipt into the metal-pit in the usual way. By this method not only are the moulds saved from all risk of breaking by being placed horizontally and pressed between the two broad surfaces of a float-block and cover, as in the method of single-page casting, but a number of plates are produced at one cast, and thus additional celerity is combined with greater certainty of sound plates. The plates of the ENCYCLOPÆDIA BRITANNICA, which is the most extensive work ever stereotyped, have been for the most part produced by this process, in pots containing each five moulds; and it is especially advantageous for large plates, the risk of breakage by the old method increasing in a greater ratio than the increase in the size of the page.

The plates are sometimes mounted upon blocks of mahogany, the height of which is the difference between the thickness of the plate and the height of the type. These blocks are furnished with brass sides, the upper part of which is turned over so as to take hold of the flange of the plate. Many attempts have been made to accommodate these blocks to the varying sizes of the plates, by forming them in portions; but, where much stereotyping is done, the plates are usually cast to uniform sizes, corresponding blocks being kept ready for use. An ingenious plan has been devised to remedy this inconvenience, by a series of hollow squares of type-metal of the requisite height and of different sizes, by means of which pages may be easily composed to any required size, from one pica m upwards; the plates being fastened on by brass holders. At a small expense once incurred, the stereotype printer may furnish himself for ever.

There are many smaller instruments requisite, which it is quite unnecessary to mention. The founder requires some practical skill, which, however, it is not difficult to acquire. The excellence of the casts will depend upon the personal knack and observation of the founder. The metal for stereotyping is generally purchased prepared for use, in preference to melting down old type, the type-founders allowing much more for it in exchange than the metal can be purchased for. The price of prepared metal is about 40s. per cwt. The following, however, are proportions which may be used when the prepared metal cannot be procured:—

1. From five to eight parts lead, one of regulus, one fiftieth of block-tin.
2. One seventh of pure regulus, six sevenths of lead. The best lead is that which comes from China, in the lining of tea-chests.

The mixing of the lead is exceedingly injurious to the workman, and should be avoided wherever it is possible. The foundry should be thoroughly ventilated, as the fumes from the melting-pit, and the moisture and smell of the drying oven, are very noxious.

An extravagant notion prevails, especially amongst persons not experienced in the mysteries of printing, of the exceeding economy of stereotyping; it would therefore be of advantage to give a fair view of the case. On an average, the cost of stereotyping may be taken as the same as that of composition, or even higher. It is quite clear, therefore, that if the first edition of a work is stereotyped, the speculator at once incurs the expense of *printing* two editions, minus the press-work. The consequence is, that if his untried book does not succeed, he very much increases his loss, or at best he increases his chance of loss, because many books that just get through a first edition never arrive at a second. Therefore the first edition of a work should never be stereotyped, unless indeed the work be of such a nature as to insure a general sale at a low price, as, for instance, Ready Reckoners, Tables of Interest, and such like. Again, what work is there so perfect as not to require some alteration and amendment in a new edition, which, in stereotype, is practicable only to a limited extent. Supposing, next, that the great demand for a work is ascertained, that the matter is sufficiently corrected to require no farther alteration, and that the work has been stereotyped; the owner must wait until the copies printed from the types from which the casting has been made are sold, before he has occasion to make use of his plates. On the one hand, suppose that he print sufficient for four years consumption; and on the other, sufficient for one year at the same rate. The account will stand thus:—

Type.

Cost of composition, 25 sheets, say	L.50	0	0
Press-work, 4000 copies, 200 reams, at 7s.	70	0	0
Paper, 200 reams, at 20s	200	0	0
	L.320	0	0
Interest on average of two years (allowing for periodical return of capital)	32	0	0
	L.352	0	0

Practical Printing. Stereotyping.

Stereotype.

Cost of stereotyping				L.50	0	0
1st year, Press-work of 1000 copies, 50 reams, at 9s.				22	10	0
Paper, 50 reams				50	0	0
				L.122	10	0
Interest, 1 year 6 months, plates				3	15	0
Ditto, 6 months print and paper				1	16	0
				L.128	1	0
2d year, Print and paper	L.72	10	0			
Interest, plates, 1 year	2	10	0			
Do. print and paper, 6 months	1	16	0			
				76	16	0
3d and 4th year				153	12	0
				L.358	9	0
Balance *against* stereotyping				L.6	9	0

Second Four Years.—Type.

Composition from reprint copy	L.43	15	0
Press-work, 4000 copics, at 7s.	70	0	0
Paper, 200 reams, at 20s.	200	0	0
	L.313	15	0
Interest, average 2 years	31	17	6
	L.345	12	6
Four editions from platcs, and interest as before	307	4	0
Balance in *favour* of stereotype	L.38	8	6
Cost of first edition, type	L.352	0	0
Ditto second ditto	345	12	6
	L.697	12	6
Cost of eight editions stereotype	664	13	0
Balance in favour of stereotype at the end of eight years	L.32	19	6

without taking into account repairs and incidental expenscs which would be incurred in stcreotype *only*, and also not reckoning the produce of overplus copies, which would be proportionatcly greater in type.

If the type be small, and the composition cxpensive, it would be considerably in favour of stereotype; but on the *per contra* would be the greater wear and damage of the plates.

Such is a fair statement of the pecuniary profit and loss of type and stereotype; but there are other considerations. Every edition from the plates must be in the same type, without any of the improvements that skill or fashion may require; whereas every edition from type may be varied to the taste of the day, and any defects in composition or making up remedied. Every edition from the plates must also get progressively worse and worse. It is asserted that no injury can accrue to the plates, but the fact is precisely the reverse; for these plates are particularly liable to injury, from their weight and brittleness, from blows, from picks and batters, which will happen notwithstanding the greatest care, from fractures at the edges in placing on the blocks or raisers, and many other fortuitous circumstances. These it is difficult to remedy, and, when remedied, they present a most unsightly appearance, sometimes from the same fount not being at hand, or sent to the melting-pot (and great changes occur in the types of a printing-office in the course of eight years), sometimes from the new letters not standing of the same height, which is a common fault, and always from their not standing in line. Again, printing from plates never looks so well as that from type; and the most inexperienced eye may instantly detect the difference, even in the first edition.

Nevertheless, in some cases stereotyping is of great advantage; but chiefly in books of numbers, in which it is of the utmost importance that every figure should be correct. In this case the proofs must be read again and again, until the correctness is unquestionable, then stereotyped; and there is no fear of alteration from the error of compositors or carelessness of readers, but the book remains the same for ever. Such works also are most expensive in getting up, and the cost of composition very much exceeds that of stereotyping. Books of logarithms may be especially mentioned, tables of longitude, indexes to maps, and other works, which, being once written, remain unchangeably the same: or where it is found expedient to have duplicates of the work, as when immense numbers are required, and it is necessary, for speed, to work on double-sized paper; such, for instance, is the Penny Magazine, from which, when once composed, a cast is taken, and the original and cast are worked side by side at the same moment, producing two copies instead of one, in which case there is another advantage, for the casting does not exceed the cost of composition, and, when worked, the stereotype remains without further expense for another edition: again, where it is expedient to send duplicate plates to a distance to be worked, thereby saving the expense of carriage, and some time; as in the Penny Magazine, where several casts are taken, and one sent to America, another to Germany, &c.; in Chambers' Edinburgh Journal, where one cast is worked at Edinburgh, and another in London; in Richardson's Dictionary, where one cast is used by the London publisher, and another in the United States.

Wood-cuts may be stereotyped with great advantage, for a small cut which has cost several guineas to engrave may be multiplied indefinitely, and that at a cost of a few shillings.

No printer should stereotype who wishes his type to be a credit to his house. The wear of material in casting is miserable; the gypsum is at best a fine powder, and grinds away the edge and face of the letter when rubbed in with the brush in a frightful manner. The letter can never be entirely freed from the plaster, and will present a very dirty appearance ever after. The wear of a fount of 1000 lbs. weight, returned six times from the foundry, is greater than would occur in six years' constant fair usage; besides which, the high spaces, quadrats, and leads, are all extra expenses, for which the economical bookseller makes no remuneration whatever.

School-books are most frequently stereotyped, in ordinary cases with the advantages and drawbacks above related. Suppose, however, a Spelling Book or Primer, say Guy's, selling from forty to fifty thousand copies yearly, in which it might be supposed that stereotype would be of infinite advantage. For such a book, stereotype plates would not last, even in decent condition, four years. Calculate the cost, without interest, the money being constantly returned.

Type.		*Stereotype.*	
Seven sheets, say	L.40	Stereotyping	L.14
Working 560 reams, at 5s.	140	Working 560 reams at 6s.	168
Paper	490	Paper	490
	L.670		L.672
Rent to be paid to printer to keep type standing, say one fourth	L.10		
Print and paper	630		
	L.640	Print and paper	L.658
Cost in four years	L.2590		L.2646

Balance against stereotype, L.56.

at the end of which time the types must be set up again, and new plates cast. But any printer will keep standing a work of which such numbers are required, without any charge whatever; and every worn or battered letter may be taken out and replaced, so that every edition will be in perfect condition for generations.

The plan of stereotyping Bibles and prayer-books has been nearly abandoned, and the entire sheets are kept standing in moveable type, at incalculable expense, by the Queen's printer, the University of Oxford, and, it is believed, that of Cambridge. Before every edition, however, is worked, every sheet must undergo a careful reading.

Of Polytypage.

The ingenuity of our lively neighbours the French has been excited for nearly a century in devising a speedy and cheap mode of making solid plates, either in sequence or in substitution of moveable type. Many considerable improvements in stereotyping are to be ascribed to these artists; but stereotyping has never been a favourite with them, and they have rather exerted their invention in a series of experiments, which may be classed under the general name of polytypage.

The first experiment noticeable is that of Dr Franklin and M. Rochon; but although curious, it is not polytypage in the common meaning, or the art of producing letters in relief. But it is very ingenious, and is the first step in that art. Franklin made an exceedingly glutinous ink, with which he wrote upon thin paper, in the ordinary manner, but rather coarsely. This writing he powdered with pounded emery or iron filings, and it was then placed between two plates, of which the lower one was exceedingly hard, and the upper one extremely soft. These were then passed between a rolling press, when the iron-filings or emery sunk into the softer plate, from which impressions might be taken in the manner of copperplate printing. The effect, as may be supposed, was exceedingly rough and unsightly. M. Rochon then proposed to write with a steel point upon a prepared plate, and bite in the tracing; this would give impressions in reverse, which, whilst the ink was yet fresh, were to be pressed strongly between clean paper, the set-off upon which would be fit for use. By this unskilful means Rochon says many private works were circulated; but it is rather doubtful. M. Rochon next undertook a much more likely project, the stamping of punches, somewhat like types, into soft metal, in the same order and with as much rapidity as they are composed in ordinary printing, with mechanical contrivances to make the impressions stand well, and also to insure the even depression of every letter. These stamped plates were originally intended to be printed by the rolling press; but afterwards the scheme was entertained of taking a cast from the plate in type-metal, and printing from that. It does not appear that this idea was brought into practice.

In 1780, Hoffman, a German, residing in France, brought stereotyping to considerable height; but, not satisfied with his success, he made many ingenious efforts in polytypage. He first used Rochon's method; and whilst he was thus engaged, a practical printer, named Carez, started a new method, which Hoffman afterwards pursued. The page, after being composed in the ordinary manner, was attached, with the face downwards, to the under side of a heavy block of wood, suspended from a long beam. Immediately under the page was an anvil, on which was a tray of oiled paper, into which the workman poured a portion of melted lead, attentively watching the cooling. When the metal seemed on the point of setting, the page, block, and beam, were brought down with a very smart blow, forcing the face of the type into the cooling metal, and producing a very sharp mould; which again was made to take the place of the type upon the block, was struck in a similar manner upon fused metal, and would thus, as was said, produce a perfect and excellent stereotype plate, which, having been properly dressed at the edges and back, was affixed to the usual wooden raiser; nor does there seem any reason why more than one cast might not be made from the same mould. Carez appears to have practised this art to some extent, and successfully.

Hoffman was no doubt acquainted with this invention, for his next scheme was a modification of it. In order to avoid the expense of composition, he prepared a series of punches, consisting as well of single letters as of common French terminations, which, with a very ingenious instrument, he pressed into a thin layer of prepared clay; and this, when baked, he stamped upon a portion of fused metal, in Carez's manner, producing a stereotype plate. It must be quite evident that in practice this could never answer, because the lining of the letters, and the exact plane of the surface, cannot possibly be achieved with that nicety which is indispensable in printing. Unfortunately, also, the expense and trouble of stamping in the punches separately must be considerably greater than that of composing types, even were it practicable, which it does not seem to be.

In 1791, M. Gegembre printed the fifty sous notes of the Caisse Patriotique upon an improved plan. He caused the whole print of the notes to be engraved in relief upon a plate of steel, the letters and ornaments being run together in a manner impracticable with separate punches; and this engraving he pressed into a plate of alloyed copper, from which stereotyped casts were taken by Carez's process. Any number of these casts could be taken from the copper mould, as indeed was necessary, since, from the softness of the metal, they were rapidly worn out; and if by chance the copper mould became injured, a new one could be readily made from the steel engraving.

When the revolutionary government commenced issuing assignats, it became necessary to have an immense number of plates to work the enormous quantity of these documents required. A design having been approved of, artists were employed to engrave *three hundred* fac-similes. Of course, if three hundred so-called fac-similes could be engraved, there could be no difficulty to other artists in engraving another hundred, nor could even the bank-officers tell which was a forged fac-simile and which were engraved by their authority. The consequence was utter want of confidence in the government paper. To remedy this, the committee of assignats caused many experiments to be instituted for the production of plates which should be not only imitative and similar, but *pro re* identical. The plan adopted was the engraving a plate *in intaglio*, from which copper punches were obtained *in relief*, and called *mother-punches*. From these *daughters* were struck, which were perfect fac-similes of the original engraving, and were worked by the roller-press in the manner of copperplates. Guillot, the director, reported, that from one engraving, for the 400 livres assignats, he had struck or polytyped 897 *mother-punches* and 1487 *daughters*, of which number only 190 were defective; of the plate for the fifty livres assignats, 4760 mother-punches and 7684 daughters, 1140 of which were defective. The chief defect was, that frequently the air compressed in the mould of a single letter would effectually prevent the fused metal sinking to the full depth, and thus there would be no letter at all upon the plate. Upon the suppression of assignats this establishment was broken up; but some of the plates and matrices are in the public repositories of France. In printing the tickets of the national lottery, Gatteaux obtained the assistance of Didot the printer, whose firm soon afterwards issued proposals for printing polytyped editions of the classics, at very reduced prices; and in 1798 they issued an edition of Virgil, followed by many other works, remarkable for their neatness and cheapness; so that their

Poly-typage.

plans may be pronounced to have been completely successful. The process differs little from those before described.

Types of the usual form, but of very hard metal, being composed, are placed within a steel box, with the face downwards upon a plate of metal, and pressed slowly and smoothly, but with great force. Since, therefore, all the letters are forced simultaneously and evenly into the plate, no uneven impression takes place. They are then disengaged, and any faults are amended by striking in a punch of the defective letter. From the matrix thus obtained plates in relief are cast, from which the paper is worked, the matrix being put away to strike other plates if needed.

M. Héran, Didot's partner, having separated from the firm, applied himself to the improvement of the art, and hit upon a novel and ingenious mode. This was the formation of a set of types the very reverse of the common, viz. instead of the letter being in relief upon the shank, it was in intaglio; therefore every separate letter would be a die, and instead of the letter being reversed, it would stand as read on the paper. The spaces, quadrats, leads, &c. were of the exact height of the type. These were to be composed like types, so that the entire page would present the appearance of a plate of copper into which words, &c. had been punched; the matter was to be read in the metal without a proof, which, as the words read from left to right, was matter of no difficulty. Upon the matrix thus composed fused metal was to be pressed, which would obviously form a complete plate fit to be printed from; and the operation could be repeated until as many plates were struck off as were required. M. Héran first endeavoured to cast his types in a mould like that used by letter-founders; but the metal proved too soft, and he afterwards struck punches into shanks of copper of the required size. Works executed from such plates are of remarkable neatness, and the process may be pronounced of very great utility, although, as far as known, it has never been introduced into England.

Towards the end of the eighteenth century, Professor Wilson of Glasgow, being engaged in a series of experiments for making etchings upon glass with fluoric acid for the purposes of art, thought it possible to make polytypes of glass from engraved copperplates. In this he in some degree succeeded, having executed several polytypes in intaglio from moulds of copperplates, and in relief from woodcuts; but it cannot be said to have been practically successful, the lines not having any degree of sharpness in either case, whilst the brittleness of the material would be a decided objection.

Messrs Heath, Perkins, and other ingenious men, having turned their attention to the prevention of forgery of bank-notes, have produced many excellent plans, amongst which is that of Mr Heath, of taking the impression *en creux* from an engraving of hardened steel upon a cylinder of soft steel afterwards hardened, from which cylinder any number of the plates, fac-similes of the first, may be readily executed. This plan does not differ in any degree from that of Hoffman and Carez, save in respect of the cylinder; but the manner in which the engraving is executed on the original steel by the lathe is most astonishing. These plans have not been adopted by the Bank of England, but most country banks of issue have greedily adopted this almost complete safeguard against forgery.

Mr Brunel has lately invented an ingenious modification in the making of moulds, which consists in spreading a coating of shell-lac upon a plate of iron, and hardening it in the fire. This is then dipped into the melting-pot, and receives a thin covering of metal, and is then pressed upon the types. The impression produced thereby is most beautiful. The lead can never sink to any depth in the hollows of the page, there are no picks or other soils to clear away, but it may be doubted whether the lead would form a very good mould to cast from.

Printing in Colours.

Printing in Colours.

One of the most beautiful aids to typography, the art of printing in colours, has been entirely neglected in this country; at least as far as relates to the embellishing works of ordinary excellence with vignettes, capitals, tail-pieces, and other devices of fancy, in beautiful tints, in the manner of the early typographers. It is true that ingenious artists of the present day have exhibited much skill in illustrating works of natural history, and have shown wonderful genius in publications professedly connected with the fine arts; but, as far as regards the average printing of the day, it is entirely neglected. This may very easily be accounted for. To print in two colours occupies more than twice the time necessary to print in one; and it also requires more skill and ingenuity. These unfortunately must be paid for; and this pecuniary consideration is sufficient to banish from our pages this lovely art. So did not our forefathers; *they* took pride in choosing the most tasteful designs, the most harmonious colours, to illuminate their productions, and beguile the reader into study by the illusive charms of gold, and blue, and crimson. Fortunately, either time was of little value, or the exclusive possession of the market enabled them to demand remunerating prices for the time thus well bestowed; but in the bustle and competition of our more mercantile days, time is money, and blue and gold, scarlet and green, give way to the equally useful but infinitely less beautiful uniformity of unredeemed black. To a country printer, however, some knowledge of colour-printing would be of infinite advantage, because, as his founts of type are more limited, he can create unlimited variety by a judicious use of colours in job-work: moreover, as he has usually much more time upon his hands, his ingenuity would have ample scope for the production of small works of *vertù*, in a taste which cannot be indulged by the denizen of a busy metropolis.

Except in the execution of works of a very high order, and the imitation of intricate and delicate patterns, printing in colours requires no addition to the ordinary accomplishment of printing, other than considerable ingenuity, and a little practice in preparing the colours. The latter may, it is true, be purchased of the ink-maker prepared for use; but the charge for them is enormous, and they require constant replacement, whilst it is not possible to have on hand every variety of tint. By the purchase of the most simple materials from the oil-shop, the ingenious printer has at his hand every colour that fancy can require, at the most moderate cost, without waste or delay. The appliances are few and cheap: a muller, a marble slab, and a palette-knife; the materials, a can of printers' varnish, to be purchased of the ink-maker, which will keep any length of time, and the raw colours hereafter given, which may be purchased from time to time; care, however, being taken that they are of the best quality, or they will fade and turn rusty in a short time, and be a deformity instead of an ornament to the work.

Useful tints of RED may be prepared of orange lead, vermilion, burnt sienna, Venetian red, Indian red, and lake. Vermilion is the most brilliant of these reds; but its beauty depends very much upon the particular parcel used. The pale vermilion is best for a bright tint, as the dark, when mixed with the varnish, produces a dull red. Orange lead and vermilion ground together produce a very bright tint, which is more permanent than vermilion alone.

YELLOWS are prepared with yellow ochre, gamboge, and chromate of lead. Of these, the brightest is the chrome; yellow ochre, when mixed with the varnish, produces a very dull tint.

Blues are made from indigo, Prussian blue, and Antwerp blue. Of these, indigo is exceedingly dark, and not very easily lightened. Prussian blue is a very useful colour; Antwerp blue is very light.

Greens may be produced from a mixture of any of the blues and yellows, as gamboge and Prussian blue, chromate of lead and Prussian blue. These may be mixed in any proportions until the required tint is produced; but it must be remembered that the varnish has a considerable yellow tinge, and will produce a decided effect upon the mixture. With a slight portion of Antwerp blue it will, without the mixture of any of the yellows, produce a decidedly greenish tinge.

Purples of any degree of richness are made by judiciously mixing reds and blues.

Sæpia produces a nice brown tint, burnt umber a very hot brown, raw umber a much lighter brown, bistre a brighter still. Neutral tints may be obtained by mixing Prussian blue, lake, and gamboge. In fact, every pigment that painters can use can be used in printing, avoiding, as much as possible, all heavy colours. In truth, if the printer is desirous of imitating any particular colour, or of producing any particular tint, he cannot do better than consult the nearest artist in oil or water colours (oil in preference), or in default of that, the neighbouring house-painter.

The necessary colours having been procured, the method of preparing them is very simple. Each must first be well ground by the muller upon the slab, even although they may have been purchased well powdered. The colour should then be well mixed with the palette-knife with the varnish, until the pigment has attained the required consistency, which will vary with the quality of the work to be executed; for if it be a posting-bill or coarse job, the ink should be very thin, and consequently a much larger proportion of varnish should be used. If, however, the work be a wood-cut or in small type, the pigment should be made as thick as possible. If the colour required be a compound, the predominant tint should be first mixed with the varnish, and the lighter tint added in small quantities, until the exact shade required be produced. Thus, if the colour be a dark green, the blue should be mixed up first, and the yellow added; but if it be a very light green, then the yellow should be first applied, and the blue added. If the tint desired be exceedingly light, it will be found that the quantity of raw material to be employed will not make the mixture sufficiently thick to be applied to the type or wood-block: in this case whitening is added to thin colours, and dry white lead to the heavier in considerable quantities, which must be adjusted in the course of mixing. To insure thorough combination, the mixture should be scraped into a corner of the slab, and a very small portion of it spread with the palette-knife, and well ground with the muller until no specks or lumps appear, then scraped up and placed in another corner. This should especially be done when white lead is used, as it will be found that every little lump when crushed will produce a white streak upon the slab. If this be not carefully done, independently of its tendency to clog the type, it will very materially alter the tint. When the pigment seems sufficiently mixed, it is better to bray it out with the muller instead of the usual brayer, and grind again each particular portion immediately before it is used. Colours may be worked either with a ball or a roller. If the job be large and coarse, and the ink consequently thin, the roller will answer every purpose; but if it be small, and requiring much nicety in the manipulation, decidedly with a ball; but in either case the ink should be well distributed, and the form well beaten or rolled. When two or more colours are employed, they must be worked at as many different times. In this case extreme nicety in the register and justification is required, in order that every colour may fall in its just place, without overlaying any other tint employed in the print. This would be a great dis-sight in any case, but most especially where the composition of colours would produce a third; as, for instance, if any part of a blue line should unfortunately fall upon a yellow, a green outline would be the result. The simplest way to guard against this is to have the wood-blocks all cut to precisely the same size, with the print in the proper place upon each; when, therefore, the first colour has been worked, the form is unlocked, the block taken out, and the second block inserted; it then falls at once into its proper position. If the form consist of type, each line should be carefully composed in its proper body, that is, if three colours be employed for as many different lines in *Pica*, *Small Pica*, and *Long Primer*, the one to be first worked should be composed in pica *letters*, the other lines in small pica and long primer *quadrats*. When the second line is to be worked, its quadrats should be taken out and letters inserted, while the type of the first line should be removed and quadrats substituted; and so of the third line. The points on the tympan must never be moved. It is clear, therefore, that if the paper be placed upon the same point-holes as before, and if the form has never been moved, the new line cannot fail to fall into its proper place. The illustrative Plate CCCCXIV. has been worked upon this plan; the black, being the largest body, was first printed, as it afforded the best guide for subsequent working. The blue was next worked, because it was much easier to adjust it to the black, than to adjust the red so exactly that the blue should precisely surround it and yet not infringe upon or retreat from the black, while there would be no difficulty in making the other red portions fall in their proper places. In these cases the paper must never be suffered to dry; indeed the sooner each colour succeeds the other the better. If it be covered with a wet blanket, and the edges well sprinkled, the danger will be little; but if it should dry and shrink in the slightest degree, it will be impossible to obtain register. For printing red-letter days in almanacs and the rubrics in prayer-books (an almost extinct practice), an especial type is used called rubrical; it is cast about an m higher than ordinary type. The black is first worked, quadrats having been inserted in the places of the red letter, which are subsequently withdrawn, and the rubrical type inserted. But as, in so small an insertion in so large a body, this process does not attain any very good register, and is expensive withal, the red-letter days have been abandoned, and some other distinguishing type (generally old English or black) has been substituted, which sufficiently indicates the day. It would not be possible here to give sufficient instructions to enable a printer to execute landscapes, portraits, and other delicate subjects, in various colours and shades. The chief difference between this and other colour-printing consists mainly in the superior individual skill and ingenuity of the artist, the excellence and truth of his engravings, and the superiority of his appliances. In truth, before the printer can produce any great effect, he must be excellently qualified as a painter, which it is not the province of an article on printing to teach. It will be sufficient to state, that the lighter and more extensive tints, and especially those in which transparent colours are used, are worked first, the colour being gradually deepened by successive blocks, until the required effects are produced; and that the outline is printed last, to give sharpness and finish to the design. The curious reader is referred to Mr Savage's beautiful book on Decorative Printing, and to the many admirable productions of Mr Baxter and Mr Vizetelly. Mr Charles Knight has taken out a patent for a new process in printing in colours, the principle of which consists in a new mode of obtaining register of the different colours. It is understood that *all* the colours are printed before the sheet of paper is taken from the tympan, but not at one impression.

The outline is printed at a second operation. The means whereby this is effected may be learned as soon as the specification is enrolled. If the plan succeed (as yet it is but imperfectly tried), it will materially reduce the cost of coloured prints of all descriptions, and especially of maps.

Gold.

There is no difficulty in printing in gold; it is within the power of any typographer. The type is composed and made ready at press in the usual manner. A quantity of raw or burnt umber is mixed with printer's varnish, to the same consistency as it would be were it intended to be used as ink; but this mixture is then compounded with a considerable quantity of gold size, the same as that used by gilders and japanners. The first mixture is necessary, because it has been found that the umber will not combine with the size. The type is then rolled with this compound, in the same manner that ordinary ink is applied, and the impression is taken upon the paper. Leaf-gold is then laid over it with a piece of wool, and pressed slightly upon it. When the varnish has had time to set, a piece of wool is rubbed roughly over the part printed, and the superfluous leaf is thereby removed, leaving the gold adhering to the varnish. The sharpness of the print will vary with the judgment of the printer in the quantity of sizing applied to the type; for if the press-work be bad, the print will be bad also. For inferior gold-printing bronze powder is extensively used. For this the varnish is made very much thicker than for gold; the method of printing is the same; but after the impression has been given, the powder is brushed over the print, and will adhere thereto, whilst the superfluity may be easily removed. In printing the golden Coronation Sun with this powder, a very distressing disease arose, the hair became perfectly green, and the men were very seriously affected; great caution should therefore be taken that particles of the powder be not allowed to fly about the room. Dutch gold cannot be used as a substitute for gold leaf.

Bank-Notes.

Bank-notes.

The numbers of bank-notes are printed by an exceedingly ingenious process, which, being regulated by machinery, makes it impossible to commit any fraud by printing two notes with the same number. The apparatus consists of a series of brass discs, of which the rim is divided by channels into projecting compartments, each containing a figure. The numbers 1 to 9 having been printed in the course of the revolution of the first disc, and this disc having returned to figure 1, the second disc comes into play and presents a 0, and the two together therefore print 10. The first disc now remains stationary until, in the course of the revolution of the second disc, the numbers 1 to 19 have been printed, when it presents the figure 2, and does not again move until another revolution of the second disc completes the number 20 to 29. Thus the two discs proceed until 99 notes have been numbered, when the third disc comes into operation, and, with the two first, produces 100, consequently the first disc performs one hundred revolutions to ten of the second and one of the third. The notes may be numbered indefinitely by this process, without the possibility of error, the machine, meanwhile, being its own check.

Printing Presses.

Printing presses.

In the description of the Stanhope Press it has been stated that many other presses upon different principles have recently been invented; most of these, however, contain some application of the Stanhope power. The most powerful, but the most expensive, of these is the Columbian or Clymer Press. The power in this is acquired by an extremely powerful lever, the pivot of which is in the top of the near staple: it passes entirely over the press, and is pulled down by a bar inserted in the near side, connected with the Stanhope coupling bar, &c. The platten is attached to the centre of the lever, therefore the impression is perfectly vertical. The principle may be popularly understood by balancing a ruler upon the edge of a piece of wood, holding firmly one end in the left hand, and pressing down the other with the right: indeed a very fair impression of a small wood-cut may be obtained by placing it with the face downwards upon a soft pad, fixing one end of a bar of wood under a staple, and pressing down the other.

Cogger's Press is very powerful. Its principle is a sector or piece of curved steel, so arranged that the lower portion is more curved than the upper; a steel stud traverses upon this. When it moves over the lower and more inclined portion of the sector, it brings down the platten with great rapidity; but in traversing the upper portion, as it presents a less inclined plane, the power is consequently much increased, and is greatest, very great, at the pinch. These presses are complained of by the workmen as being very slow; but the greatest objection to them is, that in making short pulls a ledge is worn upon the sectors, which is a great obstruction to a long fair pull: with proper attention by the pressman this would not occur.

The *Albion* Press, manufactured by Cope's executors, is a general favourite for its exceeding lightness; it runs very easily, the pull is short, the power great, and the means whereby it is attained so simple that there is little fear of the press getting out of order; it is very easily taken down for cleaning, and put up again. The power is gained by causing an inclined piece of steel to become perpendicular; in so doing the platten descends, and the impression takes place at the moment the piece of steel is assuming its upright position.

Cope and Sherwin's *Imperial* is another very excellent press, upon principles which do not greatly differ from the Albion: they are very numerous.

In Harrild's Press the power is obtained by the straightening a knuckle or elbow-joint, in precisely the same manner as the bent arm is straightened. Being of very expensive construction, they have not obtained great sale.

Printing Machines.

Printing machines.

As long as the thirst for literature was confined to books and a few periodicals of limited sale and size, the ordinary printing presses sufficed to supply the demand; nor was it discovered that any further speed was requisite, until the increased facility of conveyance, and the important events at the close of the last century, created a demand for news, that the utmost exertions of the printers were unable to supply; for the attempt to increase the speed by the composition of two distinct forms of type would avail little, so long as the presses could turn out only two hundred and fifty or three hundred sheets each per hour. Accordingly, for this branch of the art were the first machines projected. Many schemes were proposed for accelerating the movements of the press; but the first attempts at anything like the machine afterwards introduced were made by William Nicholson, a gentleman connected with periodical literature, who took out a patent about 1790, for a printing machine, of which the chief points were the following: The type was to be fixed upon a cylinder, being cast narrower towards the bottom, in order, as it were, to radiate from the centre of it. This cylinder, with its type, was to revolve in gear with another cylinder covered with soft leather; an inking apparatus was applied to the type-cylinder, and the paper was to be impressed by passing between the two; most of these plans were, when modified, adopted by after-constructors. This machine was never brought into practice. König, an ingenious German, was the next who undertook to construct a machine; and, having made considerable advance in his plans, obtained a contract with Mr Walters, the proprietor of the Times newspaper, for manufacturing two for that journal. In these Nicholson's plan was so far altered, that the type was laid upon a flat surface, and the impression was given by their passing under a cylinder of great size. He afterwards invented a machine in which the sheet was printed on both sides before it left the machinery; but, in both, his arrangements for the equal distribution of the ink were so complicated and clumsy, consisting of not less than forty wheels, and the works of every part of the machine so intricate, that it never came into practical use. The first really useful machine was constructed by Messrs Applegarth and Cowper, being an extensive modification of that of König; its principle improvement consisting in the application of two drums between the impression-cylinders, for the purpose of insuring the register of the sheet, by retaining it, after the impression of the first form, just so long that it may pass on to the second cylinder in exact time to be impressed thereby upon the second form; and of the distribution of the ink upon a plane surface, instead of by a complication of rollers, by which König's monstrous machinery was got rid of. These machines are now in general use.

For newspapers, machines are generally made to work but one side at a time. It is manifest that a machine will work a much greater number (more than double) of one form than of two; and that the machinery will be lighter and less expensive, and of course require less motive power. One form, therefore, of a newspaper, containing advertisements and the less important matter, is worked at leisure; and the second form, containing the leading article, important news, and other matter of consequence, is reserved until the last moment, and is then thrown off with immense rapidity. For the usual description of book-work, machines are constructed to work both forms. In these, perfect register and the exact and even distribution of the ink are of the greatest consequence, and such immense rapidity is not necessary. These machines, therefore, differ very much in construction, though not in principle, from those used for newspapers.

In Plate CCCCXV. will be found an engraving of Cowper's admirable perfecting machine, an explanation of which will comprehend a sufficient description of the single machine. Upon slides running the length of the frame which supports the whole machine, traverses a carriage which conveys the two forms of type, and attached to both ends of which are tables for the distribution of the ink. The reciprocating motion is given to this carriage by means of a pinion, which works alternately upon the upper and under surface of a rack. In gear with this carriage, and, supposing the paper to be omitted, in immediate contact with the type, revolve two cylinders of large dimensions, by which the impression is given; these cylinders are separated by the registering drums, but are kept in uniform and steady motion by two large wheels, the teeth of which work within each other. The ink is distributed over the forms by an apparatus attached to each end of the frame, consisting of a trough which contains the ink, in contact with the edge of which, or very nearly so, a metal roller called the *ductor* is made to revolve slowly by means of a catgut, which passes over a pulley attached to the axis of the impression-cylinder. A composition-roller is made to rise into contact with the ductor and receive a portion of ink, with which it descends, and thus communicates it to the inking-table as that passes underneath it at the extremity of the traverse. Two composition-rollers are placed somewhat diagonally across the frame, and their spindles being of extra length, as the table passes under them they are caused to revolve and also to travel slightly across it, thus evenly distributing the ink all over the surface of the inking-table, the cross motion removing any accidental accumulation of ink. The table now traverses under four other composition-rollers, supplying them with an even quantity of colour, which they in turn distribute over the type as it passes under them in going and returning, the form being thus rolled no less than eight times. These rollers are merely dropped into notches in the frame, their own weight sufficing to retain them in their places, and give the necessary impact upon the type. For the purpose of carrying the paper round the different cylinders there are two distinct series of endless tapes, one of which, coming in contact with the left surface of a small roller,[1] passes from thence to the right surface of the first cylinder, and underneath it; thence *over* the first and *under* the second drum; thence to the left surface of and under the second cylinder; from this it passes to the right, until it arrives at the roller first mentioned. The course of the second series of tapes is different; for, following the course of the first series, and in contact with it (supposing the paper withdrawn) until it has passed with it under the second cylinder, it then takes a different direction, and, turning to the left, passes over the machine until it arrives at the roller from which we have commenced the description. Both series of tapes are kept tightly stretched by means of various small rollers revolving in different parts of their course. The paper being laid upon other tapes from a table at the right of the machine, is moved forward until it comes in contact with the endless tapes, and being received between them, it is passed under the first cylinder, and the first side is then printed; thence passing over and under the drums on to the second cylinder, it receives the impression upon the other side; thence it passes onward to the point where the tapes take different directions, when it is shot out printed on both sides, upon a board between the cylinders and under the drums. The whole machine is put in motion by means of a strap which passes over a wheel under the frame, and *may* be worked by the power of men, but is mostly worked by steam. It is capable of doing very fair work at the rate of from 2000 to 2400 impressions, or 1000 or 1200 perfect sheets, per hour; it requires but two boys, one to lay on and one to take off the sheets.

The machine with which the Times is printed is also constructed by Messrs Applegarth and Cowper. It consists of four impression-cylinders, two of which are in contact with the types at the same moment; the other two rising in the meanwhile. There are consequently eight series of tapes, two for each cylinder. It requires four boys to lay on and four to take off, and the machine will give 4200 impressions within the hour. Its appearance, of course, differs very much from the machine before described.

The ingenuity of these gentlemen, especially of Mr Cowper, has been exerted in the invention of many mechanical improvements in printing. Several of his machines, upon various constructions, have been brought into use with considerable success. These, however, are the principal machines of his invention. They at first, it is believed, turned their attention to the fixing stereotype plates upon the periphery of the impression-cylinder, and brought the scheme into practice; but these are superseded by the simpler and more useful machines above described.

The machines of Mr Napier are in very general repute. They have the advantage of being easily worked by two men, thus saving the great expense and unavoidable dirt where a steam-engine is employed, with its necessary appliances, boilers, coals, &c. They stand in a very small compass, and do beautiful work. As far as regards motion and impression, they do not greatly vary from those previously described; but in the method of conveying the paper, obtaining register, and inking, they are altogether different. The paper is laid to a certain gauge, when in the revolution of the cylinder grippers are made to compress the edge of the paper upon it, very much in the manner in which the fore-finger closes on the thumb. It is by these means conveyed entirely round it, in the course of which the first impression is given. At the commencement of the second revolution these grippers open at the precise moment the grippers attached to the second cylinder close, and thus convey the sheet over the second form. Tapes pass under the second cylinder, *between* the blanket and the paper, and over a pulley upon a bar, by the mere friction of which the sheet is thrown out upon a board. These grippers are made to act with such perfect certainty that the best possible register is obtained. The inking apparatus consists of a trough with a ductor and vibrating roller, which communicates the ink to composition-rollers, by the revolution of which in contact with each other the ink is perfectly distributed, and from these to the type. A cross motion is communicated to the distributing roller by means of a worm in the elongated spindle. As but one impression is given during the traverse of the table in each direction, the cylinder which does not at the moment hold the paper would be in contact with the type, had not Mr Napier added a beautiful adjustment, whereby the cylinders rise and fall alternately, so that the one not in use passes over the form intact. This machine will work from 1000 to 1200 perfect sheets per hour, and requires but two boys. Mr Napier has constructed several other machines of great merit, one of which, for newspapers, will perfect 2000 sheets per hour by the labour of two men. Another with four cylinders, for rapid newspaper work, prints the Morning Chronicle newspaper at the rate of 6000 sheets on one side per hour. But the perfection of speed will be obtained by one for which he has lately taken out a patent, by which the extraordinary speed of 15,000 or 20,000 per hour will be obtained. The ordinary type is affixed to the periphery of a cylinder of enormous dimensions, in contact with which ten smaller impression-cylinders revolve, each with its inking and other apparatus so arranged that every revolution of the large cylinder works ten sheets of any size; and yet so steady and so silent is its motion, that there is no danger of any disruption of the type, even at that extraordinary rate. The types are held in their place by means of the rules, which are made considerably larger at the top than at the bottom, thus occupying the space which would be found in consequence of the types not being so formed as to radiate from the centre of the cylinder. Mr Napier is the inventor of many very ingenious improvements in the machinery of printing.

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[1] The description commences with that portion of the machine where the paper first enters the machinery, for *endless* tapes can of course have no *beginning*; the words *first*, *second*, and *third*, &c. must therefore be understood to refer to the position as respects the *right hand* of the reader.

Mr Rowland Hill has brought into partial use a machine giving 10,000 impressions per hour; the types are slightly pyramidical, in order to radiate from the centre of the cylinder upon which they are fixed. These machines, however, are better adapted to printing stereotype plates, to which a curved form could be given, which is the principle of Nicholson's and other early machines.

A machine-press has long been at work in Mr Spottiswoode's office, in which the impression is given by a self-acting platten, tables, rollers, friskets, and tympans. It does beautiful work, at the rate of 600 or 700 impressions per hour.

A well-seeming press has also lately been imported from America, in which there is an admirable application of two friskets, which are made to run in and out and rise and fall alternately. The tympan is upon the platten. There appears, however, to be some practical defects in the working. Owing either to this or their high price, or prejudice, they have not been successfully introduced.

These are by no means all the machines that have been devised, constructed, or brought into use. They are, however, all that it is necessary to mention, as the same principle is common to all. Every maker is at liberty to build them, with such modifications as his own talents may suggest.

The many-coloured excise stamps and cheques are printed by very complicated and ingenious machinery, the invention of the late Sir William Congreve. They are printed from steel or copper plates, the plate from which the dominant colour (as black) is transferred being cut away in those parts where the red appears, whilst the red plate has the parts which are to receive the ink in relief; the edges of the two plates being bevelled, the relievo of the red plate fits with exquisite nicety into the corresponding parts of the black plate; these being properly adjusted on the machinery, the red plate descends, and is then coloured by rollers, as is the black plate, which remains stationary; the red plate now rising, fits itself into the black plate, and the impression is instantly given, thus printing both colours at once, and with such excellent adjustment, that it is almost impossible, by the minutest examination of the print, to form any guess of the mode of execution. The apparatus for adjusting these plates has of course nothing in common with ordinary printing machines, and it differs materially from them in other respects: the table is stationary, the cylinder traverses over it, and the inking appliances follow it in its traverse.

Copperplate Printing.

Copper-plate printing.

It has already been mentioned that the principle of printing from engravings on copper or steel is the very reverse of printing from types, inasmuch as the former are graven in intaglio and the latter in relief, and consequently the pigments are contained within the lines of the one, and the surface of the plate is free of all colouring matter, whilst the surface of the other is carefully covered with ink, and the depressions as carefully kept clean. It must be sufficiently obvious that these essential differences must require very different manipulations. Accordingly, the printing of such engravings has little in common with letter-press printing. The copperplate or roller press may be described as consisting of two upright cheeks, with ribs diverging at right angles. At a short distance above these ribs is a solid iron cylinder, which is made to revolve by means of a star, consisting of many radii, as long as the height from the ground will permit. Upon the ribs runs a carriage; under the carriage, but not attached to it, is a roller, which, by means of a lever, is made to rise, thus pressing the carriage with any degree of force against the upper cylinder. The copperplate is laid over a brazier of ignited charcoal, and when at a sufficient heat the workman takes a considerable quantity of ink upon a rubber of linen rag, and smears the whole face of the plate, working it carefully into every mark of the graver; the heat of the fire, at once expelling the air and thinning the ink, causes it to enter into the minutest strokes, so that the slightest scratch or corrosion in the copper presents itself upon the paper: a plate even not sufficiently polished, that presents no visible defects to the clearest eye, will cause the paper to appear dirty; so exact are the effects of this mode of printing. When the ink has been sufficiently rubbed in, the face of the plate is cleared of the superfluous ink with another linen rubber; the workman, then, with the balls of his hands, carefully cleanses the surface, drying his hands upon a lump of whitening, until the face is perfectly cleaned and polished. In this operation the skill of the workman is exhibited, for in thus cleansing the plate he must be most careful not to rub out the ink from the gravures, and to leave colour proportioned to the depths of shadows required; for although the engraver may, indeed must, have defined every stroke, much depends upon the manner in which the printer does his part. It is not every man that has a rolling press that can produce first-rate prints. On the contrary, he must be himself no inconsiderable artist, and stands in a much higher relation to the engraver than the bellows-blower to the organist. The plate being ready for printing, is removed from the brazier to the carriage of the press; the paper, well damped, is laid upon it; a leather tympan is closed over it, the carriage run in a little, and the lever raised; the carriage, &c. being thus brought into close contact with the upper roller, the latter is made to revolve by turning the star; this causes the carriage and plate to run in, and thus an immense lineal impression is given to every part. The ink used in copperplate printing differs somewhat from that used by letter-press printers. It is of two kinds; one for fine ornamental work, one for common printing. For fine work, such as large and delicate engravings, the material used is the finest Frankfort black; it is ground on a stone with a muller, and mixed with weak burnt linseed oil, until it attains a consistency of thick paste; a little strong burnt oil is then added, and it is then ground up again, a drier to make the ink set firm on the paper being added. The drier is composed of small portions of litharge, white copperas, and sugar of lead; these should be well pounded with the muller before they are ground up with the oil and black. A small portion of the best Prussian blue may be added; but the greatest care must be taken that it be well triturated, as otherwise it is liable to make the best work smear. The blue must be ground up by itself with weak oil; to this driers are to be added. The whole compound is then to be ground up again, and added to the black: the mixture must be then ground upon the stone for about ten minutes, the palette-knife being freely used until all portions are thoroughly commingled. The ink for common work is prepared in the same manner, but without the Prussian blue; and the common English black is substituted for that of Frankfort.

Copper-plate presses, of a superior description, made chiefly of iron and brass, have lately been introduced, in which several excellent appliances are to be found to diminish the labour and improve the general quality of the work. The most important improvement would appear to consist in heating and inking the plates without removing them from the press, and distributing the ink over the surface and in great measure removing it by means of composition-rollers, the ultimate cleansing being left to manual skill as before. In copper-plate printing, however, so much depends upon the skill and care of the workman, that whatever improvement may be made in the mode of gaining pressure and other mechanical means, it does not appear probable that the present slow and careful progress will ever be superseded. (B. D.)

PRINTS, the impression taken from a copperplate engraved. See ENGRAVING.

PRIOR, in general, something before or nearer the beginning than another with which it is compared.

PRIOR more particularly denotes the superior of a convent of monks, or the next under the abbot.

Grand PRIOR is the superior of a large abbey, where several heads are required.

PRIOR, *Matthew*, an eminent English poet, was born at London in the year 1664. His father dying whilst he was very young, an uncle, a vintner, gave him some education at Westminster school, and then took him home to train him up to his own trade. However, at his leisure hours he prosecuted the study of the classics, particularly that of his favourite Horace. Through the influence of the Earl of Dorset he was sent to St John's College in Cambridge, where, in 1686, he took the degree of bachelor of arts, and afterwards became fellow of his college. In 1710, he was supposed to have had a share in writing the *Examiner*. In 1711, he was made one of the commissioners of the customs; and was sent as minister plenipotentiary to France, for negotiating a peace with that kingdom. Soon after the accession of George I. to the throne of England in 1714, he presented a memorial to the court of France, requiring the demolition of the canal and new works at Mardyke. The year following he was recalled; and upon his arrival was seized by a warrant from the House of Commons, and strictly examined by a committee of the privy council. Mr Robert Walpole moved the House of Commons for an impeachment against him; and Mr Prior was ordered into close custody. In 1717, he was excepted out of the act of grace; however, at the close of that year he was set at liberty. The remainder of his days he spent in tranquillity and retirement, and died in 1721.

PRIORIES, ALIEN, were cells of the religious houses in England which belonged to foreign monasteries. When manors or tithes were given to foreign convents, the monks, either to increase their own rule, or rather to have faithful stewards of their revenues, built a small convent here for the reception of such a number as they thought proper, and constituted priors over them. Within these cells there was the same distinction as in those priories which were cells subordinate to some great abbey. These alien priories were most of them founded by such as had foreign abbeys founded by themselves or by some of their family. The whole number is not exactly ascertained. Dugdale has given a list of a hundred, Weever of a hundred and ten.

PRISCIANUS, one of the most celebrated of the ancient grammarians, was surnamed Cæsariensis, either because he was born at Cæsarea, or had received his education there. He flourished in the reign of Justin (A. D. 518–527), and was a contemporary of the philosopher Boethius, and of Cassiodorus, the minister of Theodoric king of the Goths. He taught grammar at Constantinople, and received a salary from the court, which makes it probable that he was a Christian. Priscianus was distinguished for his thorough acquaintance with grammar, of which he has left us a proof, in a very complete work on that subject. It bears the title, *Commentariorum Grammaticorum libri xviii. ad Julianum;* or, in relation to its subject, *De Octo Partibus Orationis earundemque Constructione.* The first sixteen books are employed on an examination of the eight parts of speech of the ancients, and the last two on syntax in the proper sense of the word. We have also a poem of the same author, in hexameter verse, on the Emperor Anastasius, who died in the year 518; and the style and language are far purer than those of many others in the same age. We have also many other smaller works on grammar.

His grammatical works have been published by Krehl, Leipzig, 1819, in two vols.; and the smaller essays by Lindemann, Leyden, 1817.

PRISM, in *Geometry*, is a solid body, the two ends of which are any plane figures which are parallel, equal, and similar; and its sides, connecting those ends, are parallelograms.

PRISMOID is a solid body, somewhat resembling a prism, but its ends are any dissimilar parallel plane figures of the same number of sides, the upright sides being trapezoids. If the ends of the prismoid be bounded by dissimilar curves, it is sometimes called a *cylindroid.*

PRISONS.

The arrangements necessary to adapt prisons to the ends for which they are designed seem to require little more than the exercise of practical good sense; and yet the manner in which the practice of the world blunders on from one absurdity, and very often from one atrocity to another, shows pretty distinctly, how little the public affairs of mankind have hitherto had the benefit of that practical faculty, or of any thing that resembles it.

Ends of imprisonment.

Prisons have been applied to three purposes: 1*st*, That of safe custody; 2*dly*, That of punishment; 3*dly*, That of reformation.

It is very evident, that each of these purposes requires an arrangement of means peculiar to itself.

Though each requires a combination of means peculiar to itself, it does not follow that, of the means required for each, a portion may not be the same in all. Every body will acknowledge that this is the case.

The means of safe custody, for instance, are equally required for those who are imprisoned in order to be punished, and those who are imprisoned in order that they may be reformed, as for those who are imprisoned to the sole end of being made present at a particular time and place.

The arrangements, then, for safe custody, form a basis, on which every combination of means for attaining any of the other ends of imprisonment must always be erected. Other means for the attainment of these ends are to be considered as accessions to those required for the first.

It is a corollary from this position, that the same house may, at one and the same time, be employed for all the three purposes. Those properties in the building which make it fittest, at the least expense, for safe custody, make it fittest also for the purposes either of punishment or of reformation. This will be rendered abundantly apparent in the sequel; and from the single circumstance, that the means of punishment and reformation are only additions to those of safe custody, it wants not much of its demonstration already. If the arrangements needed, for those who are to be punished, and those who are to be reformed, interfere not with one another, or with those needed on account of the persons in safe custody merely, the truth of the corollary is indisputable; for nobody will deny that, in point of economy, there must be very great advantage.

Means of safe custody

I. We shall consider, first of all, what is the best combination of means for safe custody. Dungeons and fetters are the expedient of a barbarous age. And in respect of prisons, as of every thing which comes within the precincts of law, the expedients of a barbarous age are, with great industry, retained in those which are civilized; they are, indeed, not only retained with great industry, but preserved with a success which, if it were not experienced, would be altogether incredible. As the expedients of a barbarous age are still preserved in many more of the arrangements for the purposes of law, so it is but of yesterday that the prisons of our forefathers have been regarded as fit for reform, or the means which in their ancestorial wisdom those sages devised for attaining the ends of imprisonment were supposed capable of being altered for the better, by their less instructed sons.

It is at last, however, allowed, that inspection is a means for safe custody, which renders unnecessary all but very ordinary means of any other description. Thus, so long as a man is, and knows that he is, under the eyes of persons able and willing to prevent him, there is very little danger of his making an attempt, which he sees would be vain, to effect a breach in the wall, or force open the door, of his cell. Any great strength, therefore, in such wall or door, as well as fetters upon any part of his body, the object of which is to make provision against such an attempt, are wholly unnecessary; since the attempts are sure of not being made, or being instantly frustrated.

The plan of a prison, in which the power of inspection is rendered so complete, that the prisoner may be, and cannot know but that he is, under the eyes of his keepers, every moment of his time, and which we owe to General Bentham, so univerally known for his mechanical genius, is described by his brother, in his work entitled *Panopticon, or Inspection House;* where also a system of management is delineated, and its principles are so perfectly expounded and proved, that they who proceed in this road, with the principle of utility before them, can do little else than travel in his steps.

An idea of the contrivance may be conveyed in a few words. It is a circular building, of the width of a cell, and of any height; carried round a space, which remains vacant in the middle. The cells are all open inwards, having an iron grating instead of a wall, and, of course, are visible in every part to an eye properly placed in the vacant space. A narrow tower rises in the middle of that space, called the inspection tower, which serves for the residence of the keepers, and in which, by means of windows and blinds, they can see without being seen; the cells, by lights properly disposed, being capable of being rendered as visible by night as by day.

We have thus provision for safe custody; and along with it, five other important purposes are gained. First of all, there is great economy; the vast expense of thick, impenetrable walls, being rendered unnecessary. Secondly, all pretence of subjecting prisoners to the torture and degradation of irons is taken away. Thirdly, no misbehaviour of the prisoners can elude observation, and instant correction. Fourthly, no negligence, or corruption, or cruelty, on the part of the subordinate agents in the prison, can escape the view of their principals. And, fifthly, no misconduct towards the prisoners, on the part of their principals, can remain unknown to the public, who may obtain a regulated admittance into the inspection tower, and regulated communication with the prisoners.

The persons who are liable to be in prison, for sure custody merely, are of three classes. First, persons apprehended, and about to be put on their trial, for the commission of a crime. Secondly, persons convicted of a crime, and about to receive their punishment; and, thirdly, debtors.

Under a good system of law, very little provision would need to be made for these cases. It is one of the essential properties of a good system of law to permit as little time as possible to intervene between the apprehension and trial, and between the conviction and punishment, of a person for a crime. There would never, therefore, be many such persons in any prison at a time. And under a good system of law, there never would be any body in a prision on account of debt.[1] This is mentioned merely to show how little, under a good system of law, the apparatus and expense of a separate prison, for this set of cases, would be wanted.

These persons being inmates of a prison, for insuring their presence merely, the question is, What treatment they ought to receive?

Persons in prison before trial, and debtors, are persons of whom nothing is certainly known, but that they are unfortunate. They are, therefore, entitled to all the benevolence which is due to the unfortunate.

What is done for them in a prison must, however, be done at the expense of the community, that is, by sacrifices demanded of those who are not in prison; and those sacrifices ought, undoubtedly, to be the smallest possible. The question is, therefore, to be settled by a compromise between the principle of benevolence, and the principle of economy.

The principle of benevolence undoubtedly requires that the health of the prisoners should not be impaired; for this, importing the premature loss of life, is in reality the punishment of death, inflicted upon those to whom no punishment is due.

That health may not be impaired, three things are indispensable: 1st, a wholesome apartment; 2dly, a sufficiency of wholesome food; 3dly, sufficient clothing.

The principle of economy, with equal certainty, exacts, that all those should be of the cheapest possible kind.

All this is abundantly clear. It is equally clear that, with respect to those who are in prison for safe custody merely, the principle of benevolence requires, and the principle of economy does not forbid, that they should be free to use any indulgence, which costs nothing, or which they provide for themselves; and that no farther restraint should be placed upon their liberty than the custody of their persons, and the rule of economy, which prescribes the limits and accommodations of the place, may demand.

Few words will be necessary to show what is appropriate to the case of the man who is in prison during the interval between his sentence and his punishment.

By the supposition, in this case, his punishment is something distinct from his imprisonment; because, if not, it is a case which comes under another head, namely, that of persons who are in prison for the sake of punishment; and will be fully considered in another part of this discourse.

If he is in prison for detention merely, his punishment, as meted out and fixed by the judge, being something wholly separate; every particle of hardship imposed upon him, not necessary for his detention, is something without law, and contrary to law; is as much injustice and a crime, when inflicted upon him, as if inflicted upon any other member of the community. The same considerations, which, as we found above, ought to regulate the imprisonment of debtors, and persons in custody before trial, namely, the compromise between the principle of benevolence and the principle of economy, apply, without the smallest difference, to the case of persons who, during the interval between their sentence and its execution, are in prison for the mere purpose of preventing their escape.

We foresee a difficulty, or rather an objection, for there is really no difficulty in the case.

Persons come into prisons, who have been accustomed, in the preceding part of their lives, to all degrees of delicate and indulgent living; to whom, therefore, the hard fare prescribed by the principle of economy will occasion very different degrees of uneasiness.

Such persons, when in prison for safe custody merely (what is required when persons are in prison for punishment, or for reformation, will be seen hereafter), may be allowed to make use of any funds which they may possess for procuring to themselves all unexceptionable indulgencies. They may be also allowed the exercise of any lucrative art, consistent with the nature of the prison, for procuring to themselves the means of such indulgencies. This the principle of benevolence dictates, and there is nothing in the principle of economy which forbids it.

We shall be told, however, that there are persons who have been accustomed to a delicate mode of living, and who come into prison without the command of any funds, or the knowledge of any art, by which they may soften the hardship of their lot; and we shall be asked what is the course which our philosophy recommends for the treatment of them? The course which it recommends is very clear. Such persons are paupers, and whatsoever treatment is fit for paupers of the description to which they belong, is fit also for them. If there are any funds, to which as paupers they can apply, the application should be open to them. If there are none, and there is no person to whose benevolence they can resort, the effects of such a destitute situation must be sustained, the same way in a prison, as they must be, when any person falls into it, out of a prison.

Means of punishment

II. Having stated what appears to us necessary for illustrating the principles which ought to regulate the imprisonment of those, in respect to whom safe custody is the end in view, we come, in the next place, to the case of those, in respect to whom, in addition to safe custody, punishment is to be effected through the same medium.

This subject we shall unfortunately be under the necessity of treating superficially; because, in order to explain it fully, we ought to have before us the whole doctrine of punishment; and, for this purpose, a development, too extensive for the present purpose, would be required.

This we may assume as an indisputable principle; that whatever punishment is to be inflicted, should be determined by the judge, and by him alone; that it should be determined by its adaptation to the crime; and that it should not be competent to those to whom the execution of the sentence of the judge is entrusted, either to go beyond the line which he has drawn, or to fall short of it.

We have already established, on what seemed sufficient reasons, that for persons confined, on account of safe custody merely, the cheapest accommodation, not importing injury to health, in respect to apartment, food, and clothing, should alone be provided at the public expense.

Unless in the case of those whom the judge might condemn to lose a portion of their health, as the punishment due to them, by the sufferings of an unwholesome prison, unwholesome food, or improper clothing, this accommodation ought to be afforded even to those who are placed in prisons for the sake of punishment. And if it should be thought that the loss of health never can be a proper punishment, if it has never been regarded as such even by savages, and is repudiated by every principle of reason, then it follows, that the accommodations which we have described in the former part of this discourse, as required in the case of prisoners detained for safe custody, are required in the case of prisoners of every description.

This is a basis, therefore, upon which every thing is to rest. In every rational system of prison management, this is an essential condition. We are now to see in what manner, upon this footing, punishment, by means of imprisonment, is to be effected.

One mode is sufficiently obvious and sufficiently known. The punishment may be rendered more or less severe by its duration. Want of liberty is, in almost all cases, a source of uneasiness; want of liberty, added to the denial of all pleasures of sense, can hardly ever fail to be a source of great uneasiness. A long imprisonment, therefore, with the cheapest accommodation not importing injury to health, must be a severe punishment. This, it is evident, may be graduated to more or less of severity, not only by degrees of time, but the use of such means as the prisoner might command for procuring accommodations and indulgencies.

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[1] If evident fraud were committed in contracting the debt, or if the property of others, obtained by loan, had evidently been dishonestly spent, or dishonestly risked, such fraud or dishonesty, being crimes, not a debt, might justly subject a man to imprisonment, or any other sort of due punishment.

To this imprisonment may be added solitude. But though we mention this, as a practicable addition to simple imprisonment, it is well known how little, unless for short periods, and on very particular occasions, it is to be recommended.

The modes which lately have been most in repute, of adding to the severity of simple imprisonment for the purpose of punishment, have been two; 1st, hard labour; and, 2dly, bad prisons, and bad management in those prisons.

1. The species of labour which appears to have obtained the preference is that of treading on a wheel.

If a criminal in a prison is ever to be let out again, and to mix in society, it is desirable that nothing should be done, and least of all done on purpose, to make him a worse member of society than when he went in. There cannot be a worse quality of a punishment, than that it has a tendency to corrupt and deteriorate the individual on whom it is inflicted; unless, indeed, he is a prisoner for life; in that case, people of a certain temper might say, that making worse his disposition is a matter of little importance; and to them we have no time to make any reply.

Most of those persons who come into prison as criminals, are bad, because they have hated labour, and have had recourse to other means than their industry of attaining the supply of their wants and the gratification of their desires. People of industry, people who love labour, seldom become the criminal inmates of a prison.

One thing, however, is pretty certain, that men seldom become in love with their punishments. If the grand cause of the crimes which have brought a man to punishment is his not having a love but hatred of labour; to make labour his punishment, is only to make him hate it the more. If the more a man hates labour, the more he is likely to act as a bad member of society; to punish a man with labour, and then to turn him out upon society, is a course of legislation which savours not of the highest wisdom.

Besides, in treating labour as an instrument of punishment, call it *hard* labour, if you will, what sort of a lesson do you teach to the industrious and laborious class, who form the great body of your people? to those whose lot is labour, whose lot is hard labour, harder than any which it is in your power to impose? What compulsory labour is so hard as many species of voluntary labour?

As an instrument of reformation, labour, as we shall presently see, is invaluable. As an instrument of punishment, hardly any thing can be conceived more exceptionable. That which is the source of all that mankind enjoy, that which is the foundation of every virtue in the most numerous class of the community, would you stamp with ignominy and dishonour, by inflicting it as a punishment upon the worst and basest of your people? Is this your expedient for rendering it, what every wise legislator would wish to render it, honourable, and thence desirable?

There are other objections, perfectly decisive, against labour as a punishment. It operates with more inequality than almost any other instrument of punishment that ever has been invented. The same degree of labour would kill one man, that to another would be only a pastime. From this source we may apprehend the most horrid abuses, in the continuance of those tread-mills. We may be very sure, that the most atrocious cruelty will often be inflicted upon those who, with strength below the average standard, are placed in those penal engines; while, in the case of those whose strength is much above that standard, they will hardly operate as a punishment at all.

It is impossible that the judge can measure out this punishment; because the judge has not the means of ascertaining the relative strength of the parties who come before him. It must, therefore, be left to the jailor. The jailor, not the judge, will mete out and determine the degree of suffering which each individual is to undergo. The jailor, not the judge, is the man who adapts the punishment to the crime. Hence one of the stains which mark a careless and stupid legislation.

It is a far inferior, though still no inconsiderable proof of a blundering legislation, that the labour, if labour it must be, is not of such a sort as to be useful. The turning of a wheel, by human labour, when so many better means of turning it are possessed in abundance, is destitute of even this recommendation. It stands upon a similar footing with the contrivance of the jailor, whom Mr. Bentham celebrates: "We are told somewhere," he says, "towards the close of Sully's *Memoirs*, that for some time after the decease of that great and honest minister, certain high mounts were to be seen at no great distance from his house. These mounts were so many monuments of his charity. The poor in his neighbourhood happened to have industry to spare, and the best employment he could find for it was, to remove dirt from the place where it lay to another where it was of no use. By the mere force of innate genius, and without having ever put himself to school to learn the economy of a French minister, a plain English jailor, whom Howard met with, was seen practising this revived species of pyramid architecture in miniature. He had got a parcel of stones together at one end of his yard, and set the prisoners to bring them to the other; the task achieved, now, says he, you may fetch them back again. Being asked what was the object of this industry, his answer was, 'to plague the prisoners.'" In a note on this passage, Mr. Bentham says, "I beg the jailor's pardon; what is above was from memory; his contrivance was the setting them to saw wood with a blunt saw, made blunt on purpose. The removers of mounts were a committee of justices."

2. Bad prisons, and bad management in these prisons, is a mode of punishment, the recommendation of which has lately been revived, after we might have hoped that, in this country at least, it was exploded for ever. The language of such recommendation has, on several occasions, been heard in Parliament; and an article on Prison Discipline, which appeared in the *Edinburgh Review*, cannot be interpreted in any other sense. Even the Committee of the Society for the Improvement of Prison Discipline have not been able to withstand the force of what they may have supposed to be fashionable doctrine. In their *Fourth Report*, lately published, which we are sorry to say evinces more of good intention, than of enlightened views for its guidance, they say, "No charge can be more mistaken and unfounded, than that the plans recommended by this institution are calculated to introduce comfort into gaols. The committee are of opinion, and have always contended, that severe punishment must form the basis of an effective system of prison discipline;" thereby confounding two things, punishment, and prison discipline; which are totally distinct; and between which, it is of so much importance to preserve the distinction, that without it not a rational idea can be entertained about either.

No doubt crimes must be punished. Who needs instruction upon that head? But when the judge has prescribed, that, in a particular way, which he points out, a particular measure of pain shall be inflicted upon an individual; and when the individual is taken, and made to sustain the operations through which the pain is generated; what has this to do with the discipline of the prison? It is an act or series of acts, *sui generis*; acts not forming any part of the ordinary course of prison management; acts which would not have taken place, which ought not to have taken place, if the judge had not commanded them, and which were performed solely and exclusively in obedience to his commandment. This is the nature of punishment; other punishment than this there ought to be none.

The Committee would make severe punishment the basis of prison discipline. What business have the Committee with punishment? The assigning of punishment the legislature have given to other and fitter hands; to those who take cognizance of the offence, and alone ought to measure the punishment. Saying they would make punishment the basis of prison discipline, what do they intend by this ill-contrived expression? Do they mean, that their jailor shall hold the scales, and weigh out the proper quantity? If not, how are they to be understood; for if not the jailor but the judge is to weigh, and the jailor is to do nothing but punctually carry the prescription of the judge into execution, then is punishment, in no proper sense of the word, any part of prison discipline. It is a separate operation, performed on a particular occasion, because prescribed by the judge, and in the exact manner in which the judge has prescribed it. If it is, on the other hand, a part of prison discipline, then all the horrid consequences, inseparable from making the jailor the judge and meter of punishment, present themselves to the imagination; and he who can endure to look at them may dwell upon the picture of a prison, wherein the poor will not be more comfortable than at home, nor by the charms of imprisonment enticed to the commission of crimes.

Nothing can more clearly indicate that state of mind, which consists in confusion of ideas, than the vague language which we hear about the necessity of making prisons the seats of wretchedness, that crimes, they say, may not receive encouragement.

We have already seen, that, unless it is part of a man's punishment, expressly ordained, that he shall lose a portion of his health; that is, that his life shall be cut short; that is, that after a period of torture, he shall receive a capital punishment; a wholesome apartment, a sufficiency of wholesome food, proper clothing, all of the cheapest kind, must be provided for every body. When people talk about making prisons seats of wretchedness, do they mean something worse than this?

Many of them will no doubt answer, yes, we mean hard labour in addition. We ask again, do you mean hard labour, according to the prescription of the judge, or without the prescription of the judge? If according to the prescription of the judge, the case is the same with that which we have previously examined. This instrument of punishment is exceptionable, only because it is a bad instrument.

The whole matter evidently comes to this. If more wretchedness is desired than what is implied in confinement under the worst accommodation which the preservation of health admits, it must be meted out, either at the pleasure of the jailor, or the pleasure of the judge. The writer in the *Edinburgh Review*, and the Committee of the Society for the Improvement of Prison Discipline, speak as if they had never reflected upon the difference.

We do not mean to bestow a word upon that theory, which, for the prevention of offences, would make prisons scenes of wretchedness at the pleasure of the jailor.

The only question which can deserve a solution is, what mode of inflicting evil in a gaol can the judge make use of for best attaining the ends of punishment? The answer is not difficult. Unless, where that course of reformatory discipline, which we shall delineate under the next head, suffices; and we allow, that, though it may be made to involve no small degree of punishment, there are cases in which it would not suffice; it will certainly appear, that prisons are not the best instruments of punishment.

A single consideration suffices for the proof of this proposition. Punishment in a prison loses the grand requisite of a punishment, that of engendering the greatest quantity of terror in others, by the smallest quantity of suffering in the victim. The principal, perhaps the sole end of punishment, is to restrain by the example; because, with respect to the individual whom you have got, if you think society in any danger from him, you can keep him in sight, and no more is required. Yet, the language we hear about the tread-mill, and hear from the mouths of high persons, implies, that hardly any thing more is in their minds, than the effect upon the individual sufferers. "Nothing finer than the tread-mill; a fellow who has been in the tread-mill never comes back again." Be it so; but by your leave, this is a very insignificant part of the question.

The choice of expedients, for obtaining the punishment best adapted to the several cases for which a course of reformatory discipline does not suffice, belongs to another head of inquiry, and must, for the present purpose, be regarded as determined. All that it is necessary for us to show here is, that a prison is not the proper scene for it, nor the instruments of a prison the proper instruments. To render a punishment the most efficacious in accomplishing the great end of punishment, it must be a punishment calculated to make the strongest impression upon the senses, and, through the senses, upon the imagination, of the public at large; more especially of that part of the public who lie under the strongest temptations to the commission of similar crimes. But the punishments inflicted in a prison are withdrawn from the senses of the public, and seem as if they were intended to make the smallest possible, not the greatest possible, impression upon the imaginations of those who are to be deterred from crime. They are defective, therefore, in the most essential quality of a punishment, and can always be supplied by better means of attaining the same end.

The proper idea of a prison is that of a place of custody, and that alone. This idea ought to be clearly, and distinctly, and steadily preserved in the mind, in all disquisitions respecting prison discipline. Punishment and reformatory discipline may be annexed to safe custody; and in as far as they consist of a series of operations, requiring time for their performance, it is essential to them. As reformatory discipline consists wholly in such a series, imprisonment is a necessary condition of it. Since many, also, of the best kinds of punishment are not such as can be executed all at once, but require a period of time, imprisonment is equally necessary for these punishments. But though you must have safe custody to enable you to execute certain punishments, and also to enable you to carry into effect a course of reformatory discipline, safe custody is not the same thing with punishment, nor the same thing with reformatory discipline; and no conclusions can be depended upon, in which ideas so distinct are confounded.

Reformatory discipline.

III. Having thus considered prisons, as instruments of safe custody, and as instruments of punishment; two of the purposes to which they have been applied as means; it remains that we consider them as instruments of reformatory discipline, the third of the purposes to which they have been applied.

It is necessary, first of all, to state a clear idea of reformatory discipline.

When offences, against which it is necessary that society should have protection, are committed, it is desirable that the punishment of the offender should have three properties: 1*st*, That it should deter all other persons from committing a similar offence, which is its most important property. 2*dly*, That it should have the effect of deterring the man himself from a repetition of the offence. 3*dly*, That it should have the effect of removing his former bad habits, and planting useful habits in their stead. It is this last property which is sought to be communicated to his punishment by reformatory discipline.

As the creating and destroying of habits is the work of time, and as the restraint of safe custody, and restraint from all indulgencies, except under certain conditions, are necessary to reformatory discipline, whatever punishment is involved in such protracted coercion, is a necessary part of reformatory discipline.

What is desired is, to create a habit of doing useful acts, in order to break the habit of doing hurtful acts. To accomplish this, means must be obtained of making the individual in question perform certain acts, and abstain from the performance of certain other acts.

The means to be employed for producing performance cannot be of more than two sorts, the pleasurable and the painful. A man may be induced to perform certain acts, either by punishment or reward. He may be made to abstain from performing certain acts by an additional means, by withholding the power of performing them.

The latter is the means chiefly applicable for preventing the performance of hurtful acts in prisons; not only crimes, but acts of intemperance, gaming, or any others, the tendency of which is towards crime. As this is nearly the universal practice, the reasons of it must be so generally known, as not to need development.

The inquiry which chiefly calls for our attention is, what are the best means of producing the performance of those acts, the habit of performing which we desire to render so perfect, that it may be relied upon for the effect, even in a state of freedom?

The persons on whom reformatory discipline is intended to operate, belong to the class of those who depend upon their industry for their support. So nearly, at least, do they belong to this class exclusively, that the immaterial exceptions may, in this general inquiry, be omitted.

The necessary foundation, in the case of such persons, not only for all virtues, but for abstinence from crime, is the habit of performing some one of those series of acts, which are denominated lawful industry, and for which the performers obtain payment or reward.

Labour, therefore, in some of its useful branches, is to be regarded as the foundation of all reformatory discipline. But as the object of this discipline is to train the man to love, not to hate labour, we must not render the labour in such a case any part of his punishment. The labour must, for this important purpose, be a source of pleasure, not of pain.

The way in which labour becomes agreeable to men out of a prison, is the way in which it can be made agreeable to them in a prison; and there is no other. Advantages must accrue from the performing of it.

The way of attaching to it advantages the most intensely persuasive, in a reformatory prison or Penitentiary, is exceedingly obvious.

There it is easy to prevent the attaining of any pleasure, except through the medium of labour.

What is provided in the prison, according to the principles already explained, is lodging, food, and clothing, all of the very cheapest kind not producing injury to health. In the monotony of a prison, there is no one who will not intensely desire pleasure in addition to this.

In the sentence of a criminal, who is subjected to reformatory discipline, it may, and as often as the case requires, it ought, to be rendered a part, that he shall not be permitted to make any additions to this hard fare from any source belonging either to himself or others, except his labour; but that what he earns by his labour he may, in a certain way, lay out to procure to himself better food, or any other indulgence (certain hurtful ones excepted) which he may desire. Few cases, indeed, will be found in which this simple contrivance will not produce steadiness of application.

We have now then attained what is of principal importance. For if we have got the inmates of a prison to labour steadily in some useful branch of industry, to look to labour as the great or only source of their enjoyments, and to form habits of so doing, sufficiently confirmed to be depended upon for governing their conduct in a state of freedom, we have prepared them for being useful members of society, and our purpose is accomplished.

Here, then, comes the question, By what arrangements, in detail, can the business of confining, maintaining, and setting offenders to work, be most advantageously performed?

In other words, in what hands should the government of penitentiaries be placed, and under what rules should it be ordained for them to act?

It is an universal axiom in morals, that no security is equally to be depended upon for any desirable result, as the interest of those upon whom its accomplishment depends. If, in devolving upon a man the task of bringing about a particular end, we make it his interest to bring it about in the best possible manner, especially if we make it his interest in any high degree, we can hardly be disappointed in counting upon his most strenuous exertions. On the other hand, if he has no interest, or a very inconsiderable interest, in the end which he is entrusted to bring about; if little cognizance will be taken of his proceedings, whether good or bad; if to attend to the business would be exceedingly troublesome, to neglect it will produce little inconvenience; we may be very sure that, by a great majority of men, the business of the task devolved upon them will be very imperfectly performed. If they can make a profit out of oppression, or if, as is the case, to so great a degree in prisons, they can consult their ease by imposing additional and mischievous restraints upon the prisoners, their interests are strongly set against their duties, and ill conduct is still more perfectly secured.

This last, how deplorable soever the confession, is the state of management of all British prisons, with hardly any exception. There is a jailor, who receives a salary and power, and is told to manage the prison well; and there is a number of justices, that is, gentlemen of the neighbourhood, who obtain not a little power, and a great deal of praise, for undertaking to do certain public duties of a local nature, with little interest in doing them well, and no little interest in doing them in many respects exceedingly ill, who have the charge of looking after him. Varieties we cannot afford to particularize. This is the general description.

The management, then, of the prison, is the joint concern of the jailor and the justices, or magistrates, including sheriffs, who, jointly or severally, have no such interest, as can be expected generally to produce any considerable effect, in any thing more than such a kind of management as will not excite attention and indignation by its badness. All the degrees of bad management, which are within those limits, having little or no interest to prevent, they have abundant interest to permit.

It is surely not necessary, that we should go far into the detail of this case, to show the causes which it places in operation, and their natural effects.

First of all, it is sufficiently evident, that the jailor has an interest in obtaining his salary, and other emoluments, with as little trouble to himself as possible.

It is not less evident, that the magistrates have an interest in getting the power and credit attached to their office with as little trouble to themselves as possible.

This is enough. The book of human nature is clear upon the subject. This principle, at uncontrolled work in a prison, is perfectly sufficient to generate all the evils which those abodes of misery can be made to contain.

It is undeniable, that so far as those, who thus have the superintendence of jailors, are disposed to consult their ease, and to perform negligently a troublesome duty, which they may perform well or ill, just as they please, so far they will be indisposed to listen to any complaints against the jailor. It saves them a good deal of trouble to confide in the jailor. They speedily come, therefore, to look upon confidence in the jailor, and to speak of it as a good thing, a duty. "Has not the jailor been most carefully and judiciously selected for his office, by wise and good men? (namely ourselves). Would it not be an injury to a man of his character to distrust him? And to distrust him, for what? For the complaints of prisoners. But prisoners are always complaining, always giving trouble. Jailors are a good set of men. Prisoners are a bad set of men; especially complaining prisoners. They are the very worst kind of men; they are, therefore, to be silenced; and it is often very difficult to silence them; nothing but harsh measures will do it; when harsh measures, however, are absolutely necesssary, it is the duty of jailors to use them, and the duty of magistrates to protect such men in the discharge of so important a duty."

Such are the feelings and conclusions which are undeniably prompted, by the mere love of ease, in the bosom of such men as English magistrates.

So far as the magistrates consult their ease (men generally do consult their ease when they have not a preponderating motive to the contrary), the jailor is at liberty to consult his ease.

In the jailor's consulting his ease, every thing that is horrid in a prison finds its producing cause.

What the jailor has chiefly to guard against is, the escape of his prisoners, because that is a result which cannot be hidden, and will not escape animadversion. But the love of ease prompts him to take the easiest means for this purpose; locking up in dungeons, loading with irons, and prohibiting communication from without; in other words, all the measures which are the most tormenting to the prisoner. If the prisoner, confiding in his ingenuity or his strength, makes any attempts to free himself from this misery, by escaping, the disturbance which is thus given to the ease of the jailor is a cause of pain, proportional to the love with which he cherishes his ease; this pain excites resentment, resentment calls for vengeance, and the prisoner is cruelly punished. The demon despotism reigns in his most terrific form.

This is only one half of the evil. The servants of the jailor, the turnkeys, as they are called, and others who wait upon the prisoners, are as fond of their ease as the jailor is of his. If the jailor has no adequate motives to make him take care that the business of the prison is well done, he will repose the same confidence in his servants, which the magistrates so liberally exercise towards him. He will leave them to indulge their ease, as he could not do otherwise without disturbing his own.

From the servants of the prison indulging their ease, neglect of the prisoners is the immediate and unavoidable consequence. From neglect of prisoners, that is, of men placed in a situation destitute of all the means of helping themselves, all those evils, which, in another situation, could be produced only by the most direful oppression, immediately ensue.

Upon the servants of a gaol, cherishing their ease, and left by their superintendents to do so, every call of a prisoner for help, from relief from any annoyance, is felt as an injury, and resented as such. Cruelty speedily comes, as a co-operator with neglect, to fill up the measure of the prisoner's calamity.

The prisoner, finding himself destitute of all remedy, except he can prevail upon the people who approach him to remove some of the causes of the misery which he endures, has recourse to bribery, when he can possibly command the means; and then pillage, without limit and without mercy, is added to all the evils of this den of horrors.

If such are the consequences of entrusting the management of prisons to persons who have no interest, or not a sufficiency of interest, in good management, we have next to consider the important question, by what means a sufficiency of interest in good management can be created? We need not have any doubt, that if a sufficiency of good accrues to the managers from every particle of good management, and a sufficiency of evil from every particle of bad, we shall have as much as possible of the good, and as little as possible of the evil.

The grand object, as we have stated, of reformatory discipline is, to create habits of useful industry. A second object is, to preserve the health of the prisoners, and impose upon them no suffering, not implied in the conditions of their confinement, or prescribed by the judge. A third is, by moral and religious tuition, to generate and strengthen good dispositions. A fourth is, to attain those ends at the smallest possible expense.

It is not difficult to give the manager or keeper of a reformatory prison or penitentiary, a very strong interest in all these important results.

We have already seen, that the mode of giving to the prisoner a motive to labour, is, by giving him a share in the produce of his labour.

It is evident that an equally certain mode of giving to the jailor a motive for obtaining as much of that labour as possible, that is, for doing all that depends upon him to make the prisoners labour as much as possible, and as productively as possible, is by giving him also a share in the produce of their labour.

It may be said, however, that if the jailor receives a share of the labour of the prisoners, he will have a motive for making them labour too much: labour may be so excessive as to equal the severest torture.

Effectual expedients, however, for the prevention of this evil, are easy and obvious. In the first place, it does not seem necessary that the labour should be in any degree compulsory. If a prisoner is, according to the rule above laid down with respect to the cheapest fare, confined to the coarsest kind of bread, and water, if he does not labour, but has it in his power to add to his enjoyments by labouring, more especially if he may labour in company, but if he will not labour, must remain in solitude, the cases will be exceedingly few in which compulsion will be needful; and these might, if it were deemed of sufficient importance, be specially provided for by the legislature.

If a man may work, or not work, as he pleases, and much or little as he pleases, there is no need of any farther security against excessive labour. If there were, it would be afforded by the interest which it is easy to give to the jailor in the health of the prisoner.

Giving to the jailor a share in the produce of the labour of a prisoner has two happy effects; not only that of giving him an interest in rendering the value of that produce as great as possible, but that, also, of giving him an interest in the health of the prisoner, because the produce of a man's labour is greater when he is in health than when he is not.

This may be increased by giving to the jailor, through a very obvious channel, an interest, and an interest to any amount, in the life of each prisoner. It being ascertained what is the proportion of persons of a similar age that die annually, when not confined in a prison, all that is necessary is, to entitle the jailor to a sum of money for each of the individuals above that proportion whom he preserves alive, and to make him forfeit a sum for each individual above that proportion who dies. This sum, it is evident, may be sufficiently high, to ensure, on the part of the jailor, a strong desire for the life, and thence a proper attention to the health of the prisoners.

Another particular in this case requires attention. It is obvious, that the motive of the prisoner to render the quantity or value of his labour the greatest, is, when the share which he enjoys of it is the greatest. It is equally obvious, that the motive of the jailor to promote the augmentation of this quantity or value is the greatest when his share is the greatest.

If the whole of the produce of the labour of each of the prisoners were left to be divided between himself and the jailor, the motives of the two parties, taken jointly, would be at the highest. And the question then would be, according to what proportion should the division be made?

The peculiar circumstances of this case permit the most decisive answer to be returned. No evil can accrue, and every good purpose is best gained, by allowing the jailor to take as much as he pleases. It being first established that he can employ no compulsory methods, that the prisoner must have as much of the coarsest fare and accommodation as he needs, whether he works or not, and that work can thus be obtained from him only by the operation of reward, it will be the interest of the jailor to make his reward sufficiently high to obtain from him all the work which he can perform, and, in his situation as a criminal, he ought, generally speaking, to receive no more. The propriety of this regulation, therefore, rests on conclusive evidence.

Here, however, an objection worthy of attention occurs. If the jailor receives so great a proportion of the produce of the labour of the prisoners, he may receive a much higher remuneration than the nature of his duties requires; and so far the public is deprived of a fund which ought to be available for the public service.

This observation is true; and the question is, in what manner can the separation of what is necessary in remuneration of the jailor, and what should be detached for the benefit of the public, be most advantageously made?

If the situation of the jailor affords more than an adequate reward, he will be willing to give something annually in order to retain that situation. And for measuring exactly what he ought to give, there is a sure and well-tried expedient; it is, to lay the thing open to competition.

By this expedient, a double advantage is gained; for both the public receives as great a share of the produce of the labour of the prison, as is compatible with the due remuneration of the jailor; and the jailor being entitled, in the first instance, to share the whole of the produce with the labourers, having both to pay what he owes to the government, and obtain his own remuneration out of his share, has a motive as strong as if the whole were his own, to render the produce as great as possible.

It will easily be seen that this contract between the public and the jailor, if sufficient securities can be taken for its being cancelled, as soon as misconduct on his part should render it desirable that it should be so, ought, for important reasons, to be concluded for a considerable number of years, or for his life. It is of importance that those individuals, who are to undergo the reformatory discipline, and who are unacquainted with any trade, should, especially if they are young, be taught the trade in which their labours can be turned to the greatest account; and, to make it the interest of the jailor to have them taught, it is evident that he must have the prospect of enjoying the benefit of their skilled labour for a sufficient length of time. This short illustration we hope will suggest to the reader sufficient reflections for evidence on this point; and we must hasten to the remainder.

We have now shown, to how great an extent, upon the plan which we have thus briefly sketched, the interest of the jailor is rendered coincident with the ends which are in view, and the most effectual of all securities is obtained for the goodness of his management. We proceed to show what additional securities this plan enables us to provide.

Let us, first of all, attend to the power of inspection, which may be afforded in a degree altogether unparalleled. By the admirable properties of the building which we have recommended, not only is the conduct of the prisoners rendered wholly transparent to the jailor, but the conduct of the jailor may be rendered equally transparent to his inspectors. And as the central lodge, or tower of inspection, may be entered by any number, without giving the least disturbance to the prisoners, without their even knowing that any body is there, the public may be admitted on such terms as to afford the full benefit of public inspection, the most efficient of all inspections, over the whole economy of the prison. By means of whispering tubes, oral communication might be permitted with the prisoners, at such times, and under such regulations, as would prevent it from interfering with the working hours, or other parts of the discipline, to all persons who might have a wish to hear if they had any complaints.

Another very simple expedient would make an important addition to the list of securities. It ought to be an obligation on the jailor to keep a book, in which all complaints of the prisoners should be entered, and, as often as they could write, signed with their names. Along with the complaint should be entered a statement of what had been done for removing the ground of the complaint, or of the reasons for doing nothing. And this book should be open to the perusal of the public, and should lie in a place convenient for the inspection of all the visitors of the prison.

A still more important and indispensable security would be, the obligation of the jailor to present, annually, to the principal court of justice, such as the Court of King's Bench in England, a report on the management and state of the prison during the preceding year, containing, with all other points of useful information, exact accounts of the receipts and disbursements; to verify these statements by his oath; to print and publish them at his own expense; and to answer, upon oath, all interrogatories made to him in open court by the judge, or by any other person, how much soever the answer might tend to his own crimination; and this as often as the judge might call upon him for such a purpose. By this means, with the obvious security afforded for other still more important ends, so perfect a knowledge would be communicated of the gains of the jailor, and the mode of obtaining them, as would ensure an accurate bargain, rigidly proportioned to the amount of them, as often as the contract came to be renewed.

The last thing which we think it necessary to recommend in the shape of a security, would operate as a test of the efficacy of the management in its character of a reformatory discipline. The jailor should be held bound to pay a certain sum, varying in proportion to the length of time during which the prisoner had been subject to his discipline, for each of the prisoners who, after liberation, should be convicted of a crime.

Connected with the important part of the subject relating to the labour of the prisoners, it is proper to bring to view the advantage of a subsidiary establishment for receiving and employing those who might be liberated from the prison. It is a well-known ground of lamentation, that persons liberated from a prison, find often great difficulty in obtaining employment, and are constrained, by a kind of necessity, to betake themselves to their former evil courses, though with the inclination to have devoted themselves to honest industry, had the means not been denied them. The best mode of obviating this great evil would be, to have a subsidiary establishment, the architectural form the same as that of the prison, in which the jailor should be obliged to receive all persons who have been liberated from the prison, and who make application for admittance; and to employ them on the same terms as the prisoners, with the single exception of its being in their power to remove when they please, and to make, in respect to terms all such stipulations with the jailor as may be for their mutual advantage.

The next part of the subject to which we proceed, is the plan according to which the prison shall be supplied with the articles which the prisoners are enabled by their labour to purchase.

As there are certain articles, such as intoxicating liquors, which ought to be altogether withheld, unless for special reasons permitted, and as the jailor could not have a sufficient command over the articles conveyed into the prison, unless he had in his own hands the power of supply; as the intercourse, also, which would be created with strangers, if the prisoners were at liberty to purchase of whom they pleased, would be incompatible with the discipline of the prison, the power of supplying articles of purchase to the prisoners ought to be confined to the jailor.

If it be objected that the jailor would thus have the power of oppressing the prisoners, by selling bad articles, or good articles too dear, the answer is, that he could not. We have already seen, that in order to derive from the prisoners the greatest quantity of profit to himself, he must give to them a reward for their labour sufficient to make them labour to the most profitable account. But if he sells articles to them at more than the usual price, this is merely a reduction of the reward left to them for their labour: this he cannot reduce beyond a certain point, without reducing the amount of his profit; and any greater reward than up to this point, the nature of the case renders undesirable.

We have now then stated all that seems necessary to be said on the three great subjects: 1*st*, of the structure and form of the prison; 2*dly*, the securities which may be applied for obtaining good conduct on the part of the jailor; and, 3*dly*, the first and principal part of reformatory discipline, namely, voluntary labour.

The remaining conditions of reformatory discipline will not require much explanation.

1. Separation, as far as concerns the sexes, and as far as concerns the good from the bad, is now so generally attended to as an object of importance, that the danger sometimes is of other things being too much overlooked in the comparison.

In a prison, such as we have described, in which, by means of moveable partitions, the cells may be enlarged or contracted at pleasure, and in which the prisoners are all under continual inspection, the power of separation, to any desired extent, is complete.

The two sexes, though inmates of the same prison, and simultaneously subject to the same inspection, may be as completely disjoined as if they were inhabitants of a different region. By a piece of canvass, and nothing more costly, extended in the form of a curtain, from the boundary on each side of the female cells, in the direction of a radius across the central area to the inspection lodge, the females would be as completely cut off from seeing, or being seen by the male prisoners, as if they were separated by seas and mountains; the same effect would be obtained as to hearing, by merely leaving a cell vacant between those of the males and females; and thus the space appropriated to each of the two sexes might, in the easiest manner, be diminished or enlarged, as their relative numbers might require.

A much more complete and desirable separation than that which is aimed at, as the utmost in other prisons, is easily attainable in this. The ordinary separation of young offenders from old, of the greatly corrupted from those who are presumed to be less deeply infected, is still apt to leave associations too promiscuous and too numerous, not to be unfavourable to the progress of reformation.

The prisoners should be put together in companies of twos, and threes, and fours, seldom more; each company occupying a separate cell. It would be the interest of the jailor to put them together in such assortments as would be most conducive to the quantity and value of work they could perform, and to the goodness of their behaviour; that is, to the most perfect operation of the reformatory discipline; and his experience of their dispositions and faculties would of course fit him beyond any one else for making the selection.

It will have been all along understood, that, to attain the ends of inspection and economy, the same rooms or cells which form the day and working rooms on our plan, form also the sleeping rooms. Not the smallest inconvenience from confusion of things in the apartment can thence be derived; because the hammocks, which would be more convenient than beds, could be stowed away in little compass during the day.

It is also to be particularly observed, that whatever degree of seclusion might either be indulged to the feelings of an individual, or might be deemed conducive to his mental improvement, might still, upon this plan, be easily secured; because, by means of screens, a portion of the cell might be formed into as many private apartments as might be desired; and where experience of good conduct had laid a foundation for confidence, periods of seclusion, even from the eye of the inspector, might be allowed.

2. Nothing of great importance to be mentioned in this summary sketch seems now to remain, except schooling, and religious instruction.

The Sunday is the appropriate period of both. Sunday-schools are found by experience to be sufficient for communicating to children the important arts of reading, writing, and accounts. It would be obligatory on the jailor to afford the means of instruction in these respects to every prisoner who might not have attained them; together with all other means, not incompatible with the case, of promoting their moral and intellectual improvement.

3. The religious services proper to the day, and such other devotional exercises as might be thought requisite on other days, would be conducted by the chaplain, the prison affording remarkable facilities for bringing all the prisoners into a situation conveniently to hear; and also, which would be a circumstance of great importance, bringing the public from without, to participate in the religious services of the prison, for whom temporary accommodation in the vacant central area might be provided, and to whom, by the charms of eloquence and music, and the power of curiosity, it would be the interest of the jailor, by letting the seats, to provide sufficient attraction.

It seems to be necessary, before concluding, to obviate an objection, which, though it has seldom been urged as a reason against reformatory discipline, is yet considered as requiring a great deduction to be made in the estimate formed of its advantages. The objection is, that, by affording the means of employment to prisoners, we take away those means from a corresponding number of persons who are not prisoners, and thus sacrifice the deserving to the worthless.

This objection is drawn from some of the conclusions of Political Economy. That which affords the means of employment to labour is capital; in other words, the means of subsistence to the labourer, the tools he works with, and the raw material on which he is employed. When labourers are too numerous for the means of employment, it is evident that, if any new ones are added to the number, you can give employment to them only by taking it away from the old ones. It is, therefore, said, that by giving employment to prisoners, we make an equal number of honest workmen paupers.

In this objection, however, as is generally the case with false reasoning, a part only of the essential circumstances, not the whole, is taken into the account. In the first place, with regard to the prisoners, one principal part of the capital which puts labour in motion, namely, subsistence, is afforded to them of course, whether they labour or not.

In the next place, the objection proves too much; for, if it would be better, for the sake of affording employment to others, that the man should do nothing in prison, it would equally be better that he should have done nothing out of prison; better that we should have a portion of our population useless than productive. According to this doctrine, the proper rule, whenever population exceeds the demand for labour, and wages are low, would be to give subsistence to a portion of the people, on the condition of their abstaining from labour.

Thus much of the allegation is true, namely, that when to the subsistence, which you would have given at any rate, you add tools and raw materials, you so far diminish the quantity of tools and raw materials which can be furnished to others. But, counting only this circumstance, another most important circumstance is left out of the computation. This deduction of tools and raw materials is made once for all. The productive labourer replaces the capital, which employs him, with a profit. Advance to him, for one year, the food and other articles which he needs, you never need to advance any thing more. What he produces in the course of the year, replaces the food and all other articles which he has used, with a profit. But if he has not laboured, he has produced nothing; you have to supply him, therefore, with the means of subsistence, not one year, but every year, from the produce of other men's labour. If he labours, you have to give him once, out of the general stock of means for the employment of labour, subsistence for a year, with tools and raw material, and you have no occasion to give him any more. If he is to be idle, you give him, it is true, only subsistence, without tools and raw material, the first year; but you have to give him subsistence, that is, so far to diminish the means of employing other men's labour, every year; whereas, if he is a productive labourer, for the advance which you make to him the first year, he not only exempts you from all further deductions from the means of employing other men, but he every year adds to those means, by the whole amount of the profit made upon his labour. To make those persons, therefore, productive labourers, whom you must at any rate subsist, is to increase, not to diminish the means of employing others.

As to another objection which is sometimes offered, that the commodities produced in a prison glut the market, and injure other manufactures, this is still more evidently founded upon the consideration of part of the determining circumstance, without consideration of the remainder. If it is meant to apply not to one class, or two classes of commodities, but to the mass of commodities in general, it may instantly be seen to be untrue. The men who become sellers of the articles produced in a prison, become buyers to the same amount. Whenever a man sells a greater amount of articles than before, he gets the means of buying an equally greater amount. He always brings as much of a new demand into the market as he brings of a new supply. If he introduces more of some one commodity than the market requires, and reduces the profits on producing it, capital leaves that employment till the inequality is redressed. If the number of people is the same, and the quantity of commodities is increased, it is a contradiction in terms, not to say that the circumstances of such a people are improved.

Having answered these objections, it does not occur to us that there is any thing more which in this outline it is necessary for us to add. The plan, both of construction and management, appears to us simple, and easy to be understood; and to offer securities for the attainment of the end, such as the imperfection of the human powers seldom permit to be realized. In the delineation presented, the only merit we have to claim is that (if our endeavour has been successful) of adding perspicuity to compactness. There is not, we believe, an idea which did not originate with Mr. Bentham, whose work ought to be the manual of all those who are concerned in this material department of public administration. (A.A.A)

Observations in continuation.

THE preceding article has been preserved entire, as having been the offspring of a very powerful mind, and as presenting a perspicuous outline of the most advanced ideas of a good system of prison discipline, which prevailed up to the time of its publication, (April 1823.) Since that date, the art of managing prisons has made considerable progress, and experience has shewn more than one of the opinions above expressed to be erroneous. Some additional observations appear, therefore, to be requisite, in order to point out what has recently been done in this, and other countries, towards the advancement of this science; and what may be at present regarded as the leading objects to which all efforts for the perfection of prison discipline ought to be directed.

The public attention in England was first drawn to the evils of the existing prisons, towards the end of the last century, by the benevolent Howard; and the question of the establishment of a penitentiary system forced itself at the same time upon the consideration of the government, as a substitute for transportation, on account of the loss of the British North American Colonies, previously used for that purpose. Mr. Bentham's plan of the *Panopticon* was put forth at this juncture; but although the government seems to have had serious intentions of making some experiment of the kind, and more than one act of parliament for the erection of penitentiary houses was passed, no result followed, beyond the subsequent establishment of the penitentiary at Milbank for a certain number of convicts; a measure of too limited and partial a character to have any effect as a penal instrument, and, as it has turned out, equally worthless as a model for other prisons. The foundation, and gradual extension, of the penal colonies in New South Wales, provided an outlet for a large portion of the criminal population, and, in so far, diminished the urgency of the demand for penitentiaries; whilst the ordinary prisons continued to be managed with little thought or care, and without legislative interference. Even the review, by Sir Samuel Romilly's committee, in 1812, of the whole subject of secondary punishments, did not produce any improvement in the then existing system; and thus matters stood at the period when the preceding article appeared.

The gaol acts of 1823 and 1824,[1] which are now in force, and for which the country is indebted to the labours of Mr. Fowell Buxton and the London Prison Discipline Society, effected important changes in the administration of English prisons, especially those of the counties. They prescribed numerous regulations, amongst which the separation of the sexes, the classification of all prisoners, and the enforcement of instruction, were prominent. But the benefits anticipated from them have, from various causes, been only partially realized; and their method of classification, which is founded principally upon technical distinctions, has, in particular, proved a signal failure.

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[1] 4th Geo. IV. cap. 64, and 5th Geo. IV. cap. 85.

American penitentiaries.

The select committee on secondary punishments, of 1832, in recommending the introduction of a modified system of solitary confinement, in imitation of that practised in some American prisons, shewed its participation in the opinion then beginning to prevail, of the merits of the penitentiary system of the United States. Many travellers spoke of them in high terms, and the French government had intrusted a mission of inspection to MM. de Beaumont and de Tocqueville, whose report, published in 1833,[1] has been highly appreciated throughout Europe. The distinguishing characteristic of this work is its philosophic impartiality. It describes with fidelity the two systems, both based upon the principle of isolation, but executing it, the one by means of separation, the other by silence, which pass respectively under the names of the *Philadelphia* and the *Auburn* system of discipline. The authors come to no very definite conclusion upon the relative merits of the two systems. That of Philadelphia had only just been put into action at the time of their visit, and they had not therefore those opportunities of extensive inquiry into its working which have been afforded to more recent observers. Mr. Crawford, the commissioner despatched by the British government in 1833, bears strong testimony, in his report,[2] to the superiority of the Philadelphia system; and the mass of valuable information which he collected, leaves no very favourable impression of the penitentiaries managed on the Auburn plan. Dr. Julius, charged more recently with a similar mission from the Prussian government, declared himself, on his return in 1836, favourable to the Philadelphia system;[3] and a still later report of MM. de Metz and Blouet, made to the French government in 1837, and to which we shall more particularly advert, recommends the same system more decidedly than any of its precursors.[4] The balance of the testimony of official inquirers preponderates strongly against the Auburn discipline.

Prisons of England.

The Lords' committee of 1835[5] collected a mass of evidence exhibiting the condition of the prisons of England and Wales, and reported to the house a series of resolutions suggesting reformatory measures. Amongst these is one thus recommending the silent system: "That entire separation, except during the hours of labour, and of religious worship, and instruction, is absolutely necessary; and that silence be enforced so as to prevent all communication between prisoners, both before and after trial." This resolution, however, did not receive any express sanction from the legislature; but in 1835,[6] an act was passed, whereby the power of establishing rules for prisons was transferred from the judges to the Secretary of State, and the appointment of inspectors was authorised. These inspectors have regularly made their official reports, which have been laid before Parliament, and to which the reader is referred for a complete description of the existing prisons of Great Britain. Whilst we write, (1838) a bill for the better ordering of prisons in England and Wales, is before Parliament. This bill is a step towards the introduction of the separate system, in as far as it will enlarge the powers of the Secretary of State to substitute separation for classification, and will suppress several minor abuses which have hitherto prevailed.

Of Scotland.

The gaol acts quoted do not extend to Scotland, and the prisons in that part of the kingdom have continued, upon the whole, in a more defective state than in England. The greater part of the Scottish gaols belong to the royal burghs, whose funds being inadequate for their support, the construction and discipline have accordingly been neglected. The bad condition of these prisons is described in the report of the select committee of the House of Commons in 1826, which suggested the erection of proper places of confinement for large districts, with various other reforms. The many existing evils have since been particularized by the inspector for Scotland in his reports; and as a remedy for these, as well as for the more equal distribution of the burthen of maintaining the national prisons amongst all classes of the community, a bill has been introduced by the government during the present session (1838) for the improvement of the Scottish prisons. Under this bill, the liabilities of the royal burghs, and all other peculiar burthens, will cease; and all the expenses connected with prisons will be defrayed out of one common fund, to be raised by a general rate upon property. Suitable prisons are to be provided, under the direction of a general board, sitting in Edinburgh, to whom the sole authority and responsibility relating to all the prisons of Scotland is to be committed, subject to the controul of the Secretary of State, and of Parliament. A central authority of this nature may be the means of introducing important ameliorations into the present defective management; may materially aid the administration of justice; and may not only equalize, but greatly reduce, the cost to the community.

Of Ireland.

The prisons of Ireland are regulated by an act[7] which was framed on the basis of the English gaol acts. This law invests the Irish government with the power of appointing inspectors-general, who make annual reports; and the grand jury of each county and city are also required to appoint a board of superintendence, and a local inspector, whose duty it is to visit the prisons at least twice in every week. These measures have operated beneficially, the gaols having previously been in a most deplorable condition, and being now improved, particularly as regards the employment and instruction of prisoners. But the small prisons belonging to the local jurisdictions are stated to be still extremely defective.

Of France

If the progress of improvement in prisons has been slow in the United Kingdom, the system of management on the continent is, almost everywhere, still more defective. In France, the administration of penal justice previous to the Revolution, was altogether barbarous, consisting principally of capital and corporal punishments. But when something like a system began to be acted upon by the legislature of the Republic, a classification both of places of punishment, and of their inmates, began to be established. The French prisons are divided into the *bagnes*, for offenders sentenced to hard labour either for life or for a term of years; the *maisons centrales*, for those sentenced to long terms of imprisonment, exceeding one year; and the *maisons departementales*, for minor offenders sentenced to terms under one year. These establishments are for convicted prisoners; in addition to which, the law requires that there should be in every *arrondissement*, near to the *tribunal de premiére instance*, a *maison d'arrêt* for the detention of persons arrested, and also near to every assize court a *maison de justice* for the custody of those against whom a warrant of caption has issued from the court. There are besides the *maisons de dépôt*, or police stations, for the temporary custody of persons apprehended. These divisions, however, appear to answer little or no moral end, since the association of prisoners in every description of French prison is permitted, with scarcely any restriction, and the result is commonly a frightful degree of disorder, immorality, and mutual corruption.[1] The obligation of labour seems to be attended with little good effect; nor is there perhaps any position less favourable to reformation, than confinement in a French prison. These evils have recently excited much interest in the public mind in France, and the government has announced its intention to propose a general law for the separate confinement of the untried, though nothing seems to have yet been accomplished. Opinions are much divided in regard to the adoption of the system of silence or of cellular separation,[2] but the effect produced by MM. de Metz and Blouet's Report, has already led to a resolution in its favour, as regards the untried, by the council-general of the department of the Seine, who have recently voted a sum of three millions of francs for the construction of a prison for all the untried prisoners of Paris, upon the separate system.

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[1] *Du Système Penitentiare aux Etats-Unis, et de son Application en France; suivis d'un appendice sur les colonies penales, et de notes statistiques.* Par MM. G. de Beaumont, et A. de Tocqueville, avocats à la cour Royale de Paris. Paris, 1833.

[2] Report of William Crawford, Esq., *on the Penitentiaries of the United States, addressed to H. M. Principal Secretary of State for the Home Department. Ordered by the House of Commons to be printed.* August, 1834.

[3] *Lettre addressée à M. W. Crawford, Inspecteur-Général des prisons de la Grande-Brétagne.* Par le Docteur Julius. Leipzig, 1837.

[4] *Rapports à M. Le Comte de Montalivet, pair de France, Ministre, &c., de l'Intérieur, sur les Penitenciers des Etats-Unis.* Par M. De Metz, counseiller à la Cour Royale, et par M. Abel Blouet, architecte du gouvernement. Paris, imprim. royale, 1837.

[5] See the five Reports of this Committee, Session 1835.

[6] 5th and 6th Will. IV. cap. 38.

[7] 7th Geo. IV. cap. 74.

Of Belgium

The prisons of Belgium were, soon after the Revolution of 1830, divided into three classses, analogous to those of France, viz. prisons for punishment; for safe custody *(maisons d'arrêt et de justice;)* and police stations, *(maisons de dépôt et de passage.)* Several improvements, especially the separation of the sexes, have been effected since that period; but the classification is, in other respects, very imperfect. The convicted of all ages and descriptions, are described as living together in vicious association, and sleeping in large numbers in the same dormitory. Imprisonment is any thing but reformatory, or even deterring, but is represented as a security against want, and an encouragement to improvidence, to such an extent, that admission to the *maison centrale* is hailed with joy by the convict. A plentiful diet, a weekly allowance of money, with liberty to expend it in beer, tobacco, coffee, and other indulgences, easy labour, and the society of friends, are described as removing even the semblance of penality; and the separation of the sexes, has under such circumstances, operated rather perniciously, by leading to more shameful vices. The inspector-general is thoroughly convinced of the necessity of introducing a system of cellular separation, and a new wing has been added for the purpose to the *maison de force* at Ghent.[3] The government is stated also to have in contemplation the erection of a prison on the separate system, at Liege.

Of Holland.

In Holland, there are distinct prisons for the accused, and for the convicted; and there are separate buildings for the confinement of women, and of juvenile offenders. The convict prisons are divided into those analogous to the *maisons centrales*, for offenders of the graver class, and houses of correction for minor offenders sentenced to terms under twelve months. A council of regents is attached to every prison, and reports to the central administration. The Dutch prisons are liable to all the objections attaching to systems of association, and nothing appears to have yet been effected in those of Switzerland towards separation.

Of Switzerland.

The penitentiaries of Switzerland have acquired a high reputation, and deserve considerable study. Those of Lausanne and Geneva have carried the discipline of silence to a considerable degree of perfection, without the aid of corporal punishment; and the attention paid to the moral instruction of the prisoner is greater than in any of the penitentiaries of the United States. Lausanne is the best, and its situation, affording a view from the cell-windows, of the Lake of Geneva and the Alps, is not a little calculated to heal and elevate the mind of the penitent convict. But in neither of these establishments is communication between the prisoners effectually prevented, and they are consequently not free from the evil of mutual contamination. The penitentiary of Berne admits of more association, especially at night, than the two others mentioned, and can therefore scarcely be cited as a model of the silent system; but, looking at the whole management of the penitentiaries of Lausanne and Geneva, particularly the former, we believe that the moral reform of the prisoner may be anticipated with more confidence in these establishments than in any other prison conducted on the principle of association in silence, either in Europe or America. The small prisons, in other parts of Switzerland, are as bad as in the adjoining countries.[4]

Of Germany.

The prisons of Germany are principally known to us by the descriptions of Dr. Julius.[5] But our present space must confine us to the remark, that the last fifty years have materially ameliorated the prisoner's condition in point of health, cleanliness, and exemption from the tortures and fetters of the middle ages; and that little remains of absolute inhumanity in the treatment of offenders in any part of Germany. The bastinado is used, though not cruelly, as a disciplinary punishment in Austria, Prussia, and other states. The enforcement of silence, as well as the treadmill, have been introduced into some few prisons; but there is little classification worthy of the name, and the general system of management may be described as permitting the association, and consequent mutual corruption, of the prisoners. No prison has yet been established, on the plan of cellular separation, in any part of Germany, and the state of opinion amongst distinguished thinkers there, seems at present but little in its favour. Professor Mittermaier of Heidelberg has declared himself opposed to it,[6] and we are not aware of any recent publicist there, except Dr. Julius, who is decidedly favourable to its adoption.

At Warsaw

A prison on the separate system was completed at Warsaw in 1835, capable of receiving 380 prisoners, and is in operation with good effect.

Of Norway

The Norwegian government is understood to contemplate the reform of its prisons, having lately dispatched a mission to England to acquire information on the subject.

Of less civilized states.

We have adverted to the prisons of the most civilized European states. There remains unfortunately to be drawn a revolting picture of the places of confinement in which humanity suffers, in countries the governments of which are less advanced beyond ignorance and barbarism. In such countries, a prison is in fact a place in which the strong wreak their vengeance upon the weak; the prisoner is not *punished;* he is subjected to certain physical and moral evils, from which neither himself nor society derive any benefit. Such injuries will continue to be inflicted until the influence of the moral sciences, especially that of jurisprudence, shall have pointed out the errors and blunders which are entailing so much misery upon mankind. It is not in Turkey, nor in Spain alone, that the slow progress of social improvement is to be lamented. It is a humiliating reflection, that the principal gaol in the British metropolis has for many years past been in as disgraceful a state as any in Spain. A comparison of the description of Newgate[1] with that of the Saladero at Madrid, makes it difficult to determine in which prison the evils of indiscriminate association and total laxity of discipline have led to the worst results. It is vain to anticipate from the exertions of philanthropy a remedy for such abuses. The reform of prisons is only to be hoped for by the uniform application of principles the soundness of which has been verified by an extended experience, and which reason has demonstrated as the best means of accomplishing the end for which punishment is inflicted. If it were otherwise, the government of prisons would be dependent upon the caprice of individuals, and consequently a ready instrument of oppression and injustice.

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[1] See particularly the works of M. Moreau Christophe, the present inspector-general of the prisons of France, entitled *De l'Etat actuel des Prisons en France*, Paris, 1837; and *De la Reforme des Prisons en France*, Paris, 1838.

[2] See in favour of the silent system, *De la Reforme des Prisons, ou de la Théorie de l'Emprisonment, de ses Principes, de ses Moyens, et de ses Conditions Practiques;* Par M. Charles Lucas, tome i. Paris, 1836. tomes 2 and 3, Paris, 1838. *Des Moyens propres à Généraliser en France le Système Penitentiaire.* Par M. Berenger. Paris, imprim. royale. 1836. *Rapport à M. le Ministre Secretaire d'Etat au Departement de l'Intérieur sur la Reforme des Prisons en France.* Par M. Gasparin; 6 Septembre 1836. In favour of separation, see particularly M. Moreau Christophe's works, and the Report of MM. De Metz and Blouet, before cited.

[3] See *Des Progréset de l'Etat actuel de la Réforme Penitentiaire*, par Ed. Ducpetiaux, inspecteur général des Prisons, &c. de Belgique. Bruxelles, 1838, vol. 2, No. 9; a work full of valuable information, on the prisons and philanthropic institutions of Belgium, and several other countries.

[4] See *Mémoire sur le Systéme Penitentiaire addressé a M. le Ministre de l'Interieur en France.* Par M. Aubanel, directeur du penitencier de Genève: Geneve, 1837; also several publications of MM. Cramer-Audeoud, Tallandier, &c. on the Swiss penitentiaries, and the opinions of M. Lucas and M. Ducpètiaux, in the works above cited.

[5] *Leçons sur les Prisons*, par le Dr. N. H. Julius, traduits de l'Allemand par H. Lagarmitte; Paris 1831.

[6] See an article by this eminent jurist in the *Revue Etrangére et Francaise de Législation;* Paris, Nov. 1836.

Principles of prison construction.

We proceed now to state the general principles which ought to be observed in the construction and arrangement of prisons,[2] and what are, in our judgment, the essential requisites of a good system of prison discipline.

The situation of a prison should be healthy, open, and calculated to secure a free circulation of good air. It is objectionable for a prison to be surrounded with buildings of any description; for which reason, a detached or isolated position ought, as far as may be, to be selected. Attention is also requisite to proximity to the courts and offices of justice, so as to facilitate the removal of prisoners before or after trial. The airiness of the situation is the more desirable, as there must be an extensive subdivision of the internal parts, to provide for the confinement of each prisoner in a separate cell. The site should be dry, and free from the effects of marshy damp soils. It should also be elevated, in order to avoid fogs, and the possibility of inundation; and the buildings should be so arranged as not to be exposed to view from any adjacent grounds.

The ground appropriated should be enclosed with a strong boundary wall, of sufficient height to prevent escapes. The buildings occupied by the prisoners must not adjoin the boundary wall, but a wide open space be preserved round the interior. A single gateway, or opening in the boundary, should form the only entrance to the prison, to be placed in front, and opposite the central building. At the entrance, and outside the boundary wall, may be placed the residences of the keeper and chaplain, so that the families of those officers may be unconnected with the prison.

Except for very small prisons, the radiating plan is preferable to any other, because the various objects of inspection, facility of access, convenience, and security, cannot be obtained so completely in any multiplied form of building, as in that which diverges from a central point of observation. In this respect, the principle of Mr. Bentham's Panopticon is followed, except in as far as it aims at viewing the interior of the prisoners' cells; the practicability of which, so as to exclude the possibility of the prisoner's retiring to a part of the cell where he cannot be seen, is very doubtful. With a system of separation, however, no central observation of the prisoners whilst in their cells need be attempted. The inspection required is of the corridors, and of the general establishment, exclusive of the cells.

In arranging the buildings, the grand requisite is the provision of a sufficient number of cells for the individual separation of each offender by day and by night. The construction of the cells should be such as to preclude all communication between the prisoners, and at the same time combine adequate space and means of ventilation, to ensure their health and admit of continued employment. The general dimensions of the cells should therefore be not less than thirteen feet by seven feet, and ten feet high, so as to contain about 1000 cubical feet. The cells may be ranged upon each side of, and opening into, the corridors running longitudinally through the radiating buildings. Every endeavour should be used to prevent the possibility of communication between the cells; to ensure which object, the partition walls should not be less than eighteen inches in thickness, and worked with close joints, so as to preclude, as far as may be, the transmission of sound. The requisite machinery should be applied to the introduction of warm air, and to the ventilation of the cells;[3] and each cell should be fitted with such necessary conveniencies, that the prisoner will never, under ordinary circumstances, have occasion to leave his cell, as well as with a bell, or equivalent instrument, to notify his wants. The cells on the upper stories may be arranged like those below; and if at the end of each radiating building two or three cells be laid together into a larger apartment, it may be used by the sick, and there will be no need of a distinct building for an hospital or infirmary. Airing yards should be provided for such prisoners as may, in the opinion of the surgeon, require exercise in the open air, and for the especial use of the untried.

In large prisons, one or more of the radiating buildings should be appropriated exclusively to the female prisoners.

If there be a chapel, it should adjoin the central building, and have several distinct entrances for the prisoners. Individual separation may be maintained during divine service, by placing each prisoner in a distinct stall, or sitting within the view of the officers, and of the chaplain. The form of the chapel will be that of an amphitheatre, with rows of seats rising above each other in face of the chaplain.[4]

Reception rooms must be provided near the entrance, in which prisoners may be placed on admission, before their examination by the surgeon, as well as suitable cleansing rooms and baths. Some peculiar cells will be required for the purpose of punishing offences against the discipline of the prison, and for offenders sentenced to short periods of solitude. The kitchen and other offices for the service of the prison need not be particularly described.

The use of any ornament or embellishment, whether external or internal, in a prison, seems entirely misplaced. The style of architecture should be plain, and divested of anything not conducive to the purpose of the building. A custom has prevailed of fixing chains, or axes, on the external walls, and of inscribing admonitory sentences over the gates, the good taste of which is very questionable. The mere name of the prison appears the most appropriate inscription.

Plates CCCCXVI. and CCCCXVII. exhibit plans of the ground and first floors of a prison, on the construction recommended, which are equally applicable to the confinement of the untried and the convicted. The imprisonment of debtors in general is inadmissible at all under a good system of law, as unjust in principle, and mischievous in operation; but if there are some few cases of debtors deserving incarceration, there can be no impropriety in placing them in separate cells of the same description as are provided for other prisoners.

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[1] See *Edinburgh Review*, No. 130, art. 3.

[2] For details of the most approved modes of prison construction, with numerous plans, the reader is referred to the *Second and Third Reports of the Inspectors of Prisons*, (Home District), presented to both Houses of Parliament, sessions 1837 and 1838. The plans referred to in this article are derived from these reports.

[3] See plans minutely describing the mode of ventilation, annexed to the Inspector's Report, Session 1837.

[4] See plan of a chapel annexed to ditto.

Discipline. Assuming, then, that we have a prison adapted to the discipline intended, we come to describe what the treatment of the prisoner should be, in respect of separation, employment, instruction, diet, and the care of health, and disposal after discharge. In considering these points, we shall distinguish the case of the untried, detained for safe custody only, from that of the convicted, who are confined either for correction, or for both correction and reform.

Separation. 1*st. Separation.* Mr. Bentham rejected absolute solitude from the administration of the Panopticon, as productive of despair and injurious to health, unless used for a few days only, for the purpose of repentance. He therefore proposed the classification of the prisoners into small companies in the discretion of the gaoler, which suggestion the writer of the preceding article has adopted as a part of his reformatory discipline. Now, there is no doubt that the confinement of an individual for any lengthened period in a cell, such as those in the ordinary English county gaols, would be very prejudicial to his health. These cells have been constructed merely for dormitories, not for habitation by night and by day. They are too small to enable the prisoner to take exercise, are badly lighted, imperfectly ventilated, in no degree warmed, and destitute of those conveniencies which are indispensable to render them fit and salubrious for constant habitation. But it is not in such cold, contracted, and desolate cells, that the introduction of the separate system is recommended. Nor is absolute solitude by any means intended. We are as averse from it as Mr. Bentham could possibly be. For it should be expressly understood, that the seclusion of the prisoner is to be relieved by stated daily visits, by manual occupations, and by his possessing the means of communication at any time with the officers of the prison. We entirely concur upon this important point with the inspectors of prisons for the home district, whose explanation we here subjoin, to prevent any misconception of the nature of the confinement intended.[1]

"In the case of the untried, the prisoner is placed in an apartment at least ten feet square, and ten feet high, sufficiently large to enable him to take exercise. This apartment is well lighted, ventilated, and warmed; water is laid in; a water-closet is provided; and in the fitting up, every arrangement is adopted essential to the prisoners' health. To this apartment the prisoner is strictly confined by day and by night; nor is he allowed to leave it at any time, except for the purpose of attending divine worship in the chapel. This seclusion, however, is broken by daily and stated visits of the governor, chaplain, surgeon, and other prison-officers. The prisoner enjoys the privilege of seeing his friends; he has every facility for consulting his legal adviser; he may send and receive letters; he is permitted to have unobjectionable books; he may receive suitable articles of food; he has the option of any employment that can be conveniently furnished to him; he is exempted from all discipline that is calculated to create irritation; he is tempted to commit no violation of prison-rules, and he is thus spared the infliction of prison-punishments; he is exposed to no quarrels; he is protected from those ruffianly assaults committed in every other kind of prison, which arise from the tyranny of the strong over the weak; his mind cannot be tainted and demoralized by relations of the burglar, nor his ears assailed by the language of the blasphemous and obscene." . . . . .

"The *convicted* prisoner, according to this system, is confined by day and by night, in such an apartment as has been described. Whatever is necessary for the preservation of his health is strictly attended to, but no indulgence in any shape whatever is extended to him. The distinctions observed in the treatment of the untried and convicted, are broad and definite. It has been seen that, under this system, the untried are permitted to receive visits from their connexions; the convicted are prohibited from such intercourse; the untried may also communicate with their friends by letter, the convicted have no such privilege; the untried are allowed to receive food beyond the prison diet; the convicted are rigorously restricted to the prescribed ration; with the untried employment is optional; upon the convicted a daily task is imposed."

The inspectors, in their latest report, further state,[2]—"To guard against evils which might possibly arise from prisoners being confined in cells not fit for separate confinement, we recommend that the following provisions should form part of any law which may be framed for this purpose:—

"1st, That no cell be made for the separate confinement of a prisoner which does not contain at least 750 cubic feet, and is not lighted, warmed, ventilated, and fitted up in such a manner as is consistent with the health of the prisoner, and furnished with the means of enabling him to communicate at any time with the officers of the prison; and that no cell be used until its fitness be certified by the secretary of state."

"2d, That every prisoner shall be visited once at least every day by the governor, chaplain, and surgeon, in addition to other visits; and that every prisoner shall have the means of taking air and exercise as recommended by the surgeon, and shall be furnished with the means of moral and religious instruction, and with suitable books, to be selected by the chaplain, and also with labour and employment, unless specially withheld by order of the secretary of state."

Such, then, is the explanation of the system of separate confinement which has recently been recommended by the secretary of state to the English magistrates for adoption in all new prisons.[3] It is not, we repeat, a discipline of continuous solitude, but consists in the effectual separation of the prisoners *from each other*. It precludes their intercourse only with those whom it is for their moral good that they should not see. It rescues the untried prisoner, who may be innocent, from the shame of future recognition by gaol associates; it facilitates the correction of the convict sentenced to a short term of imprisonment; and affords the best possible opportunity of effecting the reformation of him whose confinement is sufficiently long to admit of the application of penitentiary discipline. The separate system is eminently calculated to favour the influence of Christianity on the depraved heart;[4] it has all the improving qualities of monasticism, without the entire renouncement of connexion with the world; nor is the rigour of its discipline at all comparable to that which many pious anchorets have voluntarily inflicted on themselves for the expiation of crime, or to the ordinary regime of the Grande Chartreuse, or the convent of La Trappe. Not that imprisonment should be regarded as a merely religious instrument, or visionary hopes indulged in of making criminals more virtuous than other men. It is unreasonable to expect more in general than to bring them into those habits which characterise the useful members of society. But there is little chance of attaining this object, unless the criminal be reduced to that docile and subdued frame of mind, which fits him to receive moral instruction, and to reflect upon his former errors. The acquirement of such a frame of mind, in the midst of associates, even of a carefully selected class of associates, as suggested by Mr. Bentham, we regard as impossible. "Conversè as much as may be," says Thomas a Kempis, "with God and thy own conscience. It is a good reflection which the philosopher made of himself, that he never was in other men's company, but he came out of it less a man than he went in; and this is what we may frequently confirm by our own experience."

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[1] Second Report, Session 1837.

[2] *Third Report* (Home District) Session 1838.

[3] See Lord John Russell's Official Circular, 15th August 1838.

[4] See Thomas a Kempis, *De Imitatione, &c* chap. 20, on the Love of Solitude and Silence.

The apprehension of danger to the mental or bodily health of the prisoner is unquestionably one not to be treated lightly. But there is no proof of any such result, in those prisons where the discipline of separation has hitherto been established. It has been in operation in the Glasgow Bridewell for about fourteen years; and the prisoner is never permitted to enter the open air, but is allowed exercise in a corridor, the cells not being quite so large, as we have stated to be requisite for ventilation and exercise.[1] Prisoners are not unfrequently confined here for periods of a twelvemonth and upwards; but their health has not been found to sustain any injury, and the moral effect of the imprisonment has been very favourable.[2] But it is the celebrated Eastern Penitentiary of Philadelphia that affords the strongest proofs, that individual separation can be enforced for lengthened periods with perfect safety to the body and mind. In this penitentiary, the prisoners are confined day and night in large airy cells,[3] and are cut off from all intercourse with their fellow-prisoners, whilst they are visited by the director and officers, the religious ministers, the medical attendants, the inspectors, and numerous official visitors, including the members of Congress, the judges, &c. There are prisoners in this penitentiary who have been there for years, without the slightest injury to their constitutions, and there are numerous instances in which health has been improved. In the seven years from the opening of the penitentiary in 1829 to December 1836, the average mortality did not exceed three per cent., (that at Sing-Sing being four per cent., and at Auburn two per cent.;) and of 697 prisoners during that period, the state of 312 who left the prison was as follows:[4]

78 in better health.
166 in equal health.
17 weaker, not worse.
13 in worse health.
4 much worse.
34 dead, including one suicide.
312

Our limits do not admit of the details of the discipline of this establishment, but we have pointed out the works where the reader will find them. Suffice it to add that its success has been so far encouraging, that a second penitentiary has recently been built on the same plan at Pittsburgh, in the same State of Pensylvania, and that in the States of New Jersey, Rhode Island, and Missouri, penitentiaries on the separate system have also been lately erected. The principle of separation, as applied to prisons, is no doubt comparatively new; but it is not too much to say, that experience, as far as it has gone, has served to confirm the opinion of its excellence, to which reflection upon the theory of punishment, and the nature of the human mind, would be likely to lead the inquirer.

The basis of the silent system, like that of the separate, is isolation. It aims at solitude of the minds, whilst it permits the bodily association of the prisoners. The silent system ought to consist of the cellular separation of each prisoner by night, and of labour in common, with rigorous silence during the day. It is contended that the prisoner is thus morally isolated as effectually as if he were in a separate cell, and that the associated labour being more conformable to the habits of men in society than seclusion, the probability of converting the criminal into a useful citizen is proportionally greater. The system has been brought to a high degree of efficacy in the state-prisons of Auburn, Sing-Sing, Wethersfield, Charlestown, Baltimore, and Washington, in the United States, and in the houses of correction at Wakefield and Coldbathfields in England. But its strict enforcement involves several serious evils, not the least of which is the necessity of inflicting very numerous and vexatious punishments upon the prisoners. Every detected violation of the rules must be visited with some penalty, so that not only is the imprisonment contemplated by the sentence seriously aggravated; but the notion of an offence against prison discipline is insensibly confounded with one against law. In some of the American penitentiaries, corporal punishment has been used to a brutal degree; but even where this is not the case, the penalties are of an objectionable nature, such as the reduction of food, or confinement in dark ill-ventilated cells, both which have a tendency to impair the prisoner's health. In the year 1836, the number of punishments inflicted *daily* at Coldbathfields was computed at seventy-six, or about eight and-a-half per cent. on the number of prisoners, and no less than 6794 punishments, or about twelve per diem, were inflicted in that year for talking and swearing alone.[5] Referring to the two English prisons in which the silent system is most strictly carried into execution, it appears there were in the course of last year in

	Prisoners.	Punishments.
Coldbathfields House of Correction	9,750	13,812
Wakefield House of Correction	3,438	12,445
	13,188	26,257
In all the prisons in England and Wales......	109,495	54,825

So that whilst these two prisons contain rather less than one-eighth of the whole number of prisoners, there were inflicted within them nearly one-half the whole number of punishments.[6] A feeling of perpetual irritation is thus kept up, the reverse of that tranquil and submissive frame of mind from which alone there is any chance of reformation. Nor can the system be maintained at all without so much vigilance, that a necessity has generally arisen of employing a number of the prisoners themselves as wardsmen and monitors, a practice wholly inconsistent with the punishment to which such prisoners have been sentenced, and subversive of discipline in many ways. The silent system, therefore, even when most strictly enforced, is open to many objections which do not attach to that of cellular separation, besides affording opportunities of communication which cannot exist where the prisoners are physically separated by the walls of their cells. But where the discipline of silence is loosely enforced, which is by far the most frequently the case in prisons where it is nominally established, it then becomes in fact a system of association, and open to all the evils of contamination, so baneful to the novice in crime, so pernicious in their effect upon society. Nor should it be disregarded that the observance of silence is enforced to no inconsiderable extent upon the untried, who are therefore subjected to the infliction of punishment, contrary, if not to law, at all events to the first principles of justice.

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[1] The dimensions of the cells are, for males nine feet by seven feet, and ten feet high; for females eight and a half feet by seven and a half, and seven feet three inches high.

[2] See the *Reports of the Inspector of Prisons for Scotland.*

[3] This prison contains eight corridors, and 262 cells. In three of the corridors, the cells are eleven feet nine inches long, by seven feet six inches wide, and in the other five corridors they are three feet longer. The cells on the ground floor have generally airing yards; but the prisoners in the upper cells are never allowed to enter the open air.

[4] We quote from the latest authority, MM. de Metz and Blouet's Report.

[5] Inspector's *Second Report,* (Home District,) 1837.

[6] Inspector's *Third Report,* (Home District,) 1838.

There are, in fact, but three known systems of discipline; those of separation, of silence, and of association. We have described the first two; of the last, we shall only say, that it is the fruitful source of vice and demoralization, and that the prisons in which it prevails, are schools not of reformation, but of crime. Even the partial association allowed by Mr. Bentham is, in our view, wholly inadmissible. Classification will not cure the evil. Whether committed entirely to the discretion of the gaoler, or prescribed according to technical distinctions, as in the English gaol acts, classification will never prove an adequate remedy for the evils to be averted. The prisoner must be removed from the possibility even of *recognition* by another prisoner, before he can have a chance of acquiring that self-respect which, in a right sense, is indispensable to his moral reform.

A question may occur, whether the separation of the prisoner should be left, in any case, to his own option? The answer seems clear, that he should not. The convict has of course no right to choose what the nature of his punishment shall be. The untried, who is detained for safe custody, has no right to require to be provided with associates. He is injured, if his health is impaired, or if any needless restriction is placed upon him, but he is no more entitled to insist that other offenders committed to the same prison shall be confined in the same apartment with him, than to ask for a prisoner to be removed for the purpose from another gaol. If the state has a right to prescribe the place of his detention at all, it has also the right to debar him during such detention from the society of those at whose hands he would probably sustain the injury of moral corruption.

Employment.

2*d. Employment.* Assuming cellular separation to be the best system of confinement, the most proper mode of employing the prisoners will be that which is the best suited to the single cell. That hard labour, either in association or in solitude, should constitute the *gravamen* of the prisoner's punishment, is highly objectionable. Experience has shewn how great a mistake it is to use as a punishment for the basest of the people, that labour which should be held in honour, as being the only solid foundation of public prosperity and virtue. The evils anticipated in the preceding article from the tread-wheel, have been fully realized. It is a punishment which is characterized by a remarkable amount of inequality, and consequent injustice, in its operation. Not only is it necessarily unequal, because applied to persons of different degrees of physical strength, but in some persons it is carried to an excessive point of severity, whilst in others it is a merely nominal punishment. There is so little uniformity of system, as regards the number of hours devoted to labour, the height of the steps of the wheel, the rapidity of its rotation, and the proportion of prisoners placed upon it, that the severity of the punishment varies in almost every prison. The following county houses of correction, fortuitously selected, will illustrate this:[1]

Houses of Correction.	Average number of working hours per diem.	Height of each step.	Ordinary velocity of wheels per minute.	Ordinary proportion of prisoners off the wheel, to total number employed.	Average number of feet in ascent per diem.
Walsingham,	7	8 inches	36steps	5/7	7,799
Northampton,	6½	7 do.	48 do.	¼	10,920
Coldbathfields,	7¾	8 do.	48 do.	½	16,800
Petworth,	8½	9 do.	48 do.	¼	18,473
Knutsford,	8¾	8¾ do.	48 do.	⅓	21,000

So that a prisoner sentenced to hard labour in the house of correction at Knutsford, would perform twice as much labour as at Northampton, and three times as much as at Walsingham house of correction. Nor is this all; for the severity of the labour depends also upon the season of the year in which the offender may be sentenced. In Maidstone gaol, for instance, in January, the number of working hours at the wheel is 6¼, and the number of feet of daily ascent, 12,000; whereas in the month of June, the working hours are 9½, and the feet of ascent, 18,240; so that a man sentenced to two or three months hard labour in the summer, undergoes one-third more of the tread-wheel, than he who is committed in the winter, and that without any difference of diet. Such inconsistencies form a most serious objection to the system of tread-wheel labour, which, in connection with a more or less rigorous discipline of silence, is generally adopted in our houses of correction.

There can be no great difficulty in selecting suitable employments for the solitary cell. At the Glasgow bridewell a variety of works are carried on in the cells, from oakum picking, to the difficult art of print-cutting, with a view to suit the demand for labour in the surrounding districts, and to raise a fund applicable to the expences of the prison. At Philadelphia, the trades are principally weaving, tailoring, and shoemaking, and the two latter are the chief occupations at Millbank. The hand-crank is an instrument used in many prisons as a means of labour to the prisoner kept in temporary solitude.

The principles to be regarded in the employment of prison labour, are briefly these. The labour of the *untried* should not only be perfectly voluntary, but they are entitled to pursue any occupation not inconsistent with the good order of the prison, and of course to receive the whole of the profits which such occupation may yield. Upon the *convicted*, the state has the right to impose labour, although it may be questionable whether in general it is expedient to enforce it against the will of the prisoner. Under a system of separation there would be little occasion to impose a task, because experience has shewn that the prisoner in solitude very soon begins to desire labour as a boon; and this is precisely the disposition with which he ought to regard it. The convict should therefore be supplied with work at his own request; but it does not follow that he is entitled to any part of his earnings, because being no longer a free agent, the produce of his labour is the property of the State. That a convict should derive profit from his degraded situation is manifestly an abuse; except in so far, that where the term of imprisonment is long, the principle of reward, if discreetly applied, may occasionally prove a valuable instrument of reformation. Some discretion to present the penitent prisoner with a portion of his earnings might therefore be committed to the proper authority.

The notion of allowing the keeper, or any officer of the prison to participate in the profits of the prisoners' labour appears to us wholly erroneous. In Mr. Bentham's Panopticon, it is proposed to deliver over the prisoners to a contractor, to whom an interest in their earnings is given, in order to secure his training them in industrious habits. But the reason does not apply to prisons managed according to certain regulations prescribed by law, and governed by officers who are public servants, and responsible for their conduct to competent authority. There are no sufficient grounds for delegating to a contractor, that which is the business and duty of the government; nor should the officers of a prison look to any remuneration beyond their adequate salaries, nor have any contingent interest depending upon the manner in which the prisoners are employed.

The prisoners' earnings may be properly applied towards the expences of the establishment, and in some prisons they have become so productive, as to reduce the cost of maintenance to a mere trifle. It is quite possible that prisons may thus be made self-supporting, and be carried on without any public charge. Let it not, however, be supposed that the fact of economical management is at all conclusive of the excellence of a prison. The object of imprisonment is not production, but the correction and reform of offenders; and unless the employment be made subservient to these great ends, there will be little gain to the community, however cheaply this or that prison may be maintained. There is so strong a feeling, both in this country and the United States, in favour of stimulating production by prisoners, that some danger really appears to exist, lest higher objects should be lost sight of, and it should be forgotten that nothing is more costly to society than crime, and that in their tendency to the prevention of crime consists the only true economy of penal establishments.

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[1] See *Digest of Gaol Returns,* No. 6, in Appendix to Second Report of Inspectors of Prisons, 1837.

It is hardly necessary to observe that the employment of prisoners as wardsmen, monitors, cleaners, cooks, or any other offices of trust, or menial services in the prison, is incompatible with a system of separation. The monitorial system has arisen chiefly out of the difficulty of enforcing the discipline of silence; but the practice of employing prisoners in domestic services is an abuse which prevails to a very great extent, and is a striking instance in which purposes of economy have been made to defeat the ends of justice.

Instruction

3*d. Instruction* is an important element of penitentiary discipline; but its effect must depend materially upon the length of the term of the prisoner's sentence. The late Lords' Committee recommended, that where there are fifty prisoners, there shall invariably be a chaplain whose whole time shall be devoted to his duties, and also a schoolmaster, not being one of the prisoners. In very short terms of imprisonment, little benefit can be anticipated from the labours of either chaplain or schoolmaster, and it is scarcely worth while to attempt the elementary teaching of reading and writing. But in every case, religious advice and exhortation should be imparted, and the chaplain, or an adequate number of chaplains, should devote a considerable portion of time to private converse with the prisoners, individually, in their cells. The judicious conversation of an intelligent clergyman on moral and religious subjects, and his friendly advice on such topics as may occur, are eminently calculated to raise the prisoner in the scale of morality, and to fix good resolutions in his mind. We need hardly remark, that if the chaplain is not what he ought to be, if he is a man of a weak, narrow, or ill-informed mind, or not thoroughly imbued with a Christian spirit, his labour will be in vain. But there are no bounds to the benignant influence of religion, rightly understood, in turning the wicked man's heart, nor can any vocation be more signally Christian, than that which consists in promoting the criminal's repentance.

We have referred to the plan of a chapel, according to which each prisoner may be separated during divine service. But a question naturally suggests itself, why, if separation is to be maintained, so as to preclude communion of worship, there is any occasion for a chapel at all? Divine service may be performed by a chaplain placed in the corridor, within the hearing of the prisoners, so that the prisoners are as much present at the service as if they were in the building called the chapel. This is the mode in which prayers are read at the Eastern Penitentiary of Philadelphia; and the seclusion of the cell is therefore not broken for the purpose of repairing to chapel. Whichever mode of celebrating divine service may be preferred, it is pretty certain that the private converse of the chaplain with the prisoner will always be the most beneficial part of his ministry.

As it seldom happens that all the inmates of a prison are of the same religious denomination, it will often be requisite to provide ministers of different religions, or sects, according to circumstances. Thus, although in England the majority of prisoners will in general belong to the Established Church, yet, where the number of Catholics, or of dissenters of any one sect in the prison, reaches a given point, it is clear that the services of a Catholic priest, or dissenting minister of such sect, ought to be secured and paid for by the state. For if it be concluded that religious instruction in indispensable to the reformation of the prisoner, it follows that such instruction can only be effectual when based upon the religion which the prisoner believes to be true. The circumstance, moreover, of the prisoner being deprived of his liberty, distinguishes his claim, in this respect, from that of other members of the community.

Diet, &c.

4. *Diet and care of health.* The loss of health forming no part of the prisoner's sentence, it follows that all due care must be taken of its preservation; and attention is therefore requisite to diet, clothing, cleanliness, and every other matter whereby it is liable to be affected. In some prisons the diet is so excessive as to be greatly superior to the ordinary fare of the free labourer, and consequently to constitute a *bonus* upon imprisonment; in others it is so inadequate as to impair the prisoners' constitutions, and reduce their physical strength. The latter appears particularly to be the case in those houses of correction where tread-wheel labour is enforced as a part of the silent system. The want of uniformity in the dietary of British prisons will seem very striking when the returns are referred to.[1] Under a system of separation, the sufficiency of the diet will easily be determined by the observation of the medical attendant, who will best regulate the variations of food which particular cases will require. The convict will, of course, be limited to the prison fare; the untried will, as at present, be permitted to receive such articles of food as his means may procure him. Stimulating liquors are only admissible within a prison for medical purposes, nor ought any canteen, or place for the sale of any food or liquors be permitted to exist within its walls.

It is not necessary to offer particular suggestions in regard to washing, clothing, and the other requisites of bodily health. The exercise of ordinary good sense will regulate such matters without difficulty. The utmost cleanliness should pervade every part of the prison. This is a point in which the English prisons surpass by far those of the continent. Nor need any apprehensions be entertained lest perfect cleanliness should make a prison too luxurious an abode. Cleanliness is no superfluous luxury; but should rather be regarded as having a strong tendency to purify the moral as well as the physical man.

Disposal after discharge.

5*th. The disposal of the prisoner after his discharge* is, at present, the most embarrassing question to which imprisonment gives rise. The short terms to which offenders are for the most part sentenced, make it quite visionary to anticipate reform as a general result of the best system; and even if the prisoner should have become a better man, the difficulty of his finding employment is (except in newly settled countries, like the United States) so great as to tempt him forcibly to relapse into crime. Several modes of provision for this difficulty were suggested by Mr. Bentham, such as, employment in the army or navy; encouragement of voluntary emigration to the colonies; the requiring security for good behaviour, with liberty to the surety to contract for the prisoner's labour; or a subsidiary establishment for the reception of the prisoners as a modified kind of imprisonment. Much has been done in France and elsewhere on the continent, by societies "*pour le patronage des libérés,*" whose endeavour it is to place discharged prisoners in useful occupations. The British colonies, where labour is in very great demand, offer favourable prospects to the emigrant; and if some systematic plan were organized, the opportunity of emigration would, without doubt, be joyfully accepted by many liberated convicts. To the young offender, such an opportunity is especially desirable. But compulsory banishment cannot be resorted to for the mass of offenders. It is therefore worthy of consideration, whether the convict should not, on his liberation, be placed under the temporary control of the police, in order that the police might be duly cognizant of his residence and occupation, and thus exercise a check upon his return to criminal pursuits? (See article Police). It might also be advantageous, in many cases, to commute sentences of imprisonment, either in the whole, or in part, for police surveillance, and thus to relieve the prisons of a mass of petty offenders, upon whom incarceration can rarely, even under the best system, operate beneficially. These, however, are questions belonging rather to the theory of punishment, than to the subject of prison discipline; nor is it possible to treat the latter subject at all satisfactorily, unless in connexion with an entire system of secondary punishments.

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[1] See Appendix, No. 4. to Inspector's *Second Report*, Session 1837.

Our space has limited us to the leading points of prison management, nor is it requisite that we should enter into the details of minor arrangements. In every prison much will depend upon the good sense and discernment of the keeper, and the efficiency of the inferior officers, whose duties should be prescribed with precision, and enforced with exactness. The prison should be inspected, at frequent and uncertain times, by inspectors duly authorised to inquire into every thing in and relating to it. Proper books must be kept for recording every matter of importance, in a uniform manner, which the government should prescribe for all prisons, and the fewer and simpler the books the better. Uniformity of regulations should exist, as far as possible, in all prisons used for the same purpose, which can only be effected by a central authority charged with their superintendence.

The costs of constructing prisons do not fall within the scope of the present article. It may be useful, however, to refer the reader to M. Blouet's report before quoted. That architect estimates the cost of erecting a prison in Paris, for 480 offenders, on the Auburn, or silent system, at about L.80 per cell; and on the Philadelphia, or separate system, at L.148 per cell. The first cost of establishing the separate system will unquestionably be the highest; but, as it requires a smaller number of officers, and on other accounts, it may probably prove in the end the most economical. At all events, we repeat, it is not the *cheapest*, but the *best* system, that is desirable. Nor can we imagine a more legitimate appropriation of public money, than that which is expended with a reasonable prospect of preventing crime, by introducing into prisons efficient means of correction and reform.

(x.)

PRISTINA, a city of Turkey in Europe, in the province of Beldschterin. It is strongly fortified, is the seat of a Greek archbishop, and the principal market of an extensive district. It contains 2000 houses and 10,000 inhabitants; and is the centre of one of the greatest mining ports of Turkey, abounding in iron ore, and yielding some silver.

PRITTELWELL, a town of the county of Essex, in the hundred of Rochford. It is situated about one mile from the north bank of the Thames, near Southend. The population amounted in 1821 to 1922, and in 1831 to 2266.

PRIVAS, an arrondissement in the department of the Ardèche, in France, extending over 710 square miles. It comprehends ten cantons, divided into 107 communes, and 90,640 inhabitants. The capital is the city of the same name the seat of the boards of the departmental government, and of the courts of law. It contains 520 houses, with 3340 inhabitants, employed in making woollen goods, and in tanneries. In the vicinity are abundant mines of fossil coal. Long. 4. 31. E. Lat. 44. 45. N.

PRIVATEERS are a kind of men-of-war, fitted out and provided with military stores by private individuals; and the persons concerned, instead of pay, are permitted to retain their captures, allowing the admiral his share.

Privateers may not attempt any thing against the laws of nations; as to assault an enemy in a port or haven under the protection of any prince or republic, whether he be friend, ally, or neutral; and before a commission can be granted to any privateer, the commander is to give security, if the ship be not above 150 tons, in L.1500, and if the ship exceeds that burden, in L.3000, that the owners will make satisfaction for all damages which they shall commit in their courses at sea.

Besides these private commissions, there are special commissions for privateers, granted to commanders of ships and others, who take pay, are under a marine discipline, and, if they do not obey their orders, may be punished with death.

PRIVATIVE, in *Grammar*, a particle, which, prefixed to a word, changes it into a contrary sense. Thus, among the Greeks, the α is used as a privative; as in α-θεος, *atheist*, *acephalus*, and the like.

PRIVY-Council. The king's will is the sole constituent of a privy-counsellor; and it also regulates their number, which in ancient times was about twelve. Afterwards it increased to so large a number that it was found inconvenient for secrecy and despatch; and therefore Charles II. in 1679 limited it to thirty. Since that time, however, the number has been much augmented, and now continues indefinite. Privy-counsellors are made by the king's nomination, without either patent or grant; and, on taking the necessary oaths, they become immediately privy-counsellors during the life of the king that chooses them, but subject to removal at his discretion.

The privy-council is the *primum mobile* of the state, and that which gives the motion and direction to all the inferior parts. It is likewise a court of justice of great antiquity; the primitive and ordinary way of government in England being by the king and privy-council. At present the privy-council takes cognizance of few or no matters except such as cannot well be determined by the known laws and ordinary courts; such as matters of complaint and sudden emergencies; their constant business being to consult for the public good in affairs of state.

In plantation or admiralty causes, which arise out of the jurisdiction of this kingdom, the privy-council has cognizance, being the court of appeal in such causes; and from all the dominions of the crown, excepting Great Britain and Ireland, an appellate jurisdiction (in the last resort) is vested in this tribunal, which usually exercises its judicial authority in a committee of the whole privy-council, who hear the allegations and proofs, and make their report to his majesty in council, by whom the judgment is finally given.

By the common law, the privy-council was dissolved *ipso facto* by the king's demise. But now, to prevent the inconveniences of having no council at the accession of a new prince, it is enacted, by 6 Anne, cap. 7, that the privy-council shall continue for six months after the demise of the crown, unless sooner determined by the successor. (Blackstone's *Commentaries*, book i.)

PRIZE, or Prise, in maritime affairs, a vessel taken at sea from the enemies of a state, or from pirates; and that either by a man-of-war, a privateer, or other, having a commission for that purpose.

PROBABILITY.

The doctrine of probability is an extensive and very important branch of mathematical science, the object of which is to reduce to calculation the reasons which we have for believing or expecting any contingent event, or for assenting to any conclusion which is not necessarily true. When it is considered that the whole edifice of human science, with the exception of a few self-evident truths, such as the axioms of geometry, is nothing more than an assemblage of propositions which can only be pronounced to be more or less probable, the importance of a calculus which enables us to appreciate exactly the degree of probability existing in each case, will be readily understood.

Our reasons for judging an event to be probable or improbable, are derived from two distinct sources; first, an *a priori* knowledge of the causes or circumstances which determine its occurrence; and, secondly, when the causes are unknown, experience of what has already happened in the same circumstances, or in circumstances apparently similar. Suppose, for example, a hundred white balls to be placed in an urn along with fifty black balls, and that a person, blindfold, proceeds to draw a ball, there is to us, who are acquainted with the contents of the urn, a determinate probability that the ball which is drawn will be white. The balls being supposed to be all in precisely the same circumstances with respect to facility of drawing, we assume that there is the same chance of drawing any one ball as of drawing any other; and, consequently, since there are two white balls for each black ball, and therefore two chances of drawing one of the first colour for each chance of drawing one of the second, we conclude the event which consists in the drawing of a white ball to be twice as probable as the opposite event, or the drawing of a black ball. In this case our knowledge of the contents of the urn enables us to judge of the probable result of the drawing. Suppose, however, that antecedently to the drawing, we were entirely ignorant of the contents of the urn, but that after a great number of trials have been made, (the ball drawn being always replaced in the urn after each trial, in order that the circumstances may be the same in all the trials) it has been observed that a white ball has been drawn twice as often as a black ball, we presume that the urn contains twice as many white as black balls, and consequently affords twice as many chances of drawing a white ball as of drawing a black; and this presumption becomes stronger in proportion to the number of instances included in the observation. In this case experience makes up for the want of *a priori* knowledge, and affords a measure of the probability of the result of a future trial.

It is only in a comparatively small number of cases that all the possible ways in which an event may happen are known *a priori*, and in which, consequently, the ratio of the number of chances favouring the event to the whole number of existing chances is determinate. In fact, most of the questions of this class to which the calculus can be applied, are connected with lotteries and games of hazard. The results obtained from the analysis of such questions cannot be considered as being of any great value in themselves, but they frequently throw light on subjects of far higher importance which present analogous combinations. It is true that the mathematical theory comes in aid of moral considerations, and demonstrates the ruinous tendency of gambling even when the conditions of the play are equal, mathematically speaking; but, unfortunately, those who indulge a passion for this vice are seldom capable of appreciating the force of such arguments. The principal advantage which has resulted from the application of analysis to games of chance is the extension and improvement of the calculus to which it has led.

The calculation of the probabilities of events, the chances of which are not known *a priori*, but inferred from experience, is founded on the presumed constancy of the laws of nature, in obedience to which events depending on constant though unknown causes, are always reproduced in the same order when considered in large numbers. Among the various phenomena of the physical and moral world, nothing is more remarkable than the constancy which is observed to prevail in the recurrence of events of the same kind. The ratio of male to female births furnishes a noted instance. If we consider only a small number of births, nothing can be more uncertain than the result; but taking a very large number, as those of a whole kingdom in the course of a year, the proportion of males to females is found to be almost invariable, and nearly as 21 to 20. The mean duration of human life affords another familiar example. Notwithstanding the proverbial uncertainty of life, the differences of constitutions, and the various accidents to which mankind are exposed, the average duration of the lives of a large number of individuals living in the same country is always found to be very nearly the same, insomuch that pecuniary risks depending on it, if undertaken in sufficiently large numbers, are among the least uncertain of all commercial speculations. A similar constancy is remarked in the results of statistical inquiries of every kind. The number of crimes of the same species committed in a year, the ratio of the number of acquittals to the number of trials, the number of conflagrations, of ships lost in a particular trade, of letters which pass through the post-office, of patients admitted into the public hospitals; in every case the numbers in a given time are observed to fluctuate between very narrow limits, and to approach nearer and nearer, as the observation is more extended, to fixed mean values.

This constant approximation to fixed ratios, which is proved by all experience, in the recurrence of events of the same kind, enables us to apply the calculus of probabilities to many of the most interesting questions connected with our social and political institutions; and to determine the average result of a series of coming events with as much precision as if their chances were determinate, and known *a priori*, like that of obtaining a given point with the throw of a die. Whatever be the nature of the phenomenon under consideration, whether it belong to the physical or moral order of things, the calculus is equally applicable when the requisite data have been determined from experience.

The foundations of the mathematical theory of probabilities were laid by Pascal and Fermat about the middle of the 17th century. Among some other questions relating to chances, the following was proposed to Pascal. "Two persons sit down to play on the condition that the one who first gains three games shall be the winner of the stakes. The first having gained two games, and the second one, they agree to leave off and divide the stakes in proportion to their respective probabilities of winning: what share is each entitled to take?" Pascal solved the question, but by a method which was applicable only to the particular case. Fermat, to whom it was communicated by Pascal, employed the direct and general method of combinations, and gave a solution which could be applied to the case of any number of players. His reasoning, however, did not at first appear to Pascal to be satisfactory, and a correspondence on the subject took place between these two illustrious geometers, which is preserved in their respective works, and throws some light on the history of mathematics in that age.[1]

About the same period Huygens composed his tract *De Ratiociniis in Ludis Aleæ*, which was first published in the *Exercitationes Geometricæ* of Schooten in 1658. This was the first systematic treatise which appeared on the doctrine of chances. It contained an analysis of the various questions which had been solved by Pascal and Fermat, and at the end five new questions were proposed, the solutions of which, simple as they may now appear, were then attended with considerable difficulty. The analysis of two of them was in fact given for the first time by Montmort, half a century after their publication. Huygen's tract was translated into English and published in 1692, with some additional remarks relative to the advantage of the banker in the game of Pharaon, in an *Essay on the Laws of Chance*, edited and supposed to have been written by Motte, then Secretary of the Royal Society.

James Bernoulli appears to have been the first who perceived that the theory of probability may be applied to much more important purposes than to regulate the stakes and expectations of gamesters, and that the phenomena, both of the moral and physical world, anomalous and irregular as they appear when viewed in detail, exhibit, when considered in large numbers, a constancy of succession which renders their occurrence capable of being submitted to numerical estimation. The *Ars Conjectandi*, published in 1713, seven years after the death of the author, contains a number of interesting questions relative to combinations and infinite series; but the most remarkable result which it contains is a theorem respecting the indefinite repetition of events, which may be said to form the basis of all the higher applications of the theory. It consists in this, that if a series of trials be instituted respecting an event which must either happen or fail in each trial, the probability becomes greater and greater, as the number of trials is increased, that the ratio of the number of times it happens, to the whole number of trials, will be equal to its *a priori* probability in a single trial; and that the number of trials may be made so great as to give a probability, approaching as nearly to certainty as we please, that the difference between the ratio of its occurrences to the number of trials, and the fraction which measures its *a priori* probability, will be less than any assigned quantity. Bernoulli informs us, that the solution of this important theorem had engaged his attention during a period of twenty years.

In the interval between the death of Bernoulli and the appearance of the *Ars Conjectandi*, Montmort published his *Essai d'Analyse sur les Jeux de Hazard*. The first edition was in 1708; the second, which is considerably extended, and enriched by several letters of John and Nicolas Bernoulli, appeared in 1713. The work possesses considerable merit; but being chiefly confined to the examination of the conditions of games of chance, many of which are now forgotten, it has lost much of its original interest.

About the same time, Demoivre began to turn his attention to the subject of probability, and his labours, which were continued during a long life, contributed greatly to the advancement of the general theory, as well as the extension of some of its most interesting applications. Demoivre's first publication on the subject was a Latin memoir *De Mensura Sortis*, in the *Transactions of the Royal Society* for 1711. His *Essay on the Doctrine of Chances* first appeared in 1716; a second edition in 1738; but the third and most valuable, including also his *Treatise on Annuities on Lives*, is dated 1756. This work contains a great variety of questions relating to chances, solved with much clearness and elegance; but it is chiefly remarkable for the theory of recurring series, there given for the first time, which is of important use in investigations of this kind, and is in fact equivalent to the methods employed in the modern calculus for the integration of equations of finite differences having constant co-efficients. Of the particular results obtained by Demoivre, one of the most important in reference to theory, is an extension of the theorem of James Bernoulli, above mentioned. It follows from Bernoulli's theorem, that if we have a given probability that the ratio of the number of occurrences of an event to the whole number of trials, will approach to the *a priori* probability of the event within certain given limits, those limits will become narrower and narrower, as the number of trials is multiplied; but in order to complete the theorem, it is necessary to assign the numerical value of the probability that in a large number of future trials, the number of occurrences will fall within assigned limits. For this purpose we must find the product of the natural numbers 1, 2, 3, 4, &c., up to the number of trials; an operation which, if attempted by direct multiplication, becomes very laborious, even when the number of trials is inconsiderable, and when the number is great, as 10,000 for example, is altogether beyond the reach of human industry. A formula was however discovered by Stirling, by means of which an approximate value of the product is found by the summation of a few of the first terms of a series which converges the more rapidly as the number of trials is greater. With the aid of this formula, Demoivre was enabled to assign the probability in question, and thus give a practical value to the theorem of Bernoulli.

The objects and important applications of the theory of probabilities having been made known by the works now mentioned, the subject has ever since been regarded as one of the most curious and interesting branches of mathematical speculation, and accordingly has received more or less attention from almost every mathematician of eminence. A great variety of questions connected with it and especially relating to lotteries, are interspersed in the volumes of the *Paris* and *Berlin Memoirs*, (particularly the latter,) by John and Nicolas Bernoulli, Euler, Lambert, Beguelin, and others. D'Alembert has likewise treated of the theory in several of the volumes of his *Opuscula;* and it is not a little remarkable, that in some instances its first principles should have been misunderstood by so ingenious and profound a writer. In the St. Petersburg Memoirs, (vol. v.) there is an interesting paper by Daniel Bernoulli on the relative values of the expectations of individuals who engage in play, or stake sums on contingent benefits, when regard is had to the difference of their fortunes; a consideration which, in many cases, it is necessary to take into account; for it is obvious, that the value of a sum of money to an individual, depends not merely on its absolute amount, but also on his previous wealth. On this principle Bernoulli has founded a theory of *moral expectation*, which admits of numerous and important applications to the ordinary affairs of life. The *Transactions of the Royal Society* for the years 1763 and 1764, contain two papers by the Rev. Mr. Bayes, with additions to the latter by Dr. Price, which deserve to be noticed, inasmuch as the principles on which the probability of an event is determined, when the event depends on causes of which the existence and influence are only presumed from experience, are there for the first time correctly laid down. The question proposed and solved by Bayes was this: a series of experiments having been made relative to an event, to determine the presumption there is, that the fraction which measures its probability falls within given limits.

One of the earliest applications of the theory of probability was to determine, from observations of mortality, the average duration of human life, and the value of pecuniary interests depending on its continuance or failure. This particular application appears to have been first thought of, or at least attempted to be carried into practical effect, in Holland, by Hudde and the celebrated pensionary De Witt; but the first tables of mortality, with the corresponding values of annuities on single lives, were constructed by our illustrious countryman Dr. Halley, and published in the Philosophical Transactions for 1693. For the history of this branch of the subject, we refer to the two articles, ANNUITIES and MORTALITY in this work. We may remark, however, that although the English writers, who have expressly treated of it, have almost without exception confined themselves to the explanation of the methods of computing annuity tables, and of determining from them the values of sums depending on life contingencies, the aid which this branch of economy derives from the general theory of probabilities, is by no means confined to the consideration of such elementary questions. The number of observations necessary to inspire confidence in the tables, the extent to which risks may be safely undertaken, the comparative weights of different sets of observations, and the probable limits of departure from the average results of previous observations in a given number of future instances, are all questions of the utmost importance, which come within the scope of the calculus, and cannot, in fact, be justly appreciated by any other means.

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[1] *Œuvres de Blaise Pascal*, tome iv. Paris, 1819; *Opera Petri de Fermat*, Tolosæ, 1679.

The application of the theory of probability to the subject of jurisprudence, and the verdicts of juries and decisions of tribunals, has been discussed by the Marquis Condorcet in various articles in the *Encyclopédie Méthodique;* but more especially in his *Essai sur l'application de l'Analyse à la Probabilité des Decisions rendues à la Pluralité des Voix,* Paris 1785; a work of great ingenuity, and abounding with interesting remarks on subjects of the highest importance to humanity. James Bernoulli, it appears, had intended to treat jurisprudence as a branch of probability in the *Ars Conjectandi,* but his premature death prevented that work from being completed. There is a memoir on the subject by his nephew Nicolas, in the Leipsic Acts for 1711. The most important questions to be determined, are the number of jurors of which a jury ought to consist, and the majority which should be required to agree in a verdict in order to afford, on the one hand, the greatest probability that an accused person will not be wrongly condemned; and, on the other, to give to society the greatest security that its interests will not be compromised, by allowing too great facilities for the guilty to escape. This important subject has been treated more profoundly, and with numerical elements derived from much better data than existed in the time of Condorcet, in a recent work by Poisson, to which we shall presently allude.

Another of the moral subjects to which the theory of probability has been applied, and connected with the preceding, is the appreciation of the evidence of testimony. In matters of this kind, it is easy to see that the calculus must be founded almost entirely upon hypothetical data. The veracity of a witness can scarcely be made the subject of direct experiment; and by reason of the complicated circumstances with which the facts forming the subject of testimony are usually accompanied, and the numberless ways in which mankind are influenced by their passions, credulity, or ignorance, it is perhaps equally impossible to deduce an average value from the comparison of a great number of statements which have been ascertained to be true or false. Numerical results can therefore only be obtained by having recourse to hypotheses, and consequently must be considered as only probable approximations. The knowledge, however, which is thus obtained of the various combinations of the quantities concerned, affords important aid in guiding our judgments in complicated cases, and when we have to decide upon conflicting testimony. Approximations deduced from a train of accurate and systematic reasoning, are always to be preferred to the most specious arguments drawn from any other source.

The analysis of probability has been applied with signal advantage in many researches of Natural Philosophy, but especially in appreciating the mean errors of observations. Owing to the imperfections of sense and of instruments, physical magnitudes are only susceptible of being measured within certain limits of accuracy; and where the last degree of precision is indispensable, as in practical astronomy, it is only by means of a very great number of measures, compared with one another, and combined according to the methods which this calculus points out, that we can obtain the nearest approximation to the true values which the observations are capable of giving. The mean errors of observations were treated as questions of probability by Lagrange in the Turin *Memoirs* for 1773; but it is to Laplace that the theory owes its principal extension and most important results. The method of combining numerous equations of condition now universally followed, known as the method of *minimum squares,* and which Laplace has demonstrated to be that which leaves the least probable amount of error in the final equations, was made known by Legendre in an Appendix to his *Nouvelles Méthodes pour la Détermination des Orbites des Comètes,* published in 1806. A similar method, however, or rather the same, (for they are identical in principle,) had been discovered by Gauss, and employed by him for several years before the work of Legendre made its appearance.[1]

Laplace's great work, the *Théorie Analytique des Probabilités,* first published in 1812, is one of the most remarkable productions that has ever appeared in abstract science. The principles of the calculus, as well as the peculiar methods of analysis which it requires, and the most interesting and difficult questions which it presents, are here discussed in a far more general manner than had been attempted by any former writer on the subject; and it may be said, accordingly, to have placed the theory under an entirely new aspect. It is much to be regretted that so little pains have been taken by the illustrious author to render the work intelligible to the generality of mathematical readers. Consisting for the greater part of separate memoirs presented at different times to the Academy of Sciences, arranged without regard to symmetry or order, it abounds with repetitions which only serve to embarrass the student; while the deficiency of explanation combined with the subtlety of the analysis, and the inherent intricacy of the subject, render it often a painfully difficult task to seize the force of the demonstrations. Notwithstanding these defects, however, it forms one of the most splendid creations of mathematical genius; and is alike admirable, whether we regard the extension which has been given to the calculus, or the results which have been arrived at, or the tone of lofty philosophy in which subjects bearing on some of the most important concerns of mankind are treated.

Next to the *Théorie Analytique* of Laplace, the most important work which has hitherto appeared on the subject of probability is the recent one of Poisson, entitled, *Recherches sur la Probabilité des Jugements,* (Paris 1837.) Although it might be inferred from the title that this work relates only to a single though very interesting application of the theory, the greater part of it is devoted to the development and demonstration of the general principles, and the discussion of the principal questions which present themselves in the different applications; and it is only in the last of the five books of which it consists that the special subject to which the title refers is taken into consideration. In applying the theory to the decisions of tribunals, Condorcet and Laplace had been unable to obtain positive results from the want of authentic data; but the recent publication by the French government of the *Comptes Généraux de l'Administration de la Justice Criminelle,* in France, having furnished an immense collection of facts from which the requisite data could be obtained, Poisson was led to consider the subject anew, and the results of his investigations, which are of singular interest, are given in the work now mentioned. Poisson had already given a theory of the mean errors of observations in the *Additions* to the *Connaissance des Tems* for 1827 and 1832.

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[1] *Theoria Motus Corporum Cœlestium,* p. 221.

It is in these two works of Laplace and Poisson that the higher and more abstruse parts of the theory of probabilities must be studied. A very clear exposition of the principles, accompanied with many interesting remarks on the uses and applications of the theory, is given by Lacroix in his valuable little work, *Traité Elémentaire du Calcul des Probabilités*, Paris 1822.

Since the time of Demoivre, the English treatises on the general theory of probability have neither been numerous, nor, with one or two exceptions, very important. Simpson's *Laws of Chance* (1740) contains a considerable number of examples, in the solution of which the author displays his usual acuteness and originality, but as they belong entirely to that class in which the chances are known *a priori*, they give no idea of the most interesting applications of the theory. Dodson's *Mathematical Repository* contains a large selection of the same kind. The Essay in the *Library of Useful Knowledge*, by Mr. Lubbock, gives a more comprehensive and philosophical, though an elementary view of the subject; but by far the most valuable work in the language is the Treatise in the *Encyclopedia Metropolitana*, by Professor De Morgan, 1837. In this very able production, Mr. De Morgan has treated the subject in its utmost generality, and embodied, within a moderate compass, the substance of the great work of Laplace.

Within the limits to which the present article must be confined, it would be hopeless to attempt giving a complete view of a branch of science which embraces so many complicated and intricate subjects of research, and which requires the aid of some of the most abstruse and recondite theories of the modern mathematics. In the higher applications of the theory, the analysis of many of the questions which arise, in order to be made intelligible, would require an extent of development and a parade of mathematical formulæ altogether incompatible with the plan and scope of this work. All that we can propose to ourselves, therefore, is to explain as briefly as may appear consistent with perspicuity, the general principles of the theory, and to give an outline of the manner in which these are applied to some of the more important questions which have been investigated by Laplace and Poisson. The examples will be selected with a view to shew the nature of the principal results of the mathematical theory, as well as the peculiar methods of analysis which are of most general application.

SECT. I. GENERAL PRINCIPLES OF THE THEORY OF PROBABILITY.

1. The term *probable*, in its popular acceptation, is used in reference to any unknown or future event, to denote that in our judgment the event is more likely to be true than not, or more likely to happen than not to happen. Without attempting to make an accurate enumeration of the various circumstances which are favourable or unfavourable to its occurrence, or to balance their respective influences, we suppose there is a preponderance on one side, and accordingly pronounce it to be probable that the event has occurred, or will occur, or the contrary.

2. If we can see no reason why an event is more likely to happen than not to happen, we say it is a *chance* whether the event will happen or not; or if it may happen in more ways than one, and we have no reason for supposing it will happen in any one of these ways rather than in another, we say it is a *chance* whether it will happen in any assigned way or in any other. Suppose, for example, an unknown number of balls of different colours to be placed in an urn, from which a ball is about to be extracted by a person blindfold. Here we have no reason for supposing that the ball about to be drawn will be of one colour rather than another, that it will be white rather than black, or red; and accordingly say it is a *chance* whether the ball will come out of a particular colour, or a different. In this instance, then, the term *chance* denotes, simply, the absence of a known cause. If, however, we are made acquainted with the number of balls in the urn, and the number there are of each of the different colours, the term is used in a definite sense. For instance, suppose the urn to contain ten balls, of which nine are white, and the remaining one black, we say there are nine chances in favour of drawing a white ball, and one chance only in favour of drawing the black ball. Chance, in this sense, denotes a *way of happening*, or a particular *case* or *combination* that may arise out of a number of other possible cases or combinations; and an event becomes probable or improbable according as the number of chances in its favour is greater or less than the number against it. *Chance* and *presumption* are also frequently used synonymously with *probability*.

3. The *mathematical probability* of any event is the ratio of the number of ways in which that event may happen to the whole number of ways in which it may either happen or fail. Thus, recurring to the previous example, the event, namely, the drawing of a ball from an urn containing 9 white balls and 1 black, may happen in 10 different ways, inasmuch as any one of the 10 balls may be drawn; but in one only of those ways will the event be a black ball; and therefore the probability of drawing the black ball is $\frac{1}{10}$. In like manner, as there are 9 different ways in which a white ball may be drawn, or 9 chances of drawing a white ball, and ten chances in all, the probability of drawing a white ball at the first trial is $\frac{9}{10}$. It follows immediately from this definition, that the probability of drawing a ball of either colour will remain the same, however the number of balls in the urn may be increased, provided those of each colour are increased in the same proportion. For instance, suppose the number of white balls to be 45, and the number of black balls to be 5; the number of chances in favour of drawing a black ball is 5, while there are 50 chances in all, consequently the probability of a black ball being drawn is $\frac{5}{50}=\frac{1}{10}$. In the same manner, the probability of drawing a white ball is $\frac{45}{50}=\frac{9}{10}$; the same as before. Generally, let E and F be two contrary events, that is to say, such that the one or the other of them must necessarily happen, and both cannot happen together; and let a be the number of chances or combinations which produce the event E, and b be the number of combinations which produce the event F, or cause the failure of E; then the probability that E will happen is $\frac{a}{a+b}$; and the probability that F will happen, or that E will *not* happen is $\frac{b}{b+a}$. In future, the term probability will be used only to signify mathematical probability.

4. It is to be carefully remarked, that the different chances or combinations which form the elements of probability are supposed to be perfectly equal. If this equality does not hold, and there is any circumstance respecting the event under consideration which renders one combination or set of combinations more likely to occur than another, the different combinations must be multiplied by numbers proportional to their respective facilities, after which the units in each multiplier may be regarded as so many distinct chances, from which the probability of the event will be found by the above formula. This is equivalent to saying that a combination or chance which is twice as likely to happen as another, must be regarded as two equal and similar combinations in comparison of that other; a proposition which is sufficiently obvious.

5. It follows from the above definition, that the probability of any contingent event is measured by a fraction less than unity, and may have any value between 0 and 1. It follows, also, that the sum of the two fractions which measure the probabilities of two contrary events is equal to unit, which is the measure of certainty, inasmuch as either the one or the other necessarily occurs. Thus, in the last example, the probability of the event E is $\frac{a}{a+b}$, and that of the contrary event F is $\frac{b}{a+b}$, and $\frac{a}{a+b}+\frac{b}{a+b}=1$. Hence if p denote the probability of any event E, and q the probability of the contrary event F, we have $q=1-p$. This consequence of the definition is of great importance in the calculation of probabilities.

6. We have here supposed the result of a trial to be necessarily one or other of two events E and F; but it is easy to imagine the trial to be of such a kind that it may give rise to any one of a number of events E, F, G, H, &c. each having a given number of chances in its favour. This case is represented by supposing an urn to contain balls of as many different colours or sorts as there are different events. Let the urn be conceived to contain a balls of the sort which produces the event E, b of the sort which produces F, c of the sort which produces G, and so on; and let $a+b+c+d$, &c. $=k$, so that k is the whole number of balls in the urn. The probabilities of the different events E, F, G, H, &c. are then, respectively, by the definition,

$$\frac{a}{k},\ \frac{b}{k},\ \frac{c}{k},\ \frac{d}{k},\ \text{\&c.}$$

the sum of which $=1$. In fact, if a ball be drawn at all, it must be of one or other of the different sorts contained in the urn; and consequently the sum of all the probabilities amounts to unit or certainty.

7. When an event is compounded of two or more simple events independent of each other, the probability of the compound event is equal to the product of the probabilities of the several simple events of which it is compounded. Let us imagine two urns, A and B, of which A contains a white balls and b black, and B contains a' white and b' black. Make $a+b=c$, and $a'+b'=c'$, and let the compound event whose probability is to be determined be the drawing of a white ball from both urns. Now, as each of the c balls in A may be drawn with any one of the c' balls in B, the whole number of ways in which the balls in A may be differently combined by pairs with the balls in B, or the whole number of possible cases is cc'. But the number of cases favourable to the compound event is evidently the number of different ways in which a white ball may be drawn from A with a white ball from B, and therefore equal to aa'. Hence by the definition (4), the probability that a white ball will be drawn from both urns is $\frac{aa'}{cc'}$. Now, if p denote the probability of drawing a white ball from A, and p' that of drawing a white ball from B, we have by the definition $p=\frac{a}{c}$, and $p'=\frac{a'}{c'}$; whence $\frac{aa'}{cc'}=pp'$.

In general, let p denote the probability of an event E, p' that of another event E′, p'' that of a third E″, and so on; then the probability of the concourse of the events E, E′, E″, &c., or the probability that they will all happen, is $p\times p'\times p''$, &c.; that is to say, the probability of an event compounded of any number of simple and independent events, is the product of the respective probabilities of the several simple events.

The probabilities that the several simple events E, E′, E,″ &c., will *not* all happen, or that some of them will happen and others fail, are easily determined in the same manner; it will be sufficient to indicate their several expressions. Suppose there are only three simple events, of which the probabilities are respectively p, p', and p''; and let $q=1-p$, $q'=1-p'$, $q''=1-p''$. The product $pq'q''$ expresses the probability of the compound event which consists in E happening and E′ and E″ both failing; $qp'q''$ is the probability that E′ will happen, and that E and E″ will both fail; $pp'p''$ is the probability they will all three happen; $1-pp'p''$ is the probability they will *not* all three happen, or that one of them *at least* will fail; $qq'q''$ is the probability they will all fail; and $1-qq'q''$ is the probability they will *not* all three fail, or that one *at least* of them will happen.

8. As an example of the application of this rule, suppose it were required to assign the probability of throwing aces, at one throw, with two common dice. As a common die has six symmetrical faces, there are in respect of each die six ways equally possible, in which the simple event may happen. The probability therefore of throwing ace with one die is $\frac{1}{6}$, that is, $p=\frac{1}{6}$. In respect of the second die, we have also $p'=\frac{1}{6}$; hence the probability of the compound event, or that aces will be thrown is $pp'=\frac{1}{6}\times\frac{1}{6}=\frac{1}{36}$. The probability that aces will *not* be thrown at any assigned trial is therefore (5) $1-\frac{1}{36}=\frac{35}{36}$; and the *odds* against throwing aces at any given trial are 35 to 1.

Again, suppose two numbers, each consisting of 7 digits, to be taken at random, (for instance from a table of logarithms), and let it be proposed to assign the probability that the substraction of the one from the other will be performed without its being necessary, in any case, to increase the upper figure. Here, as each digit may have any one of the ten values from 0 to 9 both inclusive, and as each of those values in the upper line may be combined with any one of them in the lower line, there are 100 different combinations or equally possible cases for each partial substraction. Now, if the upper figure be 0, there is only one of those cases favourable to the event, or which will admit of the substraction being performed, namely, when the figure below is also 0. If the upper figure be 1, there are two cases favourable, namely, those in which the under figure is 0 or 1. If the upper figure be 2, there are three favourable cases, namely, when the under figure is 0, 1, or 2. Proceeding in this way through all the digits, the whole number of favourable cases is found to be

$$1+2+3+4+5+6+7+8+9+10=55.$$

Hence, for each partial substraction there are 55 favourable cases out of 100 possible cases; therefore (4) the probability that any one of the figures in the upper line is not less than the corresponding figure in the under line is $\frac{55}{100}$; and we have $p=p'=p''=\text{\&c.}=\frac{55}{100}$ for the probability of each of the seven simple events or partial substractions, whence, by (7), the probability of the compound event is

$$p\times p'\times p''\times\text{\&c.}=\left(\frac{55}{100}\right)^7=(\cdot 55)^7=0152243,$$

which is less than $\frac{1}{65}$, and greater than $\frac{1}{66}$.

9. When an event may happen in several different ways, each independent of the others, the probability of the event is the sum of all the partial probabilities taken in respect of each of the different ways.

Suppose there are n different urns A_1, A_2, $A_3\ldots\ldots A_n$, each containing balls of two colours, white and black, and let the whole number of balls in each urn respectively, be

$$c_1,\ c_2,\ c_3,\ldots\ldots c_n,$$

and the number of white balls in each be

$$a_1,\ a_2,\ a_3,\ldots\ldots a_n,$$

and let the event E be the extraction of a white ball in drawing a ball from any urn at random. In this case there are n different ways, all equally probable, in which the event may happen, for it may be drawn with equal facility from any one of the urns. The probability that the ball will be drawn from any given urn, A_1, is therefore $\frac{1}{n}$; and if it be drawn from this urn, the probability of its being white is $\frac{a_1}{c_1}$; therefore, by (7), the probability of a white ball being drawn from A_1 is $\frac{1}{n} \cdot \frac{a_1}{c_1}$. In like manner the probability of a white ball being drawn from A_2 is shewn to be $\frac{1}{n} \cdot \frac{a_2}{c_2}$; from A_3 to be $\frac{1}{n} \cdot \frac{a_3}{c_3}$, and so on. Denoting therefore by p the whole probability of the event E, the proposition affirms that

$$p=\frac{1}{n}\left(\frac{a_1}{c_1}+\frac{a_2}{c_2}+\frac{a_3}{c_3}\ldots\ldots+\frac{a_n}{c}\right).$$

To prove this, let the fractions $\frac{a_1}{c_1}, \frac{a_2}{c_2}$ &c. be reduced to a common denominator, and suppose the equivalent fractions to be

$$\frac{a_1}{\gamma},\ \frac{\alpha_2}{\gamma},\ \frac{a_3}{\gamma}.\ \ldots\ldots\ \frac{a_n}{\gamma}.$$

We may now conceive the urns $A_1, A_2, A_3 \ldots A_n$ to be replaced by others, each containing the same number, γ, of balls, and of which the first contains a_1 white balls, the second a_2, and so on; and it is evident that the chance of a white ball being drawn from this new system of urns will be precisely the same as it was for a white ball being drawn from the first system. Now the probability of drawing a white ball from the new system will not be altered by placing the whole of the $n\gamma$ balls in a single urn, for they may still be conceived as arranged in groups, disposed in any manner whatever, each group containing the same number of balls, and the same proportion of white to black as were in the separate urns; and as each group contains the same number of balls, the chance of laying the hand on any one group is the same as that of laying it on any other. The probability of drawing a white ball from the single urn, is therefore the same as for drawing it from the group of separate urns which contain each the same number of balls. But the probability of drawing it from the single urn is the ratio of the number of white balls contained in the urn to the number of both colours, therefore (this probability being p) we have

$$p=\frac{1}{n\gamma}(a_1+a_2+a_3\ldots\ldots+a_n);$$

whence, substituting for $\frac{a_1}{\gamma}$, $\frac{a_2}{\gamma}$, &c., their respective values, $\frac{a_1}{c_1}$, $\frac{a_2}{c_2}$, &c., we have

$$p=\frac{1}{n}\left(\frac{a_1}{c_1}+\frac{a_2}{c_2}+\frac{a_3}{c_3}\ldots\ldots+\frac{a_n}{c_n}\right).$$

As a particular case suppose three urns A, B, C to be placed together, of which A contains 2 white balls and 1 black; B 3 white balls and 2 black, and C 4 white and 3 black, and let it be required to determine the probability p of a white ball being drawn from the group by a person who is ignorant of the contents of the different urns. As there is no reason for selecting one urn in preference to another, the probability that he will put his hand into the urn A is $\frac{1}{3}$; and if he draw from this urn the probability that a white ball will be drawn is $\frac{2}{3}$, there being 2 cases favourable to that event, and 3 cases in all. The probability of both events is therefore $\frac{1}{3}\ \ \frac{2}{3}=\frac{2}{9}$. In like manner, the probability of the ball being drawn from B is $\frac{1}{3}$; and if drawn from B the probability of its being white is $\frac{3}{5}$; therefore, the probability of this compound event is $\frac{1}{3} \times \frac{3}{5}=\frac{1}{5}$. Lastly, the probability of the ball being drawn from C is $\frac{1}{3}$; and if drawn from C the probability of its being white is $\frac{4}{7}$; therefore, the probability of this compound event is $\frac{1}{3} \times \frac{4}{7}=\frac{4}{21}$. Hence, by the proposition now demonstrated, the complete probability of the event E is

$$p=\tfrac{2}{9}+\tfrac{1}{5}+\tfrac{4}{21}=\tfrac{193}{315}.$$

If all the balls had been placed in a single urn, the probability of drawing a white ball would have been $\frac{9}{15}$, for there are $3+5+7=15$ balls in all, of which $2+3+4=9$ are white. But $\frac{9}{15}=\frac{189}{315}$; a fraction which differs sensibly from $\frac{193}{315}$, the measure of the probability of the same event when the balls are distributed in the manner above supposed amongst the different urns. The distinction between the two cases is important.

10. The rule laid down in (7) for finding the probability of a compound event applies alike whether the simple events are determined simultaneously or in succession. In fact, when the simple events are entirely independent of each other, the chances which determine the compound event are not influenced in any way by the intervention of time. Suppose, for example, the compound event to be the throwing of a certain number of points with a given number m of dice; the chances for and against the event are obviously the same whether the m dice are thrown at once, or a single die is thrown m times successively. But as the determination of the probability of a compound event is in general facilitated by supposing the simple events to be decided one after the other, it will be convenient to view the subject in this light in explaining the method of forming the different combinations of the chances by which the probabilities of compound events are determined.

SECT. II. OF THE PROBABILITY OF EVENTS DEPENDING ON A REPETITION OF TRIALS, OR COMPOUNDED OF ANY NUMBER OF SIMPLE EVENTS, THE CHANCES IN RESPECT OF WHICH ARE KNOWN *A PRIORI*, AND CONSTANT.

11. Suppose an urn to contain $a+b$ balls, a white and b black, and let a ball be successively drawn, and replaced in the urn after each drawing, in order that the chances in favour of drawing a ball of either colour may be the same in every trial, and let it be required to find the respective probabilities of the different possible results of any number of drawings.

Let us first suppose the number of trials to be two. The event may happen in any of these four different ways: first white, second white; first white, second black; first black, second white; first black, second black. Assuming W to represent the simple event which consists in the drawing of a white ball, and B that of a black ball, and supposing the order of the arrangement of the two letters to correspond with the order of succession of the simple events, the four possible cases or combinations will be represented thus:—

WW, WB, BW, BB.

Now let the probability of drawing a white ball in any trial be p, and that of drawing a black ball be q, (whence, $p=\frac{a}{a+b}$, $q=\frac{b}{a+b}$) the probabilities of the four possible compound events are by (7) respectively as under:

$$\begin{aligned} \text{probability of WW} &= p \times p = p^2 \\ \text{of WB} &= p \times q = pq \\ \text{of BW} &= q \times p = pq \\ \text{of BB} &= q \times q = q^2 \end{aligned}$$

If we disregard the order of succession, and consider the two arrangements WB and BW, which are equally probable, as forming the same compound event, namely, a ball of both colours in the two trials, the probability of this event, by (9), becomes $2pq$. The sum of the probabilities of all the possible arrangements is therefore

$$p^2+2pq+q^2=(p+q)^2;$$

whence it appears that the probabilities of the different arrangements in two trials are respectively the terms of the development of the binomial, $(p+q)^2$.

Let us next suppose the number of trials to be three.

The different arrangements that may be formed of the simple events in three trials, with the probability of each respectively. are as follows :—

WWW, probability of which $=ppp=p^3$
WWB, ... $=ppq=p^2q$
WBW, ... $=pqp=p^2q$
BWW, ... $=qpp=p^2q$
WBB, ... $=pqq=pq^2$
BWB, ... $=qpq=pq^2$
BBW, ... $=qqp=pq^2$
BBB, ... $=qqq=q^3$

It thus appears that the probability of obtaining two events of one kind, and one of the other, is the same in whatever order they succeed each other, and, in fact, is independent of the order. Disregarding, then, the order of succession, and considering the combination of two white balls with one black, in whatever order they may be arranged, as the same compound event, the probability of its occurrence *in any order whatever*, being the sum of its probabilities in each particular order (9), is $3p^2q$. In like manner, regarding the combination of two black balls with one white, in any order of arrangement, as the same compound event, its probability is $3pq^2$. The compound event resulting from three trials must then happen in one of four different ways, namely, 3 white balls; 2 white, combined with 1 black, in any order; 2 black, combined with one white, in any order; or, lastly, 3 black; and the sum of the probabilities of these different cases is

$$p^3+3p^2q+3pq^2+q^3=(p+q)^3.$$

Hence the probabilities of all the different possible combinations in three trials are respectively given by the development of the binomial $(p+q)^3$.

12. In general, let p denote the probability of any simple event E, then the probability of E happening twice in two trials is p^2, of happening thrice in 3 trials p^3, and of happening m times in m successive trials, p^m. In like manner, the probability of the contrary event F being q $(p+q=1)$, the probability of F happening n times in n successive trials is q^n. Hence (7) the probability of E happening m times, and then F happening n times in succession, in $m+n$ trials, is p^mq^n. But the probability of these events happening in any assigned order is the same as that of their happening in any other assigned order; therefore p^mq^n is the measure of the probability that E will occur m times, and F will occur n times in a determinate order. Now, let $m+n=h$, and let U be the number of different ways in which m events E, and n events F, can be combined in h trials, and P be the probability of any one of these combinations whatever, or the probability of E occurring m times, and F occurring n times in h trials, without regard to the order in which they succeed each other, we have then

$$P=Up^mq^n.$$

In order to determine the value of U, we may suppose the events in question to be so many different things represented by the letters A, B, C, D, E, &c. of which there are m of one kind, and n of another, and make $m+n=h$; then by the algebraic theory of combinations, we have

$$U=\frac{1\,.\,2\,.\,3\ldots\ldots\ldots\ldots h}{1\,.\,2\,.\,3\ldots\ldots m\times 1\,.\,2\,.\,3\ldots\ldots n}.$$

This value of U is symmetrical in respect of m and n, and may be otherwise written in either of the two following forms,

$$U=\frac{h(h-1)(h-2)\ldots\ldots\ldots h-m+1}{1\,.\,2\,.\,3\quad\ldots\ldots\ldots\quad m},$$

$$U=\frac{h(h-1)(h-2)\ldots\ldots\ldots h-n+1}{1\,.\,2\,.\,3\quad\ldots\ldots\ldots\quad n},$$

which shew that the probability P, or the product Up^mq^n is the $(m+1)$th term of the development of the binomial $(p+q)^h$ arranged according to the increasing powers of p, or the $(n+1)$th term of the same development arranged according to the increasing powers of q. Hence we conclude that when p and q remain constant, the probabilities of all the different compound events which can be formed by the combination of the simple events E and F in h trials, are expressed by the different terms of the formula $(p+q)^h$ expanded by the binomial theorem.

The whole number of possible cases is evidently $h+1$, for in h experiments, E may occur h times, $h-1$ times, $h-2$ times......$h-h$ times; this last being the case in which the contrary event F occurs in all the trials. The different cases are unequally probable, both by reason of the greater or smaller number of combinations by which they may be produced, and which in reference to each case is represented by U, and by reason of the inequality between p and q. It will be shewn afterwards, that when $p=q$, and h is a whole number, the most probable case is that in which the occurrences of E and F are equal; and if h is an odd number, the two most probable cases are those in which the difference in the number of occurrences of E and the number of occurrences of F is unity.

13. In order to place the proposition now demonstrated in a clearer light, let us consider separately the different terms of the development of $(p+q)^h$, namely,

$$p^h+hp^{h-1}q+\frac{h(h-1)}{1\,.\,2}p^{h-2}q^2\ldots\ldots\ldots\ldots\ldots\ldots$$
$$+\frac{h(h-1)(h-2)\ldots\ldots h-n+1}{1\,.\,2\,.\,3\quad\ldots\ldots\quad n}p^{h-n}q^n$$
$$\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots+q^h.$$

The first term p^h expresses the probability that the event E will in every one of the h trials. The second term $hp^{h-1}q$ expresses the probability that E will occur $h-1$ times, and F once, without distinction of order; that is to say F may happen at the first or last or any intermediate trial. If a determinate succession is proposed, for example, that of $h-1$ times the event E in succession, and F in the next trial, the probability of the event in the assigned order is found by suppressing the coefficient h, and is consequently $p^{h-1}q$.

The third term $\frac{h(h-1)}{1\,.\,2}p^{h-2}q^2$ expresses the probability that the result of h trials will be $h-2$ times the event E, and twice the event F, without distinction of order. If a particular order be assigned, it is necessary to suppress the coefficient, and the probability of the simple events occurring in that particular order is $p^{h-2}q^2$.

The general term $\frac{h(h-1)(h-2)\ldots\ldots h-n+1}{1\,.\,2\,.\,3\quad\ldots\ldots\quad n}p^{h-n}q^n$ expresses the probability that the result of h trials will be $(h-n)$ times the event E, and n times the event F in any order. The probability of $(h-n)$ times E and n times F in an assigned order is $p^{h-n}q^n$.

14. If we suppose the event E to be such that the chances in favour of its happening or failing are equal, that is, if $p=q=\frac{1}{2}$, the different terms of the binomial $(p+q)^h$, on suppressing the coefficients, become all equal; so that a particular order being assigned in each of the possible cases or combinations, all the cases become equally probable. Thus, suppose a shilling to be tossed 100 times in succession, the probability of head turning up in every trial is $(\frac{1}{2})^{100}$. The probability of 50 heads and 50 tails in any assigned order is $(\frac{1}{2})^{50}\times(\frac{1}{2})^{50}=(\frac{1}{2})^{100}$; if $m+n=100$, the probability of m heads and n tails is also $(\frac{1}{2})^m(\frac{1}{2})^n=(\frac{1}{2})^{m+n}=(\frac{1}{2})^{100}$. Hence the probability of any compound event formed by the combination of two simple contrary events succeeding each other in an assigned order, and each having the same probability, is independent of the ratio of the simple events, and depends only on the number of trials. Before the trials, it is an even wager that head will be turned up in succession 100 times, and that the result of 100 trials will be 50 heads and 50 tails in a given order of succession, or any proportion

of heads to tails in an order arbitrarily chosen. This consideration is frequently lost sight of in reasoning about those events of the natural world, which are termed extraordinary and miraculous. If in tossing a shilling 100 times into the air, the number of heads turned up is found nearly equal to the number of tails, the event excites no surprise; something like it was expected. On the contrary, if the difference between the number of heads and the number of tails is considerable, the event is termed extraordinary; and if head turned up in every trial without exception, we should scarcely be persuaded that such an event was entirely the result of chance, and independent of a special cause. Nevertheless, the *a priori* probability that every trial will give head, is precisely the same as the probability of throwing any given number of heads and tails in an assigned order of succession. It will, however, be proved afterwards, that if such an event as throwing head 100 times in succession were actually observed, the probability of a special cause having intervened, would approach very nearly to certainty.

15. Hitherto we have supposed the compound event to be formed by the combination of two simple events only, E and F, one of which necessarily excludes the other. Let us now suppose there are any number of simple events, E_1, E_2, E_3, &c. of which the respective probabilities are p_1, p_2, p_3, &c. and such that one or other of them necessarily happens in each trial, so that $p_1+p_2+p_3+$, &c. $=1$, and determine the probability of any assigned combination of them in a given number of trials. This case may be represented by supposing an urn to contain a number of balls of as many different colours as there are distinct events; the event E_i will be the drawing of a ball of the colour i, and its probability p_i will be the fraction whose numerator is equal to the number of balls of the colour i, and denominator the whole number of balls in the urn. Now the probability of the event E_1 happening m times in succession is p_1^m by (12); that of E_2 happening n times in succession is p_2^n; that of E_3 happening r times in succession p_3^r; and so on. Therefore (7) the probability of the compound event which is formed by the occurrence of m times E_1, n times E_2, r times E_3, and so on, these events succeeding each other in order, is the product $p_1^m\, p_2^n\, p_3^r$, &c. But the probability of the simple events succeeding each other in any particular order is the same as that of their succeeding in any other assigned order (12); consequently, if U′ denote the number of different ways in which m events E_1, n events E_2, r events E_3, &c. can be combined, or succeed each other, and P′ be the probability of the compound event in any order whatever, we have,

$$P' = U' p_1^m\, p_2^n\, p_3^r, \text{ \&c.}$$

Assuming $h=m+n+r+$, &c. we have also by the theory of combinations,

$$U' = \frac{1\,.\,2\,.\,3 \ldots\ldots\ldots\ldots h}{1\,.\,2\,.\,3 \ldots m \times 1\,.\,2\,.\,3 \ldots n \times 1\,.\,2\,.\,3 \ldots r \times \text{ \&c.}}$$

the factor U′ being the coefficient of the term which has for its multiplier $p_1^m\, p_2^n\, p_3^r$, &c. in the expansion of the multinomial $(p_1+p_2+p_3+\text{ \&c.})^h$, whence

$$P' = \frac{1\,.\,2\,.\,3 \ldots\ldots\ldots\ldots h}{1.2.3 \ldots m \times 1.2.3 \ldots n \times 1.2.3 \ldots r \times \text{\&c.}}\, p_1^m\, p_2^n\, p_3^r, \text{ \&c.}$$

We shall now proceed to give some examples of the applications of the preceding formulæ.

16. Let it be proposed to assign the probability P, of throwing ace *once*, and not oftener, in four successive throws of the same die.—Simpson, p. 15.

Here, the chance of throwing ace in a single trial being $\frac{1}{6}$, we have $p=\frac{1}{6}$, and consequently $q=\frac{5}{6}$, and also $h=4$. Now the compound event being the occurrence of the simple event E, whose probability is p, once, and of the contrary event F three times, the probability of the compound event is that term of the development of $(p+q)^4$ which is multiplied by pq^3. If, therefore, in the formula,

$$P = \frac{1\,.\,2\,.\,3 \ldots\ldots h}{1\,.\,2\,.\,3 \ldots m \times 1\,.\,2\,.\,3 \ldots\ldots n}\, p^m q^n,$$

we make $p=\frac{1}{6}$, $q=\frac{5}{6}$, $h=4$, $m=1$, $n=3$, we shall have

$$P = \frac{1\,.\,2\,.\,3\,.\,4}{1 \times 1\,.\,2\,.\,3} \times \frac{1}{6} \times \left(\frac{5}{6}\right)^3 = \frac{125}{324},$$

which is the probability required, and the same as that of throwing one ace, and not more than one, at a single throw with 4 dice.

The probability of the contrary event, that is to say, the probability of either not throwing an ace at all, or of throwing more aces than one is $1-\frac{125}{324}=\frac{199}{324}$; and therefore the odds against throwing one ace and no more in 4 throws of a common die are 199 to 125, or 8 to 5 very nearly.

17. If in this example it had been proposed to assign the probability of throwing ace once *at least*, instead of once and not more, it would have been necessary to have included those cases in which the ace occurs twice, or three times, or in each of the four trials. The binomial $(p+q)^4$ gives

$$p^4+4p^3q+6p^2q^2+4pq^3+q^4,$$

the first term of which expresses the probability of throwing ace four times in succession; the second that of throwing ace three times, and another number once; the third that of throwing ace twice, and a different face twice; the fourth that of throwing ace once, and a different face three times; and the fifth that of throwing a different face in each of the four trials. But as every one of these compound events, excepting the last, satisfies the condition of ace being thrown once at least, the whole probability of that event must be the sum of the probabilities of the different events by which it may be produced (9) and is consequently

$$\left(\frac{1}{6}\right)^4 + 4\left(\frac{1}{6}\right)^3\frac{5}{6} + 6\left(\frac{1}{6}\right)^2\left(\frac{5}{6}\right)^2 + 4\left(\frac{1}{6}\right)\left(\frac{5}{6}\right)^3 = \frac{671}{1296}$$

In general, the sum of the first $n+1$ terms of $(p+q)^h$ expresses the probability of obtaining *not less* than $h-n$ events, the probability of each of which is p, or *not more* than n contrary events, the probability of each of which is q.

Since $p+q=1$, the sum of all the terms of the series produced by the expansion of $(p+q)^h$ is equal to unit, and therefore the sum of any number of the terms is equal to unit diminished by the sum of the remaining terms. This consideration frequently gives the means of abridging the calculations. Thus, in the preceding example, instead of expanding the binomial $(\frac{1}{6}+\frac{5}{6})^4$ in order to find the probabilities of throwing 4 aces, 3 aces, 2 aces, and 1 ace only, in a series of 4 trials, we might have sought the probability of not throwing ace at all. The probability of not throwing ace in a single trial is $\frac{5}{6}$, and therefore (7) that of not throwing it in 4 trials is $(\frac{5}{6})^4=\frac{625}{1296}$. Hence the probability of the contrary event, namely, that ace will be thrown once or oftener, is $1-\frac{625}{1296}=\frac{671}{1296}$; the same as before.

18. Let a shilling be tossed; what is the probability that more than 3 heads will turn up in the first 10 trials? In this case, $p=\frac{1}{2}$, $q=\frac{1}{2}$, $h=10$; therefore $(p+q)^h=(\frac{1}{2}+\frac{1}{2})^{10}=(\frac{1}{2})^{10}(1+1)^{10}$. Now the last term of this development expresses the probability that head will not turn up in any one of the ten trials; the last but one, the probability that it will turn up once; the last but two, the probability that it will turn up twice; and the last but three, the probability that it will turn up three times; therefore the four last terms include all the different ways in which the ten trials give not more than three heads; and their sum consequently expresses the probability that *not more* than 3 heads will be thrown. Now the last four (or first four) terms of the expansion of $(1+1)^{10}$ are

$$1\,,\ 10\,,\ \frac{10\,.\,9}{1\,.\,2},\ \frac{10\,.\,9\,.\,8}{1\,.\,2\ 3},$$

and their sum is 176, which multiplied by $(\frac{1}{2})^{10}=\frac{1}{1024}$, gives $\frac{176}{1024}$, for the probability that not more than 3 heads will turn up; whence the probability of the contrary event or that more than 3 heads will be thrown, is $1-\frac{176}{1024}=\frac{848}{1024}=\frac{53}{64}$; and the odds in favour of throwing heads more than three times in 10 trials are 53 to 11.

19. A and B engage in play; the probability of A's winning a game is p, and the probability of B's winning a game is q; required the probability P, of A's winning m games before B wins n games, the play being supposed to terminate when either of those events has occurred.

It is evident that the question must be decided *at the latest*, by the $(m+n-1)$th game; for supposing $m+n-2$ games to have been played, there is only one combination according to which the match can remain undecided, namely, that in which A has won $m-1$, and B $n-1$ games; and in this case the next game necessarily decides the match.

Suppose $m+x$ games to have been played. The probability that of these games m have been won by A, and x by B, is represented by the term of the binomial $(p+q)^{m+x}$ in which the factor $p^m q^x$ occurs (13); which term is

$$\frac{1\,.\,2\,.\,3\ldots\ldots m+x}{1\,.\,2\,.\,3\ldots\ldots m\times 1\,.\,2\,.\,3\ldots\ldots x}\,p^m q^x.$$

But A cannot win m games out of $m+x$ exactly unless he wins the last game, for otherwise he must have won m games out of $m+x-1$, if not out of a smaller number. In order therefore that A may win m games out of $m+x$ exactly, it is necessary in the first place that he wins $m-1$ out of $m+x-1$ in any order, and then that he wins also the next game. Now the probability of his winning $m-1$ games out of $m+x-1$ in any order (13) is

$$\frac{1\,.\,2\,.\,3\ldots\ldots m+x-1}{1\,.\,2\,.\,3\ldots m-1\times 1\,.\,2\,.\,3\ldots x}\,p^{m-1}q^x;$$

and the probability of his winning the following game is p, whence the probability of both events is (7)

$$\frac{1\,.\,2\,.\,3\ldots\ldots m+x-1}{1\,.\,2\,.\,3\ldots\ldots m-1\times 1\,.\,2\,.\,3\ldots\ldots x}\,p^m q^x,$$

which, therefore, expresses the probability of A's winning m games out of $m+x$ exactly.

If we suppose $x=0$, this formula becomes p^m, which is the probability of A's winning m games in succession. If $x=1$, it becomes $mp^m q$, the probability that A wins m games out of $m+1$. If $x=2$, it becomes $\frac{m(m+1)}{1\,.\,2}\,p^m q^2$, the probability that A wins m games out of $m+2$. If $x=3$, it becomes $\frac{m(m+1)(m+2)}{1\,.\,2\,.\,3}\,p^m q^3$, the probability that A wins m games out of $m+3$; and so on. Continuing this process till we arrive at the term multiplied by $p^m q^x$, the sum of the probabilities of all the different compound events is

$$p^m\left\{1+mq+\frac{m(m+1)}{1\,.\,2}q^2\ldots+\frac{m(m+1)\ldots m+x-1}{1\,.\,2\;\ldots\;x}q^x\right\};$$

which expresses the probability of A's winning m games out of a number *not greater* than $m+x$.

Now it has been shewn, that the match is necessarily decided by $(m+n-1)$ games; consequently the solution of the question is obtained by substituting $n-1$ for x in the last formula, which will then express the probability of A's winning m games in any order, out of a number not greater than $m+n-1$. On making this substitution, we obtain

$$\mathrm{P}=p^m\left\{1+mq+\frac{m(m+1)}{1\,.\,2}q^2\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots+\frac{m(m+1)\ldots m+n-2}{1\,.\,2\;\ldots\;n-1}q^{n-1}\right\}.$$

The probability Q that the match will be decided in favour of B, or that B will win n games out of a number not greater than $m+n-1$, is found by changing m into n, and p into q, and is therefore

$$\mathrm{Q}=q^n\left\{1+np+\frac{n(n+1)}{1\,.\,2}p^2\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots+\frac{n(n+1)\ldots\ldots m+n-2}{1\,.\,2\;\ldots\ldots\;m-1}p^{n-1}\right\}.$$

As an example, let us suppose $p=\frac{2}{3}$, $q=\frac{1}{3}$, $m=4$, and $n=2$. The probability of A's winning the match, or the value of P, becomes

$$\left(\frac{2}{3}\right)^4\left\{1+4\,.\,\frac{1}{3}\right\}=\frac{112}{243};$$

and the probability of B's winning the match, or the value of Q,

$$\left(\frac{1}{3}\right)^2\left\{1+\frac{4}{3}+\frac{2\,.\,3}{1\,.\,2}\left(\frac{2}{3}\right)^2+\frac{2\,.\,3\,.\,4}{1\,.\,2\,.\,3}\left(\frac{2}{3}\right)^3\right\}=\frac{131}{243}.$$

In this example the skill of A is supposed to be twice as great as that of B, and the number of games that must be won by him in order to gain the match is also twice as great as the number required to be won by B in order that B may gain; one might therefore suppose, that when they begin to play the chances in favour of each are equal. But the result shews that the chances in favour of A are fewer than those in favour of B in the proportion of 112 to 131; whence it appears that it would be unsafe to wager that a player who has two chances in his favour while his adversary has only one, will gain four games before his adversary shall have gained two.

Suppose A and B, engaged in play, agree to leave off before the match is decided, it is evident that the stakes ought to be shared between them in proportion to their respective probabilities of winning, and consequently the share of each is found from either of the above expressions for P and Q. This was one of the questions proposed by the Chevalier de Méré to the celebrated Pascal, to which allusion has already been made.

20. An urn contains $n+1$ balls, marked with the numbers 0, 1, 2, 3……n; a ball is successively drawn and replaced in the urn, so that the chance of drawing any given number remains the same in each trial, what is the probability that in h trials the sum of the numbers drawn will be equal to s?[1]

The solution of this problem depends on the number of ways in which the number s can be formed by the addition of h different numbers, each of which may have any value from 0 to n. If we suppose the numbers marked on the balls to be indexes of a certain quantity x, and develope the expression $(x^0+x^1+x^2\ldots\ldots+x^n)^h$, the coefficient of any term of the development will indicate the number of different ways in which the balls may be drawn, so that the sum of the numbers drawn in h trials shall be equal to the sum of the indexes of x in that term. If, therefore, we denote by N the coefficient of that term of the development in which the sum of the indexes is s, then N will be the number of cases favourable to the event. But the whole number of possible cases is $(n+1)^h$; therefore the probability of the event is $\mathrm{N}\div(n+1)^h$.

On account of the particular form of the polynomial in question, the value of N is found without difficulty.

Because $x^0+x^1+x^2\ldots\ldots+x^n=\frac{1-x^{n+1}}{1-x}$, therefore $(x^0+x^1+x^2\ldots\ldots+x^n)^h=(1-x^{n+1})^h(1-x)^{-h}$. Now, expressing these two factors in series, we have $(1-x^{n+1})^h$

$$=1-hx^{n+1}+\frac{h(h-1)}{1\,.\,2}x^{2(n+1)}-\frac{h(h-1)(h-2)}{1\,.\,2\,.\,3}x^{3(n+1)}+\&\text{c.}$$

$$(1-x)^{-h}=1+hx+\frac{h(h+1)}{1\,.\,2}x^2+\frac{h(h+1)(h+2)}{1\,.\,2\,.\,3}x^3+\&\text{c.};$$

and the coefficients of the several terms of the product of these two series in which the sum of the indexes is s will be found as follows:—

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[1] Demoivre, *Miscellanea Analytica*, p. 196; Laplace, *Essai sur les Probabilités*, p. 253, et seq.

(1.) Multiply the first term of the first series by that term of the second series of which the argument is x^s; the coefficient of the product will be $\dfrac{h(h+1)(h+2)\ldots\ldots h+s-1}{1.2.3\ \ldots\ldots\ s}$.

(2.) Multiply the second term of the first series by that term of the second series which has for its argument x^{s-n-1}; the coefficient of the product will be

$$-h\times\frac{h(h+1)(h+2)\ldots\ldots h+s-n-2}{1.2.3\ \ldots\ldots\ s-n-1}.$$

(3.) Multiply the third term of the first series by that term of the second series which has for its argument $x^{s-2(n+1)}$; the coefficient of the product will be

$$\frac{h(h-1)}{1.2}\times\frac{h(h+1)(h+2)\ldots\ldots h+s-2n-3}{1.2.3\ \ldots\ldots\ s-2n-2}.$$

(4.) Proceed in the same manner with the fourth term of the first series, and so on with the others, advancing at each new multiplication one term to the right in the first series. and $n+1$ terms to the left in the second series, until a term is reached in the first series, the exponent of x in which is equal to, or greater than s. The sum of the several products thus obtained will be the value of N. We have therefore

$$\begin{aligned}\mathrm{N}=&\frac{h(h+1)(h+2)\ldots\ldots h+s-1}{1.2.3\ \ldots\ldots\ s}\\ &-\frac{h}{1}\times\frac{h(h+1)(h+2)\ldots\ldots h+s-n-2}{1.2.3\ \ldots\ldots\ s-n-1}\\ &+\frac{h(h-1)}{1.2}\times\frac{h(h+1)(h+2)\ldots\ldots h+s-2n-3}{1.2.3\ \ldots\ldots\ s-2n-2}\\ &-\&c.\end{aligned}$$

The series now found for N may be changed into another, having a more elegant form, by reducing all the terms to others having the common denominator $1.2.3\ldots\ldots h-1$. This will be accomplished by leaving out of the numerator and denominator of the first term all the numbers after $h-1$ to s, (including s), when s is greater than $h-1$, or by inserting the numbers between s and $h-1$ (the last included), when $s\angle h-1$; by leaving out of the numerator and denominator of the second term all the numbers from $h-1$ to $s-n$, or by inserting those numbers; and so on with the other terms. If we then make the common denominator $1.2.3\ldots h-1=k$, we shall have

$$\begin{aligned}\mathrm{N}=&\frac{1}{k}(s+1)(s+2)(s+3)\ldots\ldots(s+h-1)\\ &-\frac{h}{k}(s-n)(s-n+1)\ldots\ldots(s-n+h-2)\\ &+\frac{h(h-1)}{1.2k}(s-2n-1)(s-2n)\ldots\ldots(s-2n+h-3)\\ &-\&c.\end{aligned}$$

to be continued till the last factor of one of the terms becomes 0 or negative. If we also make

$$\begin{aligned}&s+h-1=f\\ &s-n+h-2=f-(n+1)=f'\\ &s-2n+h-3=f-2(n+1)=f''\\ &s-3n+h-4=f-3(n+1)=f'''\\ &\&c.\end{aligned}$$

and write the factors in each of the terms in the reverse order, the above value of N will become

$$\begin{aligned}\mathrm{N}=&+f(f-1)(f-2)\ldots\ldots(f-h+2)\frac{1}{k}\\ &-f'(f'-1)(f'-2)\ldots\ldots(f'-h+2)\frac{h}{k}\\ &+f''(f''-1)(f''-2)\ldots\ldots(f''-h+2)\frac{h(h-1)}{1.2k}\\ &-f'''(f'''-1)(f'''-2)\ldots\ldots(f'''-h+2)\frac{h(h-1)(h-2)}{1.2.3k}\\ &+\&c.\end{aligned}$$

21. As an example of the application of this formula, let it be required to assign the probability of throwing the point 16 with 4 common dice. (Simpson, p. 53.)

A die having no face marked 0, it is necessary, in order to adopt the formula to this case, to suppose the number of points on each face to be diminished by unit, which is equivalent to supposing $s-h$ to be substituted for s. The numbers are then 0, 1, 2, 3, 4, 5, and we have $n=5$, $h=4$, and $s=(16-4)=12$. Hence

$$\begin{aligned}&f=s+h-1=15\\ &f'=f-(n+1)=9\\ &f''=f-2(n+1)=3\\ &f'''=f-3(n+1)=-3,\end{aligned}$$

and $k=1.2.3$. Substituting these values in the formula, we find

$$\begin{aligned}\mathrm{N}=&15.14.13\times\frac{1}{6}(=+455)\\ &-9.8.7\times\frac{4}{6}(=-336)\\ &+3.2.1\times\frac{4.3}{1.2.6}(=+6)\end{aligned}$$

or $\mathrm{N}=125$. Now the probability of the event is $\mathrm{N}\div(n+1)^h$; and in the present case $(n+1)^h=6^4=1296$; consequently the probability required, namely that of throwing the point 16 with 4 dice, is $\dfrac{125}{1296}$.

22. In the numerical solution of questions of this sort, it sometimes happens that the labour may be abridged by computing the probability of throwing a different point from that which is proposed, but which has the same number of chances in its favour. For example, let it be proposed to determine the probability that in throwing 10 dice the sum of the points will be 50. In this case, the smallest number of points that can possibly be thrown is 10, and the greatest 60; and the chances in favour of throwing 10 and of throwing 60 are obviously equal. The probability of throwing any given number of points above 10 is also evidently the same as that of throwing the number which is as much under 60; and consequently the probability of throwing 50 is the same as the probability of throwing 20, these numbers being at equal distances from the extremes. Now to find the probability of throwing 20 with 10 dice, or, which is the same, the probability that in 10 successive drawings from an urn containing 6 balls, marked with the numbers 0, 1, 2, 3, 4, 5, the sum of the numbers drawn will be 10, we have $h=10$, $n=5$, $s=10$; whence $f=19$, $f'=13$, $f''=7$, f''' negative, and $k=1.2\ldots9$. Substituting these numbers in the series for N, and observing that since $f''-h+2=-1$, the third term becomes negative, we have

$$\begin{aligned}\mathrm{N}=&\frac{19.18.17.16.15.14.13.12.11}{1.2.3.4.5.6.7.8.9}(=92378)\\ &-\frac{13.12.11.10.9.8.7.6.5}{1.2.3.4.5.6.7.8.9}(=-7150),\end{aligned}$$

and consequently $\mathrm{N}=85228$. Dividing this by $(n+1)^h=6^{10}=60466176$, the probability of throwing 20, or of throwing 50, with 10 dice is found $=\dfrac{85228}{60466176}$, or between $\dfrac{1}{709}$ and $\dfrac{1}{710}$.

23. The probability that the whole number of points drawn in h trials will *not exceed s* is found by substituting for s the different values 0, 1, 2……s in the series for N, and taking the sum of the results. This labour, however, may be avoided by means of a property of the figurate numbers. It is well known that the sum of the series of numbers obtained by giving n every value from $n=1$ to $n=v$ (v being any number whatever) in the formula

$$\frac{n(n+1)(n+2)\ldots\ldots(n+u)}{1\cdot 2\cdot 3\ \ldots\ldots\ u+1}$$

is expressed by this other formula

$$\frac{v(v+1)(v+2)\ldots\ldots(v+u)(v+u+1)}{1\,.\,2\,.\,3\ \ldots\ldots(u+1)(u+2)};$$

or, which is the same thing, that the sum of the series obtained by giving x successively every value from $x=1+u$ to $x=1+u+v$ in the formula

$$\frac{x(x-1)(x-2)\ldots\ldots(x-u)}{1\,.\,2\,.\,3\qquad u+1}$$

is expressed by this other formula

$$\frac{(x+1)x(x-1)\ldots\ldots x-u}{1\,.\,2\,.\,3\ldots\ldots\ldots u+2},$$

in which $x=1+u+v$.

Comparing the different terms of the series for N (20) with these last formulæ, it will be evident, that on giving s every value successively, from 0 to s in the value of f, and denoting by N′ the sum of all the results, we shall have

$$N'=+\frac{(f+1)f(f-1)(f-2)\ldots(f-h+2)}{1\,.\,2\,.\,3\,.\,4\ \ldots\ h}$$

$$-\frac{(f'+1)f'(f'-1)(f'-2)\ldots(f'-h+2)}{1\,.\,2\,.\,3\,.\,4\ \ldots\ h}\times h$$

$$+\frac{(f''+1)f''(f''-1)(f''-2)\ldots(f''-h+2)}{1\,.\,2\,.\,3\,.\,4\ \ldots\ h}\times\frac{h(h-1)}{1\,.\,2}$$

$$-\&c.$$

for the probability that the number of points thrown will not be greater than s.

As an example, let $h=10$, $s=5$, $n=5$; we have then $f=s+h-1=14$, $f'=f-(n+1)=8$, whence $f'-h+2=0$, and consequently the second term vanishes. Hence

$$N'=\frac{15\,.\,14\,.\,13\,.\,12\,.\,11\,.\,10\,.\,9\,.\,8\,.\,7\,.\,6}{1\,.\,2\,.\,3\,.\,4\,.\,5\,.\,6\,.\,7\,.\,8\,.\,9\,.\,10}=3003.$$

The probability, therefore, of the sum of the numbers drawn in 10 drawings not exceeding 5, is $3003\div(6)^{10}$, or $\frac{3003}{60466176}$. And this is also the probability that in throwing 10 common dice the sum of the points does not exceed 16. (Simpson, p. 60.)

24. In the preceding questions the number of trials, denoted by h, has been supposed to be given; and the object, in every case, has been to determine the value of a given term, or of a given number of terms of the series produced by the development of the binomial $(p+q)^h$. But there is a numerous class of questions in respect of which the exponent h is unknown, and is required to be determined from the condition that an assigned term, or the sum of a certain number of assigned terms of the development, must have a given value. For example, let it be proposed to determine how often a common die must be thrown in order to give the probability of ace turning up *once at least*, equal to a given fraction u. Here the probability of throwing ace in any throw being $\frac{1}{6}$, we have $p=\frac{1}{6}$, and $q=\frac{5}{6}$. Now, as every term of the development of $(p+q)^h$, excepting the last, gives a combination in which ace occurs once or oftener, the question requires a value to be found for h, such, that the sum of the first h terms of that development, shall be equal to u. This may be done, in general, by the common methods of trial and error; but in the present case, the last term being the only one not included among those which contain a chance of throwing ace, it is evident that it is only necessary to find the last term alone in order to have the probability of *not* throwing ace in h trials, which by the question is $1-u$. The last term of the development is q^h; therefore we must have the equation $q^h=1-u$; whence $h\log q=\log\,(1-u,)$ and $h=\log\,(1-u)\div\log q$. Let $1-u=\frac{\beta}{\gamma}$ and $q=\frac{b}{c}$, we shall then have $\log\,(1-u)=\log\beta-\log\gamma$, and $\log q=\log b-\log c$; whence

$$h=\frac{\log\beta-\log\gamma}{\log b-\log c}.$$

Substituting in this general formula the particular numbers given in the question, namely $b=5$, $c=6$; and supposing $u=\frac{1}{2}$, and consequently $\beta=1$, $\gamma=2$, we have $h=\frac{\log 2}{\log 6-\log 5}$; whence, by computing from the logarithmic tables, $h=3{\cdot}8$. From this it follows, that in four trials the probability of throwing ace once at least, is greater than the probability of not throwing it at all.

If the question had been to determine in how many throws with two dice one may undertake, on an equality of chance, to throw aces at least once, we should have had $p=\frac{1}{36}$, $q=\frac{35}{36}$, and consequently $b=35$, and $c=36$. Substituting these numbers in the general formula, and observing, that in this case also $\beta=1$, $\gamma=2$, we get $h=\frac{\log 2}{\log 36-\log 35}=24{\cdot}6$. The probability of not throwing aces once is therefore greater than the opposite probability or that of throwing aces once or oftener, when the number of throws is 24, but less when the number is 25.

These two questions are celebrated in the early history of the theory of Probability, from the circumstance that the Chevalier de Méré, by whom they were proposed to Pascal, declared the two results above stated to be inconsistent with each other, and thence took occasion to question the accuracy of the theory of combinations by means of which they had been obtained. He reasoned thus: Since the probability of throwing ace with one die is $\frac{1}{6}$, and that of throwing aces with two dice $\frac{1}{6}$ of $\frac{1}{6}=\frac{1}{36}$; therefore, if there be a given probability in favour of throwing ace in four throws with one die, there must likewise be the same probability of throwing aces with two dice in $6\times 4=24$ throws; in other words, the chances in favour of an event E in a single trial, being six times more numerous than those in favour of F, there will be as many chances in favour of F in six trials as there are in favour of E in one. The error consists in supposing that the number of trials must increase or diminish exactly in the inverse ratio of the probability of obtaining the proposed point.[1]

25. The general question may be enunciated as follows: Let p=the probability an event E will happen, q the probability it will fail; how many trials are required to give a probability$=u$ that E will happen k times.

Let x=the number required. Taking the sum of all the terms of the development of $(p+q)^x$ in which the exponent of p is less than k, we shall have the probability that the event does *not* happen k times in x trials. This sum must consequently be made equal to $1-u$; therefore, beginning the last term, and writing the terms in the reverse order, we have the equation

$$q^x+x\,q^{x-1}p+\frac{x\,(x-1)}{1\ldots 2}q^{x-2}\,p^2\ldots\ldots$$

$$+\frac{x\ (x-1)\ldots(x-k+2)}{1\ .\ 2\ldots\ldots\ldots(k-1)}q^{x-k+1}\,p^{k-1}=1-u.$$

Let $p=e\,q$, and this equation becomes

$$q^x\left\{1+x\,e+\frac{x\,(x-1)}{1\ .\ 2}\,e^2\ldots\ldots+\frac{x\,(x-1)\ldots\ldots(x-k+2)}{1\ .\ 2\ldots\ldots(k-1)}\,e^{k-1}\right\}$$

$$=1-u$$

from which the value of x may be found by the ordinary methods of converging series.

If $p=q=\frac{1}{2}$, then $e=1$; and if we also suppose $u=\frac{1}{2}$, and consequently $1-u=\frac{1}{2}$, the equation will become

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[1] Pascal, *Œuvres*, tom. iv. p. 367; Lacroix, *Elémentaire*, p. 36.

$$1+x+\frac{x(x-1)}{1.2}\dots+\frac{x(x-1)\dots x-k+2}{1.2\dots\dots k-1}=\tfrac{1}{2}(1+1)^x.$$

But the first side of this equation is the expansion of $(1\times 1)^x$ continued to k terms; therefore, since the sum of the first k terms is equal to one-half of the whole series, and the terms of the first half of the series are the same as those of the last, it follows that the whole number of terms must be $2k$. But the whole number of terms in the expansion of $(1+1)^x$ is $x+1$; therefore $2k=x+1$, and $x=2k-1$. Suppose $k=10$, then $x=19$; hence in tossing a shilling it is an even bet that head will turn up 10 times in 19 throws.

SECT. III. OF THE PROBABILITY OF EVENTS DEPENDING ON A REPETITION OF TRIALS, OR COMPOUNDED OF ANY NUMBER OF SIMPLE EVENTS, THE CHANCES IN RESPECT OF WHICH ARE KNOWN *A PRIORI*, AND VARY IN THE DIFFERENT TRIALS.

26. Let us suppose the trials to consist in drawing balls from an urn containing a white balls, and b black balls, and that when a ball is extracted it is not returned to the urn. Make $a+b=c$, and let the extraction of a white ball be the event W, and that of a black ball the event B. At the first trial the probability of W is $\frac{a}{c}$ (4), and that of B, $\frac{b}{c}$. But at the second trial, the number of balls in the urn is diminished by 1; and the probability of drawing a white ball at the second trial is therefore not the same as it was in the first, but is influenced by the event which has already taken place. If W happened at the first trial, the number of white balls remaining in the urn is then $a-1$; the number of black is b, and the number of both colours $c-1$. The probability of W at the next trial is therefore $\frac{a-1}{c-1}$, and that of B is $\frac{b}{c-1}$. In like manner, if B happened at the first trial, the probability of W at the second is $\frac{a}{c-1}$, and that of B is $\frac{b-1}{c-1}$. Hence (7) the different combinations which can arise from two trials are the following:

$$\text{WW},\qquad \text{WB},\qquad \text{BW},\qquad \text{BB},$$

the probabilities of which are respectively,

$$\frac{a(a-1)}{c(c-1)},\qquad \frac{ab}{c(c-1)},\qquad \frac{ba}{c(c-1)},\qquad \frac{b(b-1)}{c(c-1)}.$$

Now if we neglect the order of succession in the two cases in which W and B are combined, the probability of the compound event which consists of the extraction of a ball of each colour in the two trials, is $\frac{2ab}{c(c-1)}$, and the probabilities of the three possible combinations are respectively:—

$$\frac{a(a-1)}{c(c-1)},\qquad \frac{2ab}{c(c-1)},\qquad \frac{b(b-1)}{c(c-1)}.$$

Comparing these with the probabilities of the same combinations when the chances are constant, or the ball is returned to the urn after each drawing, namely

$$\frac{a^2}{c^2},\qquad \frac{2ab}{c^2},\qquad \frac{b^2}{c^2},$$

the analogy of the two cases is obvious.

After two balls have been drawn, the whole number remaining in the urn is $c-2$; but the number of each colour depends on the two events that have already occurred. If two white balls have been drawn, the probability of drawing a white ball at the next trial will be $\frac{a-2}{c-2}$; but we have just seen that the probability of WW is $\frac{a(a-1)}{c(c-1)}$; therefore (7) the probability of WWW is $\frac{a(a-1)(a-2)}{c(c-1)(c-2)}$. The probability of drawing a black ball after two white have been drawn is $\frac{b}{c-2}$ (for there are now $c-2$ balls in the urn, of which b are white); therefore the probability of WWB is $\frac{a(a-1)b}{c(c-1)(c-2)}$. On forming in this manner all the different possible combinations which can result from three trials, we find

$$\text{WWW, probability,} = \frac{a(a-1)(a-2)}{c(c-1)(c-2)},$$

$$\text{WWB, ———} = \frac{a(a-1)b}{c(c-1)(c-2)},$$

$$\text{WBW, ———} = \frac{ab(a-1)}{c(c-1)(c-2)},$$

$$\text{BWW, ———} = \frac{ba(a-1)}{c(c-1)(c-2)},$$

$$\text{BBW, ———} = \frac{b(b-1)a}{c(c-1)(c-2)},$$

$$\text{BWB, ———} = \frac{ba(b-1)}{c(c-1)(c-2)},$$

$$\text{WBB, ———} = \frac{ab(b-1)}{c(c-1)(c-2)},$$

$$\text{BBB, ———} = \frac{b(b-1)(b-2)}{c(c-1)(c-2)}.$$

If we disregard the order of succession in those combinations into which W and B both enter, and consider the occurrence of W twice and B once as the same compound event; and also the occurrence of W once and B twice as the same compound event, in whatever order they occur, the probability of the former will be $\frac{3a(a-1)b}{c(c-1)(c-2)}$, and of the latter $\frac{3ab(b-1)}{c(c-1)(c-2)}$.

27. In general, if $m'+n'$ balls have been drawn, of which m' have been found to be white and n' black, the number of white balls in the urn will now be $a-m'$, the number of black $b-n'$, and the whole number of both colours $c-m'-n'$. Hence the probability of drawing a white ball in the next trial will be $\frac{a-m}{c-m'-n'}$; and that of drawing a black ball $\frac{b-n'}{c-m'-n'}$. Now if in these two fractions we substitute successively for m' and n' all the different numbers from 0 to $m-1$ and $n-1$ respectively, the product of the $m+n$ numbers thus obtained will (7) be the probability of drawing m white balls and n black in an assigned order, in $m+n$ trials. Let this probability be denoted by K, and we shall have

$$K=\frac{a(a-1)(a-2)\dots\dots(a-m+1)\times b(b-1)(b-2)\dots\dots(b-n+1)}{c(c-1)(c-2)\dots\dots(c-m-n+1)},$$

whatever the given order may be. Hence, if we denote by P the probability of m white balls and n black being drawn in any order whatever, in h trials, we shall have $P=UK$, where, as in (12), $U=\frac{1.2.3\dots\dots h}{1.2.3\dots\dots m\times 1.2.3\dots\dots n}$ the co-efficient of that term of the binomial $(p+q)^h$ which has for its argument $p^m q^n$; this co-efficient expressing all the different arrangements which can be formed of m things of one kind, and n things of another.

28. When the urn is supposed to contain balls of more than two different colours, the probability of any proposed number of each colour being drawn in a given number of trials is found with the same facility. Suppose it to contain a_1 of the first colour, a_2 of the second, a_3 of the third, and so on, and let $a_1+a_2+a_3$ &c.$=c$; then the probability that

in $m+n+r+\&c.=h$ trials, there will be drawn m of the first colour, n of the second, r of the third, &c. is

$$\begin{aligned} U' &\times a_1(a_1-1)(a_1-2)\dots\dots\dots(a_1-m+1) \\ &\times a_2(a_2-1)(a_2-2)\dots\dots\dots(a_2-n+1) \\ &\times a_3(a_3-1)(a_3-2)\dots\dots\dots(a_3-r+1) \\ &\times a_4(a_4-1)(a_4-2)\dots\dots\dots(a_4-s+1) \\ &\times \&c. \\ &\div c(c-1)(c-2)\dots\dots\dots(c-h+1) \end{aligned}$$

where, as in (15),

$$U=\frac{1.2.3\dots\dots\dots\dots h}{1.2.3\dots\dots m\times 1.2.3\dots\dots n\times 1.2.3\dots\dots\dots r\times\&c.}.$$

29. The following examples will shew the use of the preceding formulæ.

Suppose a bag to contain 16 balls, of which 8 are white and 8 black, what is the probability that in drawing 8 balls from the bag the whole of them will be white?

Applying the formula (27) to the solution of this question, we have $a=8$, $b=8$, $c=16$, $m=8$, $n=0$, and as the probability required is that of drawing white balls only, b cannot enter into any of the factors of the numerator; hence

$$K=\frac{8.7.6.5.4.3.2.1}{16.15.14.13.12.11.10.9}=\frac{1}{12870};$$

and since $m=h$, $U=1$, the probability sought, is therefore $\frac{1}{12870}$.

Let there be a heap of 20 cards, wherein are 7 diamonds, 6 hearts, 4 spades, and 3 clubs; required the probability that in drawing 8 of them at a venture there shall come out 3 diamonds and 2 hearts? (Simpson, p. 21.)

The probability required in this case being that of drawing 3 diamonds, 2 hearts, and 3 other cards which are neither diamonds nor hearts, the spades and clubs may be considered as forming one parcel, containing 7 cards. We have then in the formula (28) $a_1=7$, $a_2=6$, $a_3=7$, $c=20$; $m=3$, $n=2$, $r=3$, $h=8$; therefore

$$U'=\frac{1.2.3.4.5.6.7.8}{1.2.3\times 1.2\times 1.2.3}=560,$$

and the probability required becomes,

$$560\times\frac{7.6.5\times 6.5\times 7.6.5}{20.19.18.17.16.15.14.13}=\frac{1225}{3978}.$$

The odds against the event are therefore 2753 to 1225, or nearly 9 to 4.

Let 4 cards be drawn from a pack of 52; what is the probability of drawing one of each sort?

In this case we have $a_1=13$, $a_2=13$, $a_3=13$, $a_4=13$, $c=52$; also $m=1$, $n=1$, $r=1$, $s=1$, $h=4$, whence $U'=\frac{1.2.3.4}{1.1.1.1}=24$, and the probability required becomes, on substituting these numbers in the formula (28),

$$24\times\frac{13.13.13.13}{52.51.50.49}=\frac{2197}{20825}=\frac{1}{9}\text{ nearly.}$$

The odds against this event are nearly 8 to 1.

30. The following question, proposed by Huygens, and solved by Demoivre and Bernoulli (*Ars Conjectandi*, p. 59), belongs to the class of problems now under consideration.

An urn contains 12 balls, of which 4 are white and 8 black. Three gamesters A, B, and C agree that the first who, blindfold, shall draw a white ball shall be the winner of the stakes. They also agree that A shall draw first, B second, C third, A fourth, and so on; and the balls drawn are not replaced in the urn. It is proposed to find their respective probabilities of winning.

Here the play terminates as soon as a white ball is drawn, and it must therefore terminate with the 9th trial, if not sooner, inasmuch as, after 8 black balls have been drawn, the urn will contain only white balls, and the probability of drawing a white ball at the next trial will become certainty. The question will therefore be solved, if we determine the probabilities of the play ending with the 1st, 2d, 3d, 4th, &c. games respectively, and take the sum of the probabilities of its ending with the 1st, 4th, and 7th, for the probability of A's winning; the sum of the probabilities of its ending with the 2d, 5th, and 8th, for the probability of B's winning; and the sum of the probabilities of its ending with the 3d, 6th, and 9th, for the probability of C's winning.

For the sake of rendering the solution more general, let a be the number of white balls in the urn, b the number of black, and let $a+b=c$. The probability of drawing a white ball at the first trial, or of the play ending with the first trial, is then $\frac{a}{c}$.

The probability of the play ending with the second trial is compounded of the probability of a black ball being drawn at the first trial, and a white at the second; and the probability of both events (26) is $\frac{ba}{c(c-1)}$.

The probability of the play ending with the third trial is compounded of three separate probabilities, namely, that a black ball will be drawn at the first trial; that a black ball will be drawn at the second; that a white ball will be drawn at the third;—and the probability of the concourse of these events (26) is $\frac{b(b-1)a}{c(c-1)(c-2)}$.

In general the probability of a black ball being drawn in $x-1$ trials successively, and a white ball at the xth is $\frac{b(b-1)(b-2)\dots\dots(b-x+2)a}{c(c-1)(c-2)\dots\dots(c-x+1}$. Substituting for a, b, and c in this formula the numbers proposed by Huygens, we obtain in respect of the 1st, 4th, and 7th trials, or the probability in favour of A,

$$\frac{4}{12}+\frac{8.7.6}{12.11.10}.\frac{4}{9}+\frac{8.7.6.5.4.3}{12.11.10.9.8.7}.\frac{4}{6}=\frac{77}{165};$$

in respect of the 2d, 5th, and 8th trials, or the probability in favour of B,

$$\frac{8}{12}.\frac{4}{11}+\frac{8.7.6.5}{12.11.10.9}.\frac{4}{8}+\frac{8.7.6.5.4.3.2}{12.11.10.9.8.7.6}.\frac{4}{5}$$
$$=\frac{53}{165},$$

and in respect of the 3d, 6th, and 9th trials, or the probability in favour of C,

$$\frac{8.7}{12.11}.\frac{4}{10}+\frac{8.7.6.5.4}{12.11.10.9.8}.\frac{4}{7}+\frac{8.7.6.5.4.3.2.1}{12.11.10.9.8.7.6.5}$$
$$.\frac{4}{4}=\frac{35}{165}.$$

The chances in favour of A, B, and C, are therefore proportional to the numbers 77, 53, 35, respectively.

If the condition of the play had been that the ball was to be returned to the urn after each trial, the chances in favour of the three gamesters would have been easily found by the formula (12) to be respectively as the numbers 9, 6, and 4.

SECT. IV. OF MATHEMATICAL AND MORAL EXPECTATION.

31. In the theory of probability, the term *expectation* is used to denote the product found by multiplying the value of a casual benefit into the probability of the event on which it is contingent taking place. But the value of a benefit may be estimated either with respect to its absolute amount, or to the amount of relative advantage it affords the individual who receives it. This consideration has led to a distinction between mathematical and moral expectation. When we place the circumstances of the individual entirely out of consideration, and have regard merely to the abstract or absolute value of the benefit, the product of its amount by the probability of obtaining it is the *mathematical expec-*

tation of the individual; but when a relative value is assigned to the benefit, the product of this relative value by the probability of obtaining it is called the *moral expectation*, because it is estimated by certain moral considerations respecting the circumstances or fortune of the individual in whose favour the expectation exists, on the principle that a sum of money which may be relatively of very little importance to a man in possession of a large fortune may be of great importance to another who is less favourably circumstanced. We shall first consider the *mathematical expectation*.

32. Suppose A and B to engage in play; let p be the probability of A's winning a game, q the probability of B's winning it, and s a sum of money staked on the issue of the game. By the definition, the mathematical expectation of A is ps, and that of B is qs. Now if we suppose these expectations to be purchased by A and B, the sums they ought respectively to pay for them, or in other words to stake on the issue of the game, must be proportional to their respective expectations, in order that they may play on equal terms. Let therefore a be the sum staked by A, and b the sum staked by B, we have then $ps : qs :: a : b$, and consequently $pb=qa$. Now suppose $a+b=s$, or that the sum played for is the amount of the stakes; then, since b is the sum A expects to gain, and p is the probability of his gaining it, pb is the mathematical value of A's expectation of gain. In like manner qa is the mathematical value of B's expectation of gain. Hence it follows, that when the sum staked by each is proportional to his probability of winning, the mathematical expectations of the two players are equal; so that after the stakes have been placed, and before the event is decided, they might exchange places without advantage or disadvantage to either. It follows likewise, that since the sum which the one must gain is just that which the other must lose, the product qa, which is B's expectation of gain, may be regarded as A's expectation of loss; or (if taken with a negative sign) as part of A's whole expectation, which then becomes $pb-qa$. But $pb-qa=0$; whence the condition of A before the event is decided is not altered by the circumstance of his having staked on the issue of the play.

33. This conclusion at first sight appears paradoxical; for it is certain, that after the stakes are placed, A must either gain the sum b or lose a, and therefore his fortune will of necessity either be increased by the gain of his adversary's stake, or diminished by the loss of his own. The explanation depends on theorems which will afterwards be demonstrated relative to the repetition of trials, from which it results, that though in a single trial the player must either lose or gain, yet on multiplying sufficiently the number of games, a probability will at length be obtained, approaching as nearly to certainty as we please, that the sum gained or lost in the long run will not exceed a certain given fraction (which may be as small as we please) of the whole sum staked, provided the play is undertaken on terms of mathematical equality. But this indefinite repetition of the hazard is practically impossible; and innumerable cases may easily be imagined, in which an individual will be guided by other considerations than the mere mathematical value of the expectation in undertaking or declining a risk. A person of moderate fortune would scarcely be persuaded to risk L.500 for the expectation of gaining L.5, though the chances might be 100 to 1 in favour of the event which would produce that sum; but numbers would be found willing enough to pay L.5 for the expectation of gaining L.500, the chances being 100 to 1 against them. In both cases, however, the expectation would be purchased at its real abstract value. According to the formula of mathematical expectation, the man whose sole fortune consists of a lottery ticket which has an equal chance of turning up a prize of L.20,000 or a blank, is in an equally advantageous position as he who is in possession of L.10,000; yet no man of ordinary prudence, if offered his choice of the two states, would hesitate as to which he ought to give the preference. Common sense will prevent a man from risking a sum, the loss of which would be attended with great privations, even when, mathematically speaking, the chances are considerably in his favour. It is also obvious that two individuals whose fortunes are very unequal cannot engage in play with the same advantage, although the chances in favour of each, in respect of a single game, are precisely the same. The one who has a large fortune can repeat the hazard so often as to obtain a probability almost equal to certainty that his loss will not amount to any given sum; whereas the other, who cannot continue the play in case of loss, runs the risk of being ruined. It is thus evident, that in a multitude of cases the abstract theory of probability is not alone sufficient to give the value of an expectation, and that in dealing with contingent events, an individual must be guided to a certain extent by considerations of relative advantage.

34. Various hypotheses have been imagined for the purpose of reducing such relative or moral considerations to accurate calculation; but that which appears the most natural, and applicable to the greatest number of cases, consists in supposing the relative value of any infinitely small sum to be directly proportional to its absolute value, and inversely as the fortune of the individual who has an expectation of receiving it. This principle was first proposed by Daniel Bernoulli in the *Petersburg Commentaries* (vol. v.), and is there applied by him to the solution of a number of questions of great practical interest.

Let x be the absolute value of the capital, or, as it is denominated by Laplace, the physical fortune, of an individual; then, according to the hypothesis of Bernoulli, the moral advantage which he derives from an infinitely small increment of fortune $=dx$, is measured by the expression $c\frac{dx}{x}$, c being a constant to be determined by the nature of the question. Now, if we suppose the physical fortune to arise from the accumulation of the elements dx, and denote by y the relative or *moral value* of the fortune, of which the absolute or physical value is x, we shall have

$$y=\int c\frac{dx}{x}=c \text{ log. } x+\text{constant.}$$

To determine the constant, we may suppose $y=o$, when x has a given value $=a$; this gives $o=c \text{ log. } a+\text{constant}$, whence $y=c\,(\text{log. } x-\text{log. } a)$, or $y=c \text{ log. } \frac{x}{a}$; and it is to be observed, that those values of x and y can never become negative, for as Bernoulli has remarked, it is only the person who is dying of hunger that can be said to possess absolutely nothing. In every other circumstance the mere possession of existence may be accounted a moral advantage, to which, however, it would be absurd to attempt to assign a numerical value.

35. From the above formula, it is easy to deduce a numerical expression for the value of a moral expectation. Let a be the original fortune of the individual, and α, β, γ, &c. sums to be received on the occurrence of certain contingent events, E, F, G, &c. This being supposed, if the event E happens, the absolute fortune of the individual becomes $a+\alpha$, and its relative value, therefore, according to the formula, is $c \text{ log. } \frac{a+\alpha}{a}$. If F happens, his absolute fortune becomes $a+\beta$, to which the corresponding relative value is $c \text{ log. } \frac{a+\beta}{a}$; and so on. Now, let the probabilities of the events E, F, G, &c. be respectively p, q, r, &c. (assuming $p+q+r+$ &c.$=1$, so that one or other of the events will necessarily happen), and let Y represent the relative fortune of the individual arising from his expectation, then, since the

value of a benefit in expectation is equal to the amount of the benefit multiplied by the probability of obtaining it, we have

$$Y=c\left\{p\log.\frac{a+\alpha}{a}+q\log.\frac{a+\beta}{a}+r\log.\frac{a+\gamma}{a}+\&c.\right\}$$

Let also X denote the absolute value of Y; then, by the formula, we have $Y=c\log.\frac{X}{a}$. On comparing these two values of Y, we get

$$\log.\frac{X}{a}=p\log.\frac{a+\alpha}{a}+q\log.\frac{a+\beta}{a}+r\log.\frac{a+\gamma}{a}+\&c.;$$

and on passing to numbers,

$$\frac{X}{a}=\frac{(a+\alpha)^p(a+\beta)^q(a+\gamma)^r,\&c.}{a^{p+q+r+\&c.}},$$

therefore, since $p+q+r+$ &c. $=1$,

$$X=(a+\alpha)^p(a+\beta)^q(a+\gamma)^r,\ \&c.$$

In this expression X denotes the absolute value of the original fortune and of the expectation added together; if, therefore, we deduct a from X, the difference will be the value of the expectation, or the sum which, if it were to be received certainly, would procure the individual the same relative advantage as his expectation.

36. If the sums α, β, γ, &c. are supposed to be very small in comparison of a, so that quantities of the order $\left(\frac{\alpha}{a}\right)^2$ may be neglected, the preceding equation becomes

$$X=a^{p+q+r+\&c.}+a^{p+q+r\&c.-1}\left\{p\alpha+q\beta+r\gamma+\&c.\right\}$$

whence, since $p+q+r+$ &c. $=1$,

$$X=a+p\alpha+q\beta+r\gamma+\&c.$$

Deducting from this the original fortune a, the remainder $p\alpha+q\beta+r\gamma+$ &c. is the value of the expectation, or the sum equivalent to the moral advantage. But the value of the mathematical expectation of the benefits α, β, γ, &c. of which the probabilities are respectively p, q, r, &c. is also $p\alpha+q\beta+r\gamma$ + &c. (31), therefore, when the contingent benefits are very small in comparison of the original fortune, the moral advantage and the mathematical expectation are sensibly the same.

37. From the formula $X=(a+\alpha)^p(a+\beta)^q(a+\gamma)^r$ &c. Bernoulli deduces the consequence that gambling or betting is attended with a moral disadvantage, even when the chances of gain or loss, mathematically speaking, are perfectly equal. To shew this, he proposes the following question. A, whose fortune is 100 crowns, bets 50 crowns with B, on the issue of an event of which the probability is $\frac{1}{2}$, on these terms: if the event happens, A is to receive from B 50 crowns; if it fails, he is to pay B 50 crowns; what is the relative value of A's fortune, after undertaking the bet, and before the event is decided? In this case, we have $a=100$, $\alpha=50$, $\beta=-50$, $\gamma=0$; also $p=\frac{1}{2}$, $q=\frac{1}{2}$, $r=0$; and the formula (35) becomes

$$X=(100+50)^{\frac{1}{2}}\times(100-50)^{\frac{1}{2}},$$

whence $X=\sqrt{150\times50}=87$; and, consequently, the condition of A is worse by 13 crowns than it was before he hazarded the bet. The moral disadvantage is therefore equivalent to this sum, though the terms of the play, according to the mathematical theory, are equal.

38. The conclusion arrived at in this particular case is easily shewn to be universally true. Let a be the capital of the player, p his probability of winning, q his probability of losing, and s the sum at stake. In order that he may play on terms of mathematical equality, the part of the stakes contributed by himself, or the sum which he can lose, must be ps (32), and the part contributed by his adversary, or that which he may gain, must be qs. The equation in (35) therefore becomes

$$X=(a+qs)^p\times(a-ps)^q,$$

and if it can be shewn that this value of X is less than a, it will follow that his condition is rendered worse in consequence of having staked on the game. Now, dividing by a, and taking the logarithm of both sides of the equation, we get $\log.\frac{X}{a}=p\log.\left(1+\frac{qs}{a}\right)+q\log.\left(1-\frac{ps}{a}\right)$, the differential of which (making s variable) is

$$d\log.\frac{X}{a}=pqds\left(\frac{1}{1+\frac{qs}{a}}-\frac{1}{1-\frac{ps}{a}}\right).$$

But the second side of this equation is evidently negative; therefore $d\log.X\div a$ is negative; consequently the logarithm of $X\div a$ is negative, and X must be less than a. In all cases, therefore, the bet, if on even terms, produces a moral disadvantage.

39. Another consequence deduced by Bernoulli from this theory of moral expectation, is, that when property of any kind is exposed to a risk or hazard, it is more advantageous to expose it in parts to several risks independent of each other, than to expose the whole at once to a single risk, although the probability of loss be in both cases precisely the same. To prove this, he takes the following example. A merchant has a capital of L.4000, besides goods of the value of L.8000, which must be transported by sea. The probability of the loss of a vessel in the voyage being $\frac{1}{10}$, let it be proposed to find the value of the moral expectation of the merchant in the case of the goods being embarked in a single vessel, and also in the case of one half being embarked in one vessel and the other half in another. Supposing the merchandise embarked in one ship, the absolute fortune of the merchant will be increased to L.12,000 in the event of the safe arrival of the ship, and will be reduced to L.4000 in the event of its being lost. The probability of the first of these events is $\frac{9}{10}$, and of the second $\frac{1}{10}$; therefore his absolute fortune becomes, in virtue of his expectation,

$$X=(12{,}000)^{\frac{9}{10}}\times(4000)^{\frac{1}{10}},$$

whence $X=10751$. Deducting his other capital, L.4000, there remains L.6751 for the value of the moral expectation in respect of the venture.

Let us next suppose the merchandise embarked in equal parts in two ships. In this case there are three compound events to be considered, 1st, Both vessels may arrive in safety; the probability of which is $\frac{9}{10}\times\frac{9}{10}=\frac{81}{100}$. 2d, One may arrive in safety and the other be lost; the probability of which, as it may happen in two ways, (11) is $2\times\frac{9}{10}\times\frac{1}{10}=\frac{18}{100}$. 3d, Both may be lost; the probability of which is $\frac{1}{10}\times\frac{1}{10}=\frac{1}{100}$. If the first of these events happen, the capital of the merchant will become L.4000 + L.8000 = L.12,000; if the second happen it will be L.4000 + L.4000 = L.8000; and if the third happen it will be only L.4000. With these numbers the formula becomes

$$X=(12{,}000)^{\frac{81}{100}}\times(8000)^{\frac{18}{100}}\times(4000)^{\frac{1}{100}},$$

whence $X=11033$. Deducting his other capital, which was exposed to no risk, there remains L.7033 for the value of the moral expectation. This sum exceeds the former by L.282; and it is easily found by following the same process of reasoning, that in proportion as the risk is divided among a greater number of ships, the moral expectation is increased, and approaches its limit, which is the value of the mathematical expectation, or $\frac{9}{10}$ of L.8000 = L.7200.

40. The theory of moral expectation enables us likewise to assign the circumstances in which it is advantageous or

otherwise, to insure property against particular hazards. There are three principal questions to be considered in reference to this subject; 1. The amount of premium the insured may pay without disadvantage; 2. The ratio of his fortune to the value of the sum exposed to risk, in order that it may be advantageous to insure at a given premium; and 3. The capital which the insurer or underwriter ought to possess, in order that he may insure a given risk with probable advantage to himself, and safety to the insured.

Let s be the value of a cargo which a merchant embarks in a ship, p the probability of the safe arrival of the vessel, and a his capital independently of s. The mathematical value of the premium for insurance is qs; for, if we denote the premium by y, then y is the sum the insurer will gain if the vessel reaches its destination in safety, and $s-y$ is the sum he will lose if it does not; and by the theorem for the mathematical expectation $py=q(s-y)$; whence, since $p+q=1$, $y=qs$. If, therefore, the merchant insures the cargo, his absolute fortune becomes $a+s-qs=a+ps$; and if he does not insure, it is the value of X in the equation $X=(a+s)^p a^q$. Hence it will be advantageous or otherwise to insure according as $a+ps$ is greater or less than $(a+s)^p a^q$. Now the logarithm of the first of these expressions, or $\log(a+ps)$, is equivalent to the integral $\int \frac{pds}{a+ps}$; and the logarithm of the second, or $p\log(a+s)+q\log a$, is equivalent to $\int \frac{pds}{a+s}$; but since p is a proper fraction, $a+ps$ is less than $a+s$, and therefore the first integral is greater than the second. Consequently $a+ps$ is, in general, greater than $(a+s)^p a^q$, and the insurance is attended with advantage. Let us now assume $x=a+ps-(a+s)^p a^q$, and x will be the sum the merchant could afford to pay the insurer above the mathematical value of the risk without moral disadvantage. If he pays less than $qs+x$, his relative fortune is increased by insuring; and if he pays more he is a loser. In practice the premium may be considered as less than $qs+x$, but greater than qs; so that while the insured pays more than the mathematical value of the risk, he gains a moral advantage by the transaction.

To solve the second question, let e be the premium demanded for insuring the amount s; then, the other capital of the merchant being a, his fortune after being insured is $a+s-e$; while if he takes the risk on himself, its value becomes $(a+s)^p a^q$. If, therefore, the value of a be determined from the equation $a+s-e=(a+s)^p a^q$, we shall have the amount of capital he ought to possess in order that it may be *morally* a matter of indifference to him whether he insures or not. As an example, let the value of the merchandise, or s, be L.10,000, $e=$L.800, and $p=\frac{19}{20}$. The equation then becomes

$$a+9200=(a+10,000)^{\frac{19}{20}} a^{\frac{1}{20}};$$

whence a is found by approximation $=5043$. It follows, therefore, that unless his other capital amount to L.5043, it would be disadvantageous to neglect insuring, although the premium demanded exceed the mathematical value of the risk (which is $\frac{1}{20}\times$L.10,000=L.500) by L.300.

The third question, the amount of capital the underwriter ought to possess, is determined precisely in the same way. Let b be his capital. After accepting the risk of the sum s for the premium e, his capital will become $b+e$ in the case of the vessel arriving in safety, and $b-s+e$ in the case of its being lost. The formula of the moral expectation therefore becomes $X=(b+e)^p(b-s+e)^q$; and in order that there may be neither advantage nor disadvantage in undertaking the risk, this value of X must be equal to his original capital, b. Supposing, therefore, s, e, p, q, to have the same significations as above, the equation from which b is to be determined is $b=(b+800)^{\frac{19}{20}}(b-9200)^{\frac{1}{20}}$, whence $b=14243$. Unless, therefore, the capital of the insurer amounts to L.14,243, there would be a moral disadvantage in undertaking the risk of insuring a cargo worth L.10,000 for a premium of L.800; and it is easy to see, that if a smaller premium were demanded, the capital ought to be still greater. On making $e=600$, (which still exceeds the mathematical value of the risk), the value of b becomes L.29,878. Hence it follows, that a company possessing a large capital may not only with safety engage in speculations which might prove ruinous to another whose resources are more limited, but even derive from them a sure profit.[1]

41. The theory of moral expectation which we have now been considering had its origin in a problem proposed by Nicolas Bernoulli to Montmort, which, from its having been discussed at great length by Daniel Bernoulli in the *Petersburg Memoirs*, has been usually called the Petersburg problem. It is this; A and B play at heads and tails. A agrees to pay B 2 crowns if head turn up at the first throw; 4 crowns if it turn up at the second, and not before; 8 if it turn up at the third, and not before; and, in general, 2^n crowns if it turn up at the nth throw, and not before: required the value of B's expectation? Here the probability of head turning up at the first throw is $\frac{1}{2}$; the probability of its turning up at the second, and not at the first, is $\frac{1}{2}\times\frac{1}{2}=\frac{1}{4}$; the probability of its not turning up either at the first or second, and of its turning up at the third, $\frac{1}{2}\times\frac{1}{2}\times\frac{1}{2}=\frac{1}{8}$, and so on. Hence the probabilities of B receiving 2, 4, 8, 16......2^n crowns are respectively $\frac{1}{2}, \frac{1}{4}, \frac{1}{8}, \frac{1}{16} \ldots\ldots \frac{1}{2^n}$, consequently (31) the mathematical value of B's expectation is

$$\frac{1}{2}\times 2+\frac{1}{4}\times 4+\frac{1}{8}\times 8+\frac{1}{16}\times 16 \ldots +\frac{1}{2^n}\times 2^n \text{ crowns.}$$

Now, as no limit can be assigned to n, inasmuch as it is possible that head may not turn up till after a very great, or any assignable number, of throws, this series, of which each term is unity, may go on for ever, and consequently the value of B's expectation becomes infinite. Yet it is obvious that no one would pay any considerable sum for the expectation. This disagreement between the dictates of common sense and the results of the mathematical theory, appeared to Montmort to involve a great paradox; although the question differs in this respect from no other question of chances in which the contingent benefit is very great, and the probability of receiving it very small. If the play could be repeated an infinite number of times, B might undertake to pay without disadvantage any sum, however large, for his expectation. A result, however, more in accordance with ordinary notions, is obtained from the principle of Bernoulli. Let a be the amount of B's fortune before the play begins, x the value of his expectation, or the sum he pays A in consideration of the agreement, and make $z=a-x$. If head turn up at the first throw, B's fortune becomes $z+2$; if at the second, and not before, $z+2^2$; if at the third, and not before, $z+2^3$; and so on. But the probabilities of these events being respectively $\frac{1}{2}, \frac{1}{4}, \frac{1}{8} \ldots\ldots \frac{1}{2^n}$, the formula for the moral expectation becomes (35)

$$X=(z+2)^{\frac{1}{2}}(z+2^2)^{\frac{1}{4}}(z+2^3)^{\frac{1}{8}} \ldots (z+2^n)^{\frac{1}{2^n}}.$$

Now the sum which B ought to pay will be determined by making the value of his moral expectation, after the bet, and before the play begins, equal to his previous fortune; we have therefore $a=X$, that is,

$$a=(z+2)^{\frac{1}{2}}(z+2^2)^{\frac{1}{4}}(z+2^3)^{\frac{1}{8}} \ldots\ldots$$

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[1] See the *Commentarii Acad. Petropolitanæ*, tom. v.; Laplace, *Théorie des Prob.* p. 432; Lacroix, *Traité Elémentaire*, p. 132.

The general term of this series being $(z+2^n)^{\frac{1}{2^n}} = 2^{\frac{n}{2^n}}\left(1+\frac{z}{2^n}\right)^{\frac{1}{2^n}}$, the equation may be put under the form

$$a=(2^{\frac{1}{2}}+2^{\frac{2}{4}}+2^{\frac{3}{8}}+2^{\frac{4}{16}}\ldots.)\times\left(1+\frac{z}{2}\right)^{\frac{1}{2}}\left(1+\frac{z}{4}\right)^{\frac{1}{4}}\left(1+\frac{z}{8}\right)^{\frac{1}{8}}\ldots;$$

and since the logarithm of the first factor of this expression is $\left(\frac{1}{2}+\frac{2}{4}+\frac{3}{8}+\frac{4}{16}+\&c.\right)\log 2$, or $=\frac{1}{2}\left\{1+2\left(\frac{1}{2}\right)+3\left(\frac{1}{2}\right)^2+4\left(\frac{1}{2}\right)^3+\&c.\right\}\log 2=\frac{1}{2}\left(1-\frac{1}{2}\right)^{-2}\log 2=2\log 2$, we have $\log a=2\log 2+\frac{1}{2}\log\left(1+\frac{z}{2}\right)+\frac{1}{4}\log\left(1+\frac{z}{4}\right)+\frac{1}{8}\log\left(1+\frac{z}{8}\right)+\&c.$ from which a value of z may be found by trial and error for any given value of a. Suppose $z=100$; on computing the first 10 terms of the series there results $a=107{\cdot}89$, whence (since $x=a-z$) $x=7{\cdot}89$; that is to say, if B possessed only 100 crowns before beginning the play, it would be morally disadvantageous for him to risk 8 crowns for the expectation, although its mathematical value be infinitely great. If we suppose $z=1000$, the sum of 11 terms gives $a=1011$, nearly; so that if B possessed a fortune of 1011 crowns, the value of the moral expectation would, to him, be about 11 crowns.

It is scarcely necessary to remark, that the results deduced from the principle of Bernoulli are of a character widely different from those which are calculated according to the mathematical expectation. The latter gives the precise value of a contingent benefit, without any assumption or hypothesis respecting the personal circumstances of the individual who may gain or lose it; whereas the considerations of relative advantage, of which it is the object of Bernoulli's theory to take account, are entirely arbitrary, and by their very nature incapable of being made the subject of accurate computation. It is evidently impossible to have regard to, or appreciate, all the circumstances which may render the same sum of money a more important benefit to one man than to another; and consequently every rule that can be given for the purpose must be liable to numerous exceptions. The principle, however, is thus far valuable, that it gives in the most common cases a plausible and judicious estimate of the value of things which are not susceptible of exact appreciation; and it has the advantage of being readily submitted to analysis. A different principle, proposed by the celebrated naturalist Buffon, consists in making the value itself of a casual benefit, instead of its infinitely small elements, inversely proportional to the fortune of the expectant; but as this hypothesis has seldom been adopted, it is unnecessary to discuss it in this place.

SECT. V.—OF THE PROBABILITY OF FUTURE EVENTS DEDUCED FROM EXPERIENCE.

42. In the preceding part of this article it has been assumed, in every case, that the number of chances favourable and unfavourable to the occurrence of a contingent event is known *a priori*, and consequently, that the probability of the event, or the ratio of the number of favourable cases to the whole number of cases possible, can be absolutely determined. But in numerous applications of the theory of probabilities, and these, generally speaking, by far the most important, the ratio of the chances in favour of an event to those which oppose it is altogether unknown; and we can form no idea of the probability of the event excepting from a comparison of the number of instances in which it has been observed to happen, with the whole number of instances in which it has been observed to happen and fail. In order to assign the probability of a contingent event in such cases, it is necessary to consider all the different causes or combinations of circumstances by which the event could possibly be produced, and to determine its probabilities successively on the hypotheses that each of these causes exists to the exclusion of all the others. The comparative facilities which these hypotheses give to the occurrence of the event which has actually arrived, will then enable us to determine the relative probabilities of the different hypotheses, and consequently their absolute probabilities, since their sum is necessarily equal to unity; and when the probabilities of the different hypotheses, and of the occurrence of the event on each hypothesis, have been determined, the probability of the event occurring in a future trial will be found by the methods already explained.

43. Taking a simple case, let us suppose an urn to contain 4 counters, which are either white or black; that the number of each colour is unknown, but in four successive drawings (the counter drawn being replaced in the urn after each trial) a white counter has been drawn three times, and a black one once; and let it be proposed to assign the probability of drawing a counter of either colour at the next trial.

In the present case three hypotheses may be formed relative to the number of white and black counters in the urn. 1st, The urn may contain 3 white counters and 1 black; 2d, It may contain 2 white and 2 black; 3d, It may contain 1 white and 3 black; for a counter of each colour having been drawn, the other two possible cases, namely, that they are all white or all black, are excluded by the observation. Now, let p_1, p_2, p_3, be the probabilities respectively of drawing a white counter on each hypothesis, and q_1, q_2, q_3, the probabilities of drawing a black. Supposing the first hypothesis to be true, or that the compound event which has been observed was produced by the cause indicated by that hypothesis, we have $p_1=\frac{3}{4}$, $q_1=\frac{1}{4}$; and the probability of the observed event, or that 3 white counters and 1 black would be drawn, (12) is $4p_1^3\,q_1=\frac{27}{64}$. The second hypothesis gives $p_2=\frac{1}{2}$, $q_2=\frac{1}{2}$, whence $4p_2^3\,q_2=\frac{16}{64}$. The third hypothesis gives $p_3=\frac{1}{4}$, $q_3=\frac{3}{4}$, whence $4p_3^3\,q_3=\frac{3}{64}$. The probabilities of the observed compound event, on each of the three hypotheses, are therefore, respectively, $\frac{27}{64}$, $\frac{16}{64}$, $\frac{3}{64}$; and the question now arises, how are the probabilities of the different hypotheses to be estimated? As we have no data, *a priori*, for determining this question, we must assume the probabilities of the different hypotheses to be respectively proportional to the probabilities they severally give of the observed compound event; in other words, we must assume the probability of any hypothesis to be greater or less according as it affords a greater or smaller number of combinations favourable to the event which has been observed to take place. Thus, if C and C_1 be two independent causes from which an observed event E may be supposed to arise, and C furnishes 20 different combinations out of a given number, favourable to the occurrence of E, while C_1 furnishes only 10 such combinations out of the same number, we naturally infer that the probability of the cause C having operated to produce E, is twice as great as the probability that the event was produced by the operation of the cause C_1. Applying this principle to the present example, the probabilities of the three hypotheses are respectively proportional to the three fractions $\frac{27}{64}$, $\frac{16}{64}$, $\frac{3}{64}$, or to the numbers 27, 16, 3; and as no other hypotheses are admissible, the sum of their probabilities must be unity; therefore, making ϖ_1 the probability of the first hypothesis, ϖ_2 that of the second, and ϖ_3 that of the third, we have

$$\varpi_1=\frac{27}{46},\quad \varpi_2=\frac{16}{46},\quad \varpi_3=\frac{3}{46}.$$

44. Having found the probabilities of the different hypotheses, that of drawing a white counter at the next trial

is obtained without difficulty; for according to what was shewn in (9), the probability of this simple event must be equal to the sum of its probabilities relative to the different hypotheses, each multiplied into the probability of the hypothesis itself. Now it has been seen that, on the first hypothesis, the probability of drawing a white ball is $\frac{3}{4}$; on the second $\frac{2}{4}$, and on the third $\frac{1}{4}$; and that the probabilities of the hypotheses are respectively $\frac{27}{46}$, $\frac{16}{46}$, $\frac{3}{46}$; therefore the probability of a white counter being drawn at the next trial is

$$\frac{3}{4}\times\frac{27}{46}+\frac{2}{4}\times\frac{16}{46}+\frac{1}{4}\times\frac{3}{46}=\frac{116}{184}.$$

In like manner, the probability of a black counter being drawn at the next trial is

$$\frac{1}{4}\times\frac{27}{46}+\frac{2}{4}\times\frac{16}{46}+\frac{3}{4}\times\frac{3}{46}=\frac{68}{184};$$

and the sum of these two fractions is unity, as it ought to be, since the counter drawn must necessarily be white or black.

45. The reasoning which has been employed in this particular case is of general application. Let E be an observed event, simple or compound, of which the particular cause is unknown, but which may be ascribed to any one of the n causes, C_1, C_2, C_3,……C_n, which, before the event has happened, are all equally probable, and such that the operation of any one of them excludes that of the others, so that the event E is produced by one of them alone, and not by the joint agency of several of them. Let the probabilities of the observed event E on the hypothesis that it has proceeded from each of those causes be respectively P_1, P_2, P_3,…P_n, so that if the cause, for instance, C_i were the true one, the probability of the event E, previous to the observation, would be P_i; and let the probabilities (as determined by the event) of the existence of the different causes be respectively ϖ_1, ϖ_2, ϖ_3,………ϖ_n. From the principle laid down in the preceding paragraph, namely, that the probabilities of the different causes or hypotheses are proportional to the probabilities they respectively give of the observed event, we have

$$\varpi_1 : \varpi_2 : \varpi_3 \ldots\ldots : \varpi_n :: P_1 : P_2 : P_3 \ldots\ldots : P_n$$

whence, making $P_1+P_2,+P_3\ldots\ldots+P_n=\Sigma P_i$, and observing that $\varpi_1+\varpi_2+\varpi_3\ldots\ldots+\varpi_n=1$ (since it is assumed that there are no other causes than those specified from which the event could arise), we have

$$\varpi_1=\frac{P_1}{\Sigma P_i},\ \varpi_2=\frac{P_2}{\Sigma P_i},\ \varpi_3=\frac{P_3}{\Sigma P_i},\ldots\ldots\varpi_n=\frac{P_n}{\Sigma P_i},$$

whence it appears that the probability of each hypothesis respecting the cause of the observed event is found by dividing the probability of the event on the supposition that that particular cause alone existed, by the sum of its probabilities in respect of all the causes. Let us now assume the probabilities of a future event E′ (which may be the same with E or different, but depending on the same causes) in respect of the several hypotheses, to be, p_1, p_2, p_3,……p_n; so that if the particular cause C_i be the true one, the probability of E′ is p_i; and let Π be the probability of E′ in respect of all the causes, then by (9), Π will be equal to the sum of the probabilities p_1, p_2, p_3……p_n relative to the different hypotheses, each multiplied by the probability of the hypothesis; that is to say we shall have

$$\Pi=p_1\varpi_1+p_2\varpi_2+p_3\varpi_3\ldots\ldots+p_n\varpi_n;$$

or $\Pi=\Sigma p_i\varpi_i$, the symbol Σ indicating the sum of all the different values of p and ϖ in respect of the different causes C_1, C_2, C_3,……C_n.

46. It may be worth while to remark that the word cause is not here used in its ordinary acceptation to denote the combination of circumstances, physical or moral, of which the event is a *necessary* consequence. In the sense we have used the term, the cause C is that which gives rise to the determinate probability P, that the event E will happen; but so long as this probability falls short of certainty, its existence also implies that of another probability, 1—P, that the contrary event F will happen. If we make P=1, the existence of the cause C would necessarily involve the occurrence of E; and it is in this particular sense that the word cause is ordinarily used. In the theory of probabilities the causes of events are considered only in reference to the number of chances they afford for the occurrence of those events which they may possibly, but do not necessarily, produce.

47. The following example may serve to illustrate the method of applying the preceding formulæ. An urn contains n balls, which are known to be either white or black. A ball is drawn at random and found to be white; required the probability of drawing a white ball at the next trial?

In this case, the number of hypotheses that may be made respecting the contents of the urn, is n; for we may suppose that it contained one, or two, or any number of white balls from 1 to n, and each of these cases may be considered as a distinct cause of the observed event E. Let these causes or hypotheses be C_1, C_2, C_3,……C_n, and let us suppose the true cause was C_i, or that the urn contained i white balls. On this hypothesis the probability of the observed event E is $\frac{i}{n}$, whence $P_i=\frac{i}{n}$; and therefore, making i successively equal to 1, 2, 3,….n, we have $\Sigma P_i=\frac{1}{n}(1+2+3\ldots+n)$. But the sum of this arithmetical series is $\frac{n(n+1)}{2}$, therefore $\Sigma P_i=\frac{1}{2}(n+1)$, and consequently,

$$\varpi_i=\frac{P_i}{\Sigma P_i}=\frac{2i}{n(n+1)},$$

which is the probability of the assumption that the event proceeded from the cause C_i, or that the urn contained i white balls. If we suppose $i=n$ we have $\varpi_n=\frac{2}{n+1}$ for the probability that all the balls are white; and if we also suppose $n=3$, this becomes $\frac{1}{2}$; whence if an urn contain 3 balls which must be either black or white, and a white ball be drawn at the first trial, it is an even wager, after the trial, that all the balls are white.

48. Having found, from the observed event E, the probabilities of the different hypotheses, we have now to determine the probability Π of the event E′ (the drawing of a white ball) at the next trial. Here two cases present themselves; according as the ball is replaced in the urn, or is not; or in general, according as the law of the chances remains constant during the series of trials or varies.

1st, Let us suppose that the ball has been replaced in the urn. In this case the probability of the event E′, on the hypothesis that the urn contains i white balls, is $\frac{i}{n}$; that is to say $p_i=\frac{i}{n}$. But the probability ϖ_i of this hypothesis, as found above, is $\frac{2i}{n(n+1)}$; therefore $p_i\varpi_i=\frac{2i^2}{n^2(n+1)}$; whence the general formula (45) $\Pi=\Sigma p_i\varpi_i$ becomes $\Pi=\Sigma\frac{2i^2}{n^2(n+1)}=\frac{2}{n^2(n+1)}\Sigma i^2$. Now $\Sigma i^2=\Sigma i(i+1)-\Sigma i$. But by the property of the figurate numbers referred to in (23), the sum of the series of numbers obtained by giving i every value from $i=1$ to $i=n$ in the formula $\frac{n(n+1)}{1\,.\,2}$ is expressed by $\frac{n(n+1)(n+2)}{1\,.\,2\,.\,3}$; therefore $\Sigma i(i+1)=\frac{n(n+1)(n+2)}{3}$.

We have also as above

$$\Sigma i=1+2+3\ldots\ldots+n=\frac{n(n+1)}{2};$$

consequently,

$$\Sigma i^2=\frac{n(n+1)(n+2)}{3}-\frac{n(n+1)}{2}=\frac{n(n+1)(2n+1)}{2\,.\,3}$$

and therefore

$$\Pi=\frac{2}{n^2(n+1)}\times\frac{n(n+1)(2n+1)}{2\,.\,3}=\frac{2n+1}{3n}.$$

2d, Suppose the ball which has been extracted is not replaced in the urn. In this case, on the hypothesis that the urn at first contained i white balls, the probability of drawing a white ball at the next trial is $\frac{i-1}{n-1}$; that is, $p_i=\frac{i-1}{n-1}$; and the probability of the hypothesis is the same as in the former case, or $\varpi_i=\frac{2i}{n(n+1)}$; therefore $p_i\,\varpi_i=\frac{2i(i-1)}{(n-1)n(n+1)}$; and consequently $\Pi=\Sigma p_i\varpi_i=\frac{2}{(n-1)n(n+1)}\Sigma i(i-1)$. Now the value of $\Sigma i(i-1)$ will evidently be found by writing $n-1$ for n in the above expression for $\Sigma i(i+1)$; whence $\Sigma i(i-1)=\frac{(n-1)n(n+1)}{3}$, and, therefore, in this case

$$\Pi=\frac{2}{(n-1)n(n+1)}\times\frac{(n-1)n(n+1)}{3}=\frac{2}{3}.$$

When n is a very large number, the ratio of $2n+1$ to $3n$, the value of Π in the former case, does not sensibly differ from $\frac{2}{3}$, and therefore in both cases $\Pi=\frac{2}{3}$. Hence it follows, that if an event, depending on unknown causes, can happen only in one of two ways, and it has been observed to happen once, the odds are two to one in favour of its happening in the same way at the next occurrence.

49. The expression for ϖ in (45) was determined on the supposition that previously to the experiments being made, we are entirely ignorant of the relative numbers of the two sorts of balls in the urn, and have no reason to suppose one hypothesis more probable than another. If, however, we happen to know, previously to the experiment, that the different causes C_1, C_2, C_3, &c. have not all the same number of chances in their favour, or that the probabilities of the different hypotheses have relative values, it becomes necessary to introduce those relative values, in consequence of which ϖ_1, ϖ_2, &c., will receive a modification. Let us conceive a number of urns, each containing balls of two colours, black and white, to be distributed in n groups, A_1, A_2, A_3.........A_n, in such a manner that the ratio of the number of white balls to the number of black balls is the same in respect of each urn belonging to the same group, and consequently that the probability of drawing a ball of either colour is the same from whichever urn in the group it may happen to be drawn, but different in respect of the different groups; and let the probabilities of drawing a white ball from each of the different groups be respectively P_1, P_2, P_3,......P_n. Now, let us suppose there are a_1 urns in the group A_1, a_2 in the group A_2, and so on, and let $s=$ the whole number of urns, so that $s=a_1+a_2+a_3\ldots\ldots+a_n$; then, if we make $\frac{a_1}{s}=\lambda_1$, $\frac{a_2}{s}=\lambda_2$, and so on, λ_1 will be the *a priori* probability that a ball drawn from any urn at random, will be drawn from the group A_1; λ_2 the probability it will be drawn from the group A_2; and, in general, λ_i the probability it will be drawn from the group A_i. This being premised, suppose a trial to be made, and that the event E is a white ball; the probability ϖ_i of the hypothesis that the ball was drawn from the group A_i is found as follows. The *a priori* probability of the ball being drawn from the group A_i is λ_i; and if the ball is actually drawn from that group, the probability of its being white is P_i; therefore the probability of both events is $\lambda_i P_i$; and consequently (45), $\varpi_i=\frac{\lambda_i P_i}{\Sigma\lambda_i P_i}$, the symbol of summation Σ extending to all the values of i from $i=1$ to $i=n$.

50. In the applications of the theory to physical or moral events, the different groups of urns here imagined may be regarded as so many independent causes C_1, C_2, C_3, &c. by any one of which the event E might have been produced; ϖ_i is the probability that the event was produced by the particular cause C_i; P_i is the probability that the cause C_i if it had alone existed, would have produced the observed event E; and λ_i is the probability, previously to the experiment, that C_i would be the efficient cause. The formula $\varpi_i=\frac{\lambda_i P_i}{\Sigma\lambda_i P_i}$, therefore, shews that the probability of any one of the possible causes (C_i) of an observed event is equal to the product of the probability (P_i) of the event taking place if that cause acted alone multiplied into the probability λ_i that the cause C_i is the true one, and divided by the sum $(\Sigma\lambda_i P_i)$ of all the similar products formed relatively to each of the causes from which the event can be supposed to arise.

51. The formulæ now obtained can only be used when the number of hypotheses is finite; but in the applications of the theory it most frequently happens that an infinite number of hypotheses may be made respecting the causes of an observed event, as would be the case in the above example if the number of balls in the urn had been unknown. In such cases, in order to find the values of ϖ and Π, it becomes necessary to transform the sums Σ into definite integrals, which is accomplished by means of the theorem $\Sigma X=\int_0^1 X\,dx$, where X is a function of x. Suppose a ball to have been drawn a great number of times in succession from an urn (the number in which is unknown) and replaced in the urn after each drawing, and that the result has been a white ball m times and a black ball n times, the probable constitution of the urn, and thence the probability of drawing a white ball at a future trial will be found as follows. Assume the hypothesis that the ratio of the number of white balls to the whole number in the urn is $x:1$, and let ϖ be the probability of the hypothesis. On this hypothesis the probability of drawing a white ball in any trial is x, and that of drawing a black ball $1-x$, and consequently, the probability of drawing m white and n black in $m+n$ trials is $Ux^m(1-x)^n$ by (12). We have therefore for the probability of the observed compound event $P=Ux^m(1-x)^n$; whence in consequence of the above formula for transforming a sum into a definite integral $\Sigma P=U\int_0^1 x^m(1-x)^n\,dx$ (U being independent of x) and therefore

$$\varpi=\frac{P}{\Sigma P}=\frac{x^m(1-x)^n}{\int_0^1 x^m(1-x)^n\,dx}.$$

The value of the integral in the denominator of this fraction is obtained by the usual method of integrating by parts. Since

$$d\,\frac{x^{m+1}(1-x)^n}{m+1}=x^m(1-x)^n dx-\frac{n}{m+1}x^{m+1}(1-x)^{n-1}dx,$$

therefore

$$\int x^m(1-x)^n dx=\frac{x^{m+1}(1-x)^n}{m+1}+\frac{n}{m+1}\int x^{m+1}(1-x)^{n-1}dx,$$

In like manner we get $\int x^{m+1}(1-x)^{n-1}dx$

$$=\frac{x^{m+2}(1-x)^{n-1}}{m+2}+\frac{n-1}{m+2}\int x^{m+2}(1-x)^{n-2}dx.$$

Continuing this operation n times, or till the exponent of $(1-x)$ becomes $n-n=0$, the last integral will be

$$\int x^{m+n}dx=\frac{x^{m+n+1}}{m+n+1};$$

therefore, collecting the several terms into one sum, we have

$$\int x^m(1-x)^n dx=\frac{x^{m+1}(1-x)^n}{m+1}+\frac{nx^{m+2}(1-x)^{n-1}}{(m+1)(m+2)}\cdots\cdots\cdots$$
$$\cdots\cdots\cdots+\frac{n(n-1)(n-2)\cdots\cdots\cdots 2\,.\,1\,.\,x^{m+n+1}}{(m+1)(m+2)\cdots\cdots\cdots\ m+n+1}.$$

When $x=0$, all the terms of this series vanish, and when $x=1$ they all vanish excepting the last; therefore between the limits $x=0$ and $x=1$, the value of the integral is the last term of the series when x in that term $=1$; that is to say,

$$\int_0^1 x^m(1-x)^n dx=\frac{n(n-1)(n-2)\cdots\cdots\ 2\,.\,1}{(m+1)(m+2)\cdots\cdots m+n+1}.$$

For the sake of brevity, let the symbol $[x]$ be adopted to represent the continued product $1\,.\,2\,.\,3\ldots x$ of the natural numbers from 1 to x,[1] whence by analogy $[x+y]$ will represent the continued product of the same series from 1 to the number denoted by $x+y$. Multiplying, then, the numerator and denominator of the above expression by $1\,.\,2\,.\,3\ldots\ldots m=[m]$, we get

$$\int_0^1 x^m(1-x)^n dx=\frac{[m][n]}{[m+n+1]};$$

whence the probability of the hypothesis, in consequence of the equation above found, becomes

$$\varpi=\frac{[m+n+1]}{[m][n]}x^m(1-x)^n.$$

From this value of ϖ we are enabled to deduce that of Π, the probability of drawing a white ball at the next trial. By (45) $\Pi=\Sigma\varpi p$. Now, since by hypothesis the number of white balls in the urn is to the whole number of both colours in the ratio of x to 1, the probability of drawing a white ball is x; consequently $p=x$, and therefore $\Pi=\Sigma\varpi x=\int_0^1 \varpi x dx=\frac{[m+n+1]}{[m][n]}\int_0^1 x^{m+1}(1-x)^n dx$. But the value of $\int_0^1 x^{m+1}(1-x)^n dx$ will evidently be obtained by substituting $m+1$ for m in the expression found for $\int_0^1 x^m(1-x)^n dx$. This substitution gives

$$\int_0^1 x^{m+1}(1-x)^n dx=\frac{[m+1][n]}{[m+n+2]},$$

whence, observing that $[m+1]\div[m]=m+1$, and $[m+n+2]\div[m+n+1]=m+n+2$, we have

$$\Pi=\frac{m+1}{m+n+2}.$$

The probability of the contrary event, or of drawing a black ball, is $1-\Pi=\frac{n+1}{m+n+2}$. As the numbers m and n become larger, these two fractions approach nearer and nearer to their limits $\frac{m}{m+n}$ and $\frac{n}{m+n}$, which are the *apriori* probabilities p and q of the respective events when the ratio of the number of white balls in the urn is to that of the black balls as m to n.

52. The probability of drawing m' white balls and n' black balls in $m'+n'$ future trials is found in a similar manner, and the problem may be thus stated. E and F are two contrary events, depending on constant but unknown causes; and it has been observed, that in $m+n=h$ successive instances the event E has occurred m times and F n times, required the probability that in $m'+n'=h'$ future instances, E will occur m' times and F n' times.

Assume, as in the last case, the facility of the occurrence of E to that of F to be in the ratio of x to $1-x$; we have then, as before, for the probability of the hypothesis, $\varpi=\frac{[h+1]}{[m][n]}x^m(1-x)^n$. Now on this hypothesis the probability of E in the next instance is x, and that of F is $1-x$, whence the probability of m' times E and n' times F in the next h' trials being denoted by p, we have (12) $p=U'x^{m'}(1-x)^{n'}$, making $U'=\frac{1\,.\,2\,.\,3\ldots h'}{1\,.\,2\,.\,3\ldots m'\times 1\,.\,2\,.\,3\ldots n'}=\frac{[h']}{[m'][n']}$. We have therefore $\varpi p=U'\frac{[h+1]}{[m][n]}x^{m+m'}(1-x)^{n+n'}$ for the probability of the compound event on this hypothesis. To find its probability Π on the infinite number of hypotheses formed by supposing x to increase by infinitely small increments from $x=0$ to $x=1$, we have $\Pi=\Sigma\varpi p=\int_0^1 \varpi p dx$. On substituting for ϖp the value just found, we get $\Pi=U'\frac{[h+1]}{[m][n]}\int_0^1 x^{m+m'}(1-x)^{n+n'}dx$, and it is manifest that the value of this integral will be obtained by substituting $m+m'$ for m, and $n+n'$ for n in the value of $\int_0^1 x^m(1-x)^n dx$ found above. This substitution gives

$$\int_0^1 x^{m+m'}(1-x)^{n+n'}dx=\frac{[m-m][n+n']}{[h+h'+1]},$$

whence we conclude

$$\Pi=U'\frac{[m+m'][n+n'][h+1]}{[m][n][h+h'+1]}.$$

The most probable hypothesis will be found by making the value of ϖ a maximum, or its differential coefficient equal to zero. Differentiating the equation $\varpi=\frac{[h+1]}{[m][n]}x^m(1-x)^n$, and making $\frac{d\varpi}{dx}=0$, we get $m(1-x)=nx$, whence $x=\frac{m}{m+n}$. The most probable supposition, therefore, respecting the contents of the urn is, that the two sorts of balls are in the same proportions as have been shewn by the previous drawings. We shall have further occasion for these formulæ when we come to consider the cases in which m and n are large numbers.

SECT. VI.—OF BENEFITS DEPENDING ON THE PROBABLE DURATION OF HUMAN LIFE.

53. In applying the principles of the theory of probability to the determination of the values of benefits depending on life, the fundamental element which it is necessary to determine from observation is the probability that an individual at every given age within the observed limits of the duration of life, will live over a given portion of time, for instance one year; for when this has been determined for each year of age, the probability that an individual, or any number of individuals, will live over any assigned number of years, is easily deduced. Thus, if the probabilities that an individual A, whose age is y, will live over 1, 2, 3…x years, be denoted respectively by $p_1, p_2, p_3\ldots p_x$; and if $q_1, q_2, q_3\ldots q_x$ denote the same probabilities in respect of an individual whose age is $y+1$ years; $r_1, r_2, r_3\ldots r_x$, the same in respect of an individual whose age is $y+2$ years, and so on; then, since the probability p_2 which A has of living over 2 years is obviously compounded of the probability p_1 of his living over 1 year, and of the probability q_1 that, having attained the age $y+1$, he will live another year, we

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[1] This convenient notation has been adopted by Mr. De Morgan.

have, by (7), $p_2=p_1q_1$. Again, the probability p_3 that A will live over three years, being compounded of the probability p_2 that he will live over two years, and of the probability r_1 that, having attained the age $y+2$ years, he will survive another year, we have $p_3=p_2r_1=p_1q_1r_1$. In like manner $p_4=p_1q_1r_1s_1$, and so on; so that the probabilities p_2, p_3, $p_4 \ldots p_x$ are successively derived from p_1, q_1, r_1, s_1, &c. which are supposed to be the data of observation.

If a large number n of individuals, all born in the same year, were selected, and if it were observed that the number of them remaining alive at the end of the first year is n_1, at the end of the second year n_2, at the end of the third n_3, and so on, then the probabilities p_1, p_2, p_3, &c. would be given directly by the observation, being respectively equal to the quotients $\frac{n_1}{n}$, $\frac{n_2}{n}$, $\frac{n_3}{n}$, &c. But the most accurate observations of mortality are furnished by the experience of the annuity and assurance offices, where they are not made on an isolated number, diminishing, and consequently giving a less valuable result every year, but on a comparison of the numbers which, in a series of years, enter upon and survive each year of age. This observation gives p_1, q_1, r_1, s_1, &c, whence p_2, p_3, p_4, &c. are found, as above, for every year of life.[1]

54. The values of annuities on lives, and of reversionary sums to be paid on the failure of lives, are found by combining the probabilities p_1, p_2, p_3, &c. with the rate of interest of money. Let $r=$ the rate of interest, that is to say, the interest of L.1 for a year, and $v=$ the present value of L.1 to be received at the end of a year, we shall then have $v=1\div(1+r)$. Now an annuity, payable yearly, is always understood in this sense, that the first payment becomes due at the end of a year after the annuity is created. Suppose then the annuity to be L.1, the present value of the first payment, if it were to be received certainly, is v; but the receipt of this sum is contingent on the annuitant being alive at the end of the year, the probability of which we suppose to be p_1; therefore (7) the present value of L.1 subject to the contingency, is vp_1. In like manner, the present value of L.1 to be received certainly at the end of x years is v^x; but the annuity will only be received at the end of the xth year if the annuitant be then living, the probability of which is p_x; therefore the present value of that particular payment is v^xp_x. Hence if A denote the present value of the annuity, or the sum in hand which is equivalent to all the future payments, we shall have $\mathrm{A}=\Sigma v^xp_x$; the sum Σ including all values of x from $x=1$ to $x=$ the number for which $p=0$. If the annuity be a pounds, its value is obviously $=a\Sigma v^xp_x=a\mathrm{A}$.

55. The series denoted by Σv^xp_x may be divided into two parts, $\Sigma v^np_n+\Sigma v^zp_z$, where n is to be taken from 1 to n, and z from $n+1$ to the number for which p vanishes. The first gives the value of the *temporary* annuity on the given life for n years, and the second the value of the *deferred* annuity, that is to say, of the annuity to commence n years hence if the individual shall be then living, and to continue during the remainder of his life. Let A be the value of the annuity on the life of a person now aged y years for the whole of life, $\mathrm{A}^{(tn)}$ the value of a temporary annuity on the same life for n years, and $\mathrm{A}^{(dn)}$ the value of an annuity deferred n years on the same life, we have then $\mathrm{A}=\mathrm{A}^{(tn)}+\mathrm{A}^{(dn)}$.

To find $\mathrm{A}^{(dn)}$, let A_n be the value of an annuity on a life aged $y+n$ years. If the person now aged y years lives over n years, the value of an annuity on the remainder of his life will *then* be A_n. The present value of this sum, if it were to be received certainly, is $v^n\mathrm{A}_n$, and the probability of receiving it is p_n; therefore its value is $v^np_n\mathrm{A}_n$. Hence

$$\mathrm{A}^{(dn)}=v^np_n\mathrm{A}_n,\text{ and }\mathrm{A}^{(tn)}=\mathrm{A}-v^np_n\mathrm{A}_n;$$

so that the values of temporary and deferred annuities are readily computed from tables of A and p for all the different ages.

56. The equation $\mathrm{A}=\mathrm{A}^{(tn)}+\mathrm{A}^{(dn)}$ gives a formula by which the values of A are readily deduced from one another. Let $n=1$; we have then $\mathrm{A}=\mathrm{A}^{(t1)}+vp_1\mathrm{A}_1$. But $\mathrm{A}^{(t1)}$, the value of an annuity for one year, is merely the value of the first payment to be received in the event of the given life surviving one year. Its value is therefore vp_1; and we have consequently $\mathrm{A}=vp_1+vp_1\mathrm{A}_1$, or $\mathrm{A}=vp_1(1+\mathrm{A}_1)$. This formula, which gives the value of an annuity at any age in terms of the next higher age, and greatly facilitates the computation of the annuity tables, is due to Euler.

57. The value of an annuity on the joint lives of any number of individuals, that is, to continue only while they are *all* living, is calculated precisely in the same manner as the annuity on a single life. Let there be any number of individuals, A, B, C, D, &c. and let the probabilities of each living over one year be respectively p_1, q_1, r_1, s_1, &c. and let P_1 be the probability that they will *all* live over one year; then

$$\mathrm{P}_1=p_1\times q_1\times r_1\times s_1,\ \&c.$$
$$\mathrm{P}_2=p_2\times q_2\times r_2\times s_2,\ \&c.$$
$$\cdots\cdots\cdots\cdots\cdots\cdots$$
$$\mathrm{P}_x=p_x\times q_x\times r_x\times s_x,\ \&c.$$

and the value of an annuity of L.1 on the joint lives is $\Sigma v^x\mathrm{P}_x$, from $x=1$ to $x=$ the number which renders any one of the probabilities p, q, r, s, &c. nothing.

58. The value of an annuity on the survivor of any number of given lives, that is, to continue so long as any one of them exists, is thus found. The probability that A will be alive at the end of the xth year being p_x, the probability that he will not be alive at the end of that time is $1-p_x$. The probability that *all* the lives will be extinct at the end of the xth year is therefore

$$(1-p_x)(1-q_x)(1-r_x)(1-s_x),\ \&c.$$

and the probability that they will not all be extinct, or that at least one of them will be in being, is

$$1-(1-p_x)(1-q_x)(1-r_x)(1-s_x),\ \&c.$$

which becomes by multiplication

$$\begin{aligned}&p_x+q_x+r_x+s_x+\&c.\\&-p_xq_x-p_xr_x\ldots\ldots-q_xr_x-q_xs_x\ldots\ldots-r_xs_x-\&c.\\&+p_xq_xr_x+p_xq_xs_x\ldots\ldots+q_xr_xs_x+\&c.\\&-p_xq_xr_xs_x-\&c.\\&+\&c.\end{aligned}$$

Multiplying each of the terms by v^x, and taking the sums of the respective products from $x=1$, and observing that $\Sigma v^xp_xq_x$ is the value of the annuity on the joint lives of A and B, $\Sigma v^xp_xq_xr_x$ that on the joint lives of A, B, and C, and so on, we have this rule:—

The value of an annuity on the survivor of any number of lives is equal to the sum of the annuities on each of the lives, minus the sum of the annuities on each pair of joint lives, plus the sum of the annuities on the joint lives taken by threes, and so on. When there are only two lives, the value of the annuity on the life of the survivor becomes

$$\Sigma v^xp_x+\Sigma v^xq_x-\Sigma v^xp_xq_x.$$

59. Let V denote the value of an assurance on the life of A, or the present worth of L.1 to be received at the end of the year in which A shall die. In respect of any year, the xth, after the present, the probability of A dying in the course of that year is $p_{x-1}-p_x$. For let u be the probability that a life $x-1$ years older than A will live over one year, then $1-u$ is the probability of a life of that age not living over one year; therefore p_{x-1} being the probability of A living over $x-1$ years, $p_{x-1}(1-u)$ is the chance of his living over $x-1$ years, and dying in the following year (7). But $p_{x-1}(1-u)=p_{x-1}-p_{x-1}u$; and by (53), $p_{x-1}u=p_x$; therefore $p_{x-1}-p_x$ is the chance that A will survive $x-1$

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[1] For further details on this subject, see MORTALITY, vol. xv. p. 550.

years and not survive x years. Now v^x is the value of L.1 to be received certainly at the end of the xth year; therefore in respect of the xth year the value of the expectation is $v_x(p_{x-1}-p_x)$; whence we have for the value of the assurance

$$V=\Sigma v^x(p_{x-1}-p_x),$$

from $x=1$ to $x=$ the number which makes $p=0$. Now, if we observe that $p_0=1$, and $\Sigma v^x p_{x-1}=v\Sigma v^{x-1}p_{x-1}$, it will be obvious that $\Sigma v^x p_{x-1}=v(1+\Sigma v^x p_x)$; whence, denoting $\Sigma v^x p_x$ by A, (A being as in (54) the value of the annuity on the given life), we have

$$V=v(1+A)-A\text{; or } V=v-(1-v)A.$$

60. The values of assurances on joint lives, (that is, to be paid at the end of the year in which any one of the lives shall fail), or on the survivor of any number of joint lives, are calculated from the corresponding annuities by means of the same formula. Thus, let A' be the value of an annuity of L.1 on any number of joint lives, and V' the value of an assurance of L.1 on the same joint lives, then $V'=v-(1-v)A'$. If A'' be the annuity, and V'' the assurance on the life of the survivor of any number of given lives, we have still $V''=v-(1-v)A''$.

61. Assurances on lives are usually paid not in single payments, but by equal yearly payments, the first being made at the time the contract is entered into, and the succeeding ones at the end of each future year during the life of the assured. The present value of the sum which the assured contracts to pay is therefore equal to the first payment added to the value of an annuity of the same amount on his life; and if the assurance is made on terms of mathematical equality, this sum must be precisely equal to the value of the assurance in a single payment. Therefore, if y denote the amount of the yearly payment, we have the equation $y(1+A)=V$; whence $y=V\div(1+A)$.

62. The value of a temporary assurance for n years, that is, of an assurance to be paid only in the event of the individual dying before the end of n years is thus found. Let V be the present value of L.1, to be paid on the death of a person now aged y years, and V_n the present value of L.1, to be paid on the death of a person now aged $y+n$ years. At the end of n years from the present time, the value of L.1 assured on the life of a person now aged y years will be V_n, if he be then living. But the present value of L.1 to be received certainly at the end of n years is v^n; and the probability that the life will continue n years is p_n; therefore the present value of V_n, subject to the contingency of the life continuing n years, is $v^n p_n V_n$. If, therefore, we subtract this from V, we shall have the value of the temporary assurance in a single payment, namely $V-v^n p_n V_n$.

The equivalent annual premium is found by observing, that as the first payment is made immediately, and n payments are to be made in all, the value of all the premiums after the first is that of a temporary annuity of the same amount for $n-1$ years. Denoting therefore the annual premium by u, and the value of a temporary annuity for $n-1$ years by $A^{(tn')}$, the value of all the premiums is $u+uA^{(tn')}=u(1+)A^{(tn')}$; and we have consequently $u(1+A^{(tn')})=V-v^n p_n V_n$, whence

$$u=\frac{V-v^n p_n V_n}{1+A^{(tn')}}.$$

63. The following question is of frequent occurrence. Required the present value of a sum of money to be received at the end of the year in which A dies, provided he die while B is living.

Let the sum be L.1, $W=$ its present value, $p_x=$ the probability of A living over x years, and $q_x=$ the probability of B living over x years. The chance of receiving the sum at the end of any given year, the xth, depends on two contingencies; 1. A may die in the course of that year, and B live over it; 2. A and B may both die in that year, A dying first. The probability of A dying in the xth year has been shewn (59) to be $p_{x-1}-p_x$; whence (7) the probability of the first contingency is $(p_{x-1}-p_x)q_x$. The probability that A and B will both die in the xth year is $(p_{x-1}-p_x)(q_{x-1}-q_x)$; and for so short a period as one year, it may be considered an even chance whether A or B will die first, whatever be the difference of their ages; therefore the probability in respect of the second contingency is $\frac{1}{2}(p_{x-1}-p_x)(q_{x-1}-q_x)$. Hence the whole probability of the sum being received at the end of the xth year, is $(p_{x-1}-p_x)q_x+\frac{1}{2}(p_{x-1}-p_x)(q_{x-1}-q_x)=\frac{1}{2}(p_{x-1}-p_x)(q_{x+1}+q_x)$, which being developed, and multiplied by v^x, becomes

$$\tfrac{1}{2}v^x(p_{x-1}q_{x-1}+p_{x-1}q_x-p_x q_{x-1}-p_x q_x),$$

and the sum of all the values of this expression from $x=1$, gives the value of W.

It has been already shewn (59) that $\Sigma v^x(p_{x-1}-p_x)=v-(1-v)A$, where $A=$ the annuity on the life of A. In like manner, if we denote by $\overline{AB}$ the value of an annuity on the joint lives of A and B, we shall have $\Sigma v^x(p_{x-1}q_{x-1}-p^x q^x)=v-(1-v)\overline{AB}$, which is the value of an assurance to be paid on the death of the first dying. Assume p' such that $p'_x=p'_1 p_{x-1}$, then p'_x is evidently the probability that an individual A′ one year *younger* than A, will live over x year (53), and $\Sigma v^x p_{x-1}q_x=\frac{1}{p'_1}\Sigma v^x p'_x q_x=\frac{1}{p'_1}\overline{A'B}$; denoting by $\overline{A'B}$ the value of an annuity on the joint lives of A′ and B. Again, let $q'_x=q'_1 q_{x-1}$, then q'_x is the probability that B′, who is one year *younger* than B, will live over x years, and $\Sigma v^x p^x q_{x-1}=\frac{1}{q'_1}\Sigma v^x p_x q'_x=\overline{AB'}$; denoting by $\overline{AB'}$ the value of an annuity on the joint lives of A and B′. Collecting the different terms, we have therefore

$$W=\tfrac{1}{2}\left\{v-(1-v)\overline{AB}+\frac{1}{p'_1}\overline{A'B}-\frac{1}{q'_1}\overline{AB'}\right\},$$ whence W is easily computed from tables of annuities on joint lives.

If A and B are both of the same age, the two last terms destroy each other, and W is equal to $\frac{1}{2}$ the value of L.1, to be paid on the failure of the joint lives, as it evidently ought to be, since there is in this case the same chance of A dying before B as of B dying before A.

The formula gives the value of L.1 in a single payment; the equivalent yearly payment is W divided by $1+\overline{AB}$, for the contract ceases on the failure of the joint lives by the death of either.

It would be easy to extend the formula to the case of an assurance to be paid on the contingency of the failure of any number of lives during the continuance of any number of other lives, or of an assurance to continue only during a stated time; but as it is not our purpose to give solutions of the various problems of this kind which may occur in practice, but merely to shew the manner in which the general principles of the theory are applied to them, we shall not pursue the subject farther, but refer the reader to the article ANNUITIES, and to the standard works of Baily[1] and Milne,[2] in which it is treated in detail.

SECT. VII. OF THE APPLICATION OF THE THEORY OF PROBABILITY TO TESTIMONY, AND TO THE DECISIONS OF JURIES AND TRIBUNALS.

64. The case of a witness making an assertion may be represented by an urn containing balls of two colours, the

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[1] *The Doctrine of Life Annuities and Assurances analytically investigated and practically explained, &c.* By Francis Baily. London, 1813. This work is now out of print, but a French translation of it has recently been published at Paris.

[2] *A Treatise on the Valuation of Annuities and Assurances on Lives and Survivorships, &c.* By Joshua Milne. London, 1815.

ratio of the number of one colour to that of the other being unknown, but presumed from the result of a number of experiments, which consist in drawing a ball at random, and replacing it in the urn after each trial. A true assertion being represented by a ball of one colour, and a false one by a ball of the other, it follows from the theorem in (51), that if a witness has made $m+n$ assertions, of which m are true and n false, the probability of a future assertion being true is $\frac{m+1}{m+n+2}$, and that of its being false $\frac{n+1}{m+n+2}$. Let the first of these fractions be represented by v, and the second by w, then v is the measure of the veracity of the individual, or the probability of his speaking the truth, and w the opposite probability, since $v+w=1$. In general, the existing data are insufficient to enable us to determine the numerical values of v and w in this manner; and therefore in applying the formulæ to particular cases, we must assign arbitrary values to these quantities, founded on previous knowledge of the moral character of the individual, or on some notions, more or less sanctioned by experience, of the relative number of true and false statements made by men in general, placed in similar circumstances.

65. Having assumed v and w, let us suppose a witness to testify that an event has taken place, the *a priori* probability of which is p, and let it be proposed to determine the probability of the event after the testimony. In this case the event observed (E) is the assertion of the witness, and two hypotheses only can be made respecting its cause; 1st, that the event testified really took place; and 2d, that it did not. On the first hypothesis the witness has spoken the truth, the probability of which is v; and an event has occurred of which the probability is p; therefore (7) the probability (P_1) of the coincidence is vp. On the second hypothesis, the witness has testified falsely, the probability of which is w; and the event attested did not happen, the probability of which is q; therefore the probability (P_2) of the coincidence is wq. Hence, by the formula (47) $\varpi_1 = P_i \div \Sigma P_i$) the probability ($\varpi_1$, of the first hypothesis becomes $\frac{vp}{vp+wq}$, and the probability (ϖ_2) of the second $\frac{wq}{vp+wq}$. The sum of these two probabilities is unit, a condition which ought evidently to be fulfilled, since no other hypothesis can be made, and consequently one or other of the two must be true. It is to be observed, that these values of ϖ_1 and ϖ_2 are the respective probabilities, after the testimony has been given, that the event attested took place, and that it did not.

Since $\varpi_1 = \frac{vp}{vp+wq}$, we have $\varpi_1 - p = \frac{p(v-vp-wq)}{vp+wq}$ $= \frac{p\{v(1-p)-wq\}}{vp-wq} = \frac{p(vq-wq)}{vp-wq}$; but $v-w=v-1+v=2v-1$, therefore $\varpi_1 - p = \frac{p(2v-1)q}{vp+wq}$. This fraction being positive or negative, according as $2v-1$ is greater or less than unity, or as v is greater or less than $\frac{1}{2}$, it follows that if $v > \frac{1}{2}$, then $\varpi_1 > p$; that is to say, the probability of the event after the testimony is greater than its *a priori* probability when the veracity of the witness is greater than $\frac{1}{2}$. On the contrary, if the veracity of the witness is less than $\frac{1}{2}$, the effect of the testimony is to render the probability of the event less than its *a priori* probability.

66. If the event asserted by the witness be of such a nature that its occurrence is *a priori* extremely improbable, so that p is a very small fraction, and q consequently approaches nearly to unity, although at the same time the veracity of the witness be great, and measured by a fraction approaching to unity, the value of ϖ_1 becomes nearly equal to $p \div w$, (for on this supposition $p+wq : v$ is nearly equal to w). But it is obvious, that however great the improbability of a witness giving false testimony may be supposed, the improbability of a physical event may be any number of times greater; in other words, however small a value may be given to w, the value of p may still be any number of times smaller; so that notwithstanding the veracity of the witness, the probability of the event after the testimony, namely $\varpi_1 = p \div w$ may be less than any assignable quantity. On this principle mankind do not easily give credence to a witness asserting a very extraordinary or improbable event. The odds against the occurrence of the event may be so great, that the testimony of no single witness, however respectable his character, would suffice to induce belief.

67. In the case of the character of a witness being altogether unknown, we may suppose v to have all possible values within certain limits, and to find the value of ϖ_1 by integrating the fraction $\int \varpi_1 dv$ between those limits. Since $\varpi_1 = \frac{vp}{vp+wq}$, we have $\int \varpi_1 dv = \int \frac{pvdv}{vp+wq}$, which on substituting $1-v$ and $1-p$ for w and q respectively, becomes $\int \frac{pvdv}{1-p+(2p-1)v}$, the integral of which is

$$p\left\{\frac{v}{2p-1} - \frac{1-p}{(2p-1)^2}\log.\Big(1-p+(2p-1)v\Big)\right\} + C,$$

C being a constant, the value of which will be determined from the assumed limits. If v be supposed to vary between the limits $v=0$ and $v=1$, then

$$\int \varpi_1 dv = \frac{p}{2p-1}\left\{1 - \frac{1-p}{2p-1}\log.\frac{p}{1-p}\right\};$$

and if we assume $p=\frac{3}{4}$, we have $\int \varpi_1 dx = \frac{3}{2}(1-\frac{1}{2}\log.3)$, which, since the logarithm is the Napierian logarithm, and Nap. log. $3=1.0986$, becomes $\frac{3}{2} \times .4507 = .676$, or nearly $\frac{2}{3}$. Whence we see, that on this hypothesis the probability of the event is diminished in consequence of the testimony.

68. The credit due to the testimony of a witness depends not merely on his good faith, but also on the probability that he is not himself deceived with respect to the event he asserts. The chances of a witness being deceived through credulity or ignorance are much more numerous in general than the chances of intentional fraud; and this must be the case more particularly when the event is of such a nature that it may happen in various ways which may be mistaken one for another: as for instance, in the case of a lottery ticket being drawn, and the witness asserting that it bears a particular number, which might with equal probability be any other number on the wheel. The following question will illustrate the method of applying the calculus when a distinction is made between these sources of error.

An urn contains s balls, of which a_1 are marked A_1, a_2 marked $A_2 \ldots\ldots a_n$ marked A_n. A ball having been drawn at random, a witness of the drawing affirms that the ball drawn is marked A_m; required the probability of the testimony being true.

Here we have $s=a_1+a_2+a_3 \ldots\ldots + a_n$, ($n$ being the number of the different indices or sorts of balls); so that if we make $p_1 = a_1 \div s, p_2 = a_2 \div s \ldots\ldots p_m = a_n \div s$, then p_1 is the *a priori* probability that the ball drawn is of the class marked A_1, p_2 the probability that it belongs to the class whose index is A_2, and so on. It is evident that n different hypotheses may be made respecting the index of the ball which has been drawn, for it may belong to any one of the different classes $A_1, A_2 \ldots A_n$. Let the probabilities of these hypotheses be respectively $\varpi_1, \varpi_2 \ldots \varpi_n$, (that is, in respect of any particular index i, ϖ_i is the probability after the assertion that the ball drawn is marked A_i); and let the probabilities of the assertion on each of these hypotheses be respectively $P_1, P_2 \ldots P_n$, (that is, if the ball drawn be marked A_i, then P_i is the probability the witness will assert it to be marked A_m). Lastly, let v be the veracity of the witness, and u the probability that he has not been deceived.

(1.) Let us first consider the hypothesis that the ball drawn is marked A_m, and consequently that the assertion is true. In order to find P_m, the probability of the assertion being made, there are four cases to be considered. 1st, we may suppose the witness is not deceived himself (u), and that he speaks the truth (v). The probability of the assertion in this case is uv. 2d, The witness knows the truth, but intends to deceive, or testifies falsely. In this case the probability of the assertion being made, on the hypothesis under consideration, is 0. 3d, The witness has been deceived himself, but intends to speak the truth. In this case also the probability of the assertion being made is 0. 4th, The witness has been deceived himself, and intends to deceive. In this case the assertion might be made; and to find the probability of its being made we have to consider, that since the witness has been deceived, he must have supposed some other index than A_m to have been drawn; and since he intends to deceive, he must assert some other index to be drawn than that which he supposes to be drawn. Setting aside, therefore, the index which he supposes to have been drawn, there remain $n-1$ others, any one of which he is as likely to name as any other. The probability, therefore, of his naming A_m when he intends to deceive is $1\div(n-1)$. Hence the probability of the assertion in this case is compounded of the probabilities of three simple events, as follows: 1. Probability the witness is deceived $=(1-u)$; 2. Probability he intends to deceive $=(1-v)$; 3. Probability he names A_m $=1\div(n-1)$. The probability of the assertion is therefore in this case $=(1-u)(1-v)\div(n-1)$. Adding this to the probability found in the first case, we have P_m, the whole probability of the assertion being made on the hypothesis that the index of the ball drawn was A_m, namely

$$P_m=uv+\frac{(1-u)(1-v)}{n-1}.$$

(2.) Let us now consider one of the remaining hypotheses, and suppose that the ball actually drawn was marked A_i, and not A_m, as attested by the witness. As before, there are four possible cases for consideration. 1st, The witness knows the fact and speaks the truth. In this case the assertion could not be made, or its probability is 0. 2d, The witness knows the fact, and intends to deceive. In this case the probability of his asserting A_m to be drawn is compounded of the probability that he is not deceived (u), the probability that he testifies falsely ($1-v$), and the probability that, knowing the index A_i to be drawn, he selects A_m from among the $n-1$ which remain after rejecting A_i, $(1\div(n-1))$. The probability of the assertion being made in this case is therefore $u(1-v)\div(n-1)$. 3d, The witness is deceived, and intends to speak the truth. By reasoning as in the last case, it is easy to see that the probability of the assertion being made in this case is $v(1-u)\div(n-1)$. 4th, The witness is deceived, and intends to deceive. The probability of the assertion being made in this case will be found by considering, that as the witness is himself deceived, he must suppose some particular index to be drawn different from A_i, (which is drawn by hypothesis), for instance A_e, the probability of which is $1\div(n-1)$; and intending to deceive, he must fix on some index different from A_e, which he supposes to be drawn; and he announces A_m, the probability of which selection is also $1\div(n-1)$. The probability, therefore, that the witness supposes A_e to be drawn, and annnounces A_m, is $1\div(n-1)^2$. But it is evident, that whatever can be affirmed with respect to the particular index A_e, may be affirmed with equal truth of every one of the other n indexes, excepting A_i, which is actually drawn, (since by hypothesis the witness is deceived), and A_m, which he announces, (since by hypothesis he lies). There are therefore $n-2$ different ways in which he may at the same time be deceived, and intend to deceive, and announce A_m; consequently the probability of this announcement in any of these ways is $(n-2)\div(n-1)^2$. Multiplying this into the probability of his being deceived $(1-u)$, and the probability of his giving false testimony $(1-v)$, the probability of the assertion in this case becomes $\frac{(1-u)(1-v)(n-2)}{(n-1)^2}$. Hence the whole probability of the assertion, in all the cases included in the hypothesis that the ball actually drawn was marked A_i, is

$$P_i=\frac{u(1-v)}{n-1}+\frac{(1-u)v}{n-1}+\frac{(1-u)(1-v)(n-2)}{(n-1)^2}.$$

As this expression will evidently be the probability of the assertion on any other of the $n-1$ hypotheses that the ball actually drawn was marked with an index different from A_m, the sum of the probabilities of the assertion on all these hypotheses is ΣP_i, where i is successively each of the numbers 1, 2, 3,…n, excepting m.

We have now to find ϖ_m, the probability of the first hypothesis. Since the hypotheses, in the present question, are not all equally probable *a priori*, we must have recourse to the formula (49) $\varpi_i=\lambda_i P_i\div\Sigma\lambda_i P_i$, and consequently in the present case we have

$$\varpi_m=\frac{\lambda_m P_m}{\lambda_m P_m+\Sigma\lambda_i P},$$

the sign of summation Σ including every value of i from 0 to n, excepting $i=m$. Now the value of P_i being the same in respect of each of the hypotheses which suppose the assertion untrue, $\Sigma\lambda_i P_i=P_i\Sigma\lambda_i$; and the sum of all the values of λ_i from $i=0$ to $i=n$ being 1, on excluding $\lambda_m=a_m\div s$, we have $\Sigma\lambda_i=(s-a_m)\div s$. Substituting this, together with the values of P_m and P_i, as above found, and making $u'=1-u$, $v'=1-v$, the formula becomes, after the proper reduction,

$$\varpi_m=\frac{a_m\{(n-1)uv+u'v'\}}{a_m\{(n-1)uv+u'v'\}+(s-a_m)\{u'v+uv'+\frac{n-2}{n-1}u'v'\}};$$

which is the probability of the hypothesis that a ball marked A_m was drawn, or that the testimony is true.

When there are no two balls in the urn having the same index, the numbers a_1, a_2, a_3, &c. become each $=1$, and $s=n$. In this case the formula gives

$$\varpi_m=\frac{(n-1)uv+u'v'}{(n-1)uv+u'v'+(n-1)(u'v+uv')+(n-2)u'v'},$$

which, on observing that $uv+u'v+uv'+u'v'=1$, becomes by reduction

$$\varpi_m=uv+\frac{(1-u)(1-v)}{n-1}.$$

This is the probability of the truth of the testimony of a witness, who affirms that the number m is drawn from an urn which contains n balls, numbered 1, 2, 3…n. It is obvious, that when u and v are fractions approaching to unity, and n is a considerable number, the second term becomes very small, and may be neglected. The probability then becomes simply $\varpi_m=uv$.

69. We now proceed to consider the probability of an event attested by several witnesses; and first let us suppose the witnesses to agree in their testimony. The measures of the veracity of the several witnesses being respectively v_1, v_2, v_3, &c., and the *a priori* probability of the event being p, we have by (58) for its probability after the testimony of the first witness,

$$\varpi_1=\frac{v_1 p}{v_1 p+(1-v_1)(1-p)}.$$

In order to find the probability of the event after the second witness gives his testimony, we may suppose the *a priori* probability to be changed from p to ϖ_1 by the testimony of the first witness, and the same formula gives

$$\varpi_2=\frac{v_2\varpi_1}{v_2\varpi_1+(1-v_2)(1-\varpi_1)}=\frac{v_1v_2p}{v_1v_2p+(1-v_1)(1-v_2)(1-p)}.$$

Let a third witness now come forward, and give testimony in favour of the same event. Its probability after his testimony will become in like manner

$$\varpi_3=\frac{v_3\varpi_2}{v_3\varpi_2+(1-v_3)(1-\varpi_2)}=\frac{v_1v_2v_3p}{v_1v_2v_3p+(1-v_1)(1-v_2)(1-v_3)(1-p)}.$$

In general, let ϖ^x be the probability of an event after it has been attested by x witnesses, and let v_x be the veracity of the last witness, then ϖ_{x-1} being the probability of the event after $x-1$ eyewitnesses have each testified in its favour, we have

$$\varpi_x=\frac{v_1v_2\ldots\ldots v_xp}{v_1v_2\ldots v_xp+(1-v_1)(1-v_2)\ldots(1-v_x)(1-p)}.$$

If we suppose the witnesses all equally credible, or that $v_1=v_2=v_3\ldots=v_x$, this becomes

$$\varpi_x=\frac{v_xp}{v^xp+(1-v)^x(1-p)}=\frac{1}{1+\left(\frac{1-v}{v}\right)^x\frac{1-p}{p}}.$$

Now, if $v=\frac{1}{2}$, then $(1-v)\div v=1$, and $\varpi_x=p$; whence it appears that the probability of an event is not increased by the testimony of any number of witnesses, when the veracity of each is only $\frac{1}{2}$; but when v is greater than $\frac{1}{2}$, the event becomes more probable as the number of witnesses is greater, and when v is a considerable fraction, its probability increases very rapidly with the number of witnesses.

70. When the values of v and p are given, that of x in the last formula may be found so as to render ϖ_x of any given value. Hence we may find the number of witnesses required to make it an even wager, whether an event exceedingly improbable, and in favour of which they give unanimous testimony, has happened or not. For example, let the odds against the event be a million million to one, that is, let $p=\frac{1}{1{,}000{,}000{,}000{,}001}=\frac{1}{10^{12}+1}$, and let v the veracity of each witness be $\frac{9}{10}$. In order that ϖ_x may equal $\frac{1}{2}$, we must have $\left(\frac{1-v}{v}\right)^x\frac{1-p}{p}=1$. Now $\frac{1-v}{v}=\frac{1}{9}$, and $\frac{1-p}{p}=10^{12}$, therefore $\left(\frac{1}{9}\right)^x\times10^{12}=1$; whence $x\log\frac{1}{9}=\log\frac{1}{10^{12}}$ or $x\log9=12$ and therefore $x=\frac{12}{\cdot95424}=12\cdot6$ nearly, so that 13 independent witnesses would suffice to render it more probable that the event really took place than that it did not.

This example is given by Mr. Babbage, (Ninth Bridgewater Treatise, Note E), with a view to shew the fallacy of Hume's celebrated argument respecting miracles. What the example proves is simply this, that if we suppose an urn to contain a million million of white balls, and only one black ball, and that on a ball being drawn at random from the urn, thirteen eyewitnesses of the drawing, each of whom makes only one false statement in ten, without collusion, and independently of each other, affirm to A, who was not present at the drawing, that the ball drawn was black, then A would have rather a stronger reason for believing than for disbelieving the testimony. But it is sufficiently obvious, that the event attested in this case, though exceedingly improbable *a priori*, cannot be regarded as in any way miraculous. On the contrary, the black ball might be drawn with the same facility, and was *a priori* as likely to be drawn, as any other *specified* ball in the urn. Let it be granted that an event is within the range of fortuitous occurrence, and that there exists a single chance in its favour out of any number of millions of chances, it may then happen in any one trial; nay, a number of trials may be assigned, such that its non-occurrence would be many times more improbable than the contrary.

71. Let us next consider the case of a number of witnesses contradicting each other. If the first witness announces an event of which the probability is p, then the probability, after the testimony, of its having happened is ϖ_1, and the probability that it has not happened $1-\varpi_1$. Suppose a second witness now to appear, and testify that the event has not happened, and let the probability of the truth of his testimony be denoted by ϖ'_2; then $1-\varpi_1$ being the probability before his testimony was given that what he asserts is true, and v_2 being the measure of his veracity, we have, as in (69), $\varpi'_2=\frac{v_2(1-\varpi_1)}{v_2(1-\varpi_1)+(1-v_2)\varpi_1}$, whence, since $\varpi_1=\frac{v_1p}{v_1p+(1-v)(1-p)}$, there results

$$\varpi'_2=\frac{(1-v_1)v_2(1-p)}{(1-v_1)v_2(1-p)+v_1(1-v_2)p}$$

for the measure of the probability that the event has not happened. The probability that it has happened is therefore $1-\varpi'_2$, and accordingly if ϖ'_2 be less than $\frac{1}{2}$, there is a stronger reason for believing that the event happened than that it did not. The method of forming the expression for the probability of the event, after it has been attested or denied by a third witness, or any number of successive witnesses, is obvious.

If we suppose the values of v_1 and v_2 to be equal, the expression becomes $\varpi'_2=1-p$, which is the *a priori* probability that the event did not happen. It is obvious that this must be the case, inasmuch as two contradictory testimonies of equal weight neutralize each other. In general, the probability of an event which is affirmed by m witnesses, and denied by n witnesses, all equally credible, is the same as that of an event which is affirmed by $m-n$ witnesses who agree in their testimony.

72. When a relation has been transmitted through a series of narrators, of whom the first only has a direct knowledge of the event, and each of the others derives his knowledge from the relation of the preceding, the probability of the event is diminished by every succeeding relation In order to obtain a general expression for the probability of traditionary testimony, we may take the event considered in (68), namely the extraction of a ball marked A_m from an urn containing s balls, of which a_1 are marked A_1, a_2 marked A_2,...a_n marked A_n, there being in all n different indices. Now suppose the relation to have passed through a chain of narrators, T, T_1, T_2,...T_x, in number $x+1$, of whom the first only was an eyewitness of the event, each of the others receiving his knowledge of it from the one preceding him, and communicating it in his turn to the succeeding, the question is to determine the probability that a ball marked A_m was drawn, after this event has been narrated by T_x, the last witness of the series.

73. In order to apply the general formula of (68) to this case, it is necessary to remark that the event observed is the attestation of T_x of his having been informed by T_{x-1} that the ball drawn from the urn, the drawing of which was seen by T, was marked A_m. There are n different hypotheses respecting the index of the ball actually drawn, but it is only necessary to consider two of them, namely, the hypothesis that the ball actually drawn was marked A_m, and any one of the other hypotheses which consist in supposing that a ball with a different index from A_m was drawn, for example A_r. Let the probability of the attestation, on the hy-

pothesis that the index of the ball drawn was A_m, be denoted by y_x, and its probability on the hypothesis that the index was A_i by y'_x, (y_x and y'_x corresponding to P_m and P_i in (68), which express the same probabilities in respect of the eyewitness T), then by (68), the probability of the hypothesis that A_m was drawn is

$$\varpi_m=\frac{\lambda_m y_x}{\lambda_m y_x+\Sigma\lambda_i y'_x}.$$

But since y'_x is the same for all the hypotheses that the index drawn was different from A_m, $\Sigma\lambda_i y'_x=y'_x\Sigma\lambda_i$; and by (68) $\Sigma\lambda_i=(s-a_m)\div s$, and $\lambda_m=a_m\div s$, therefore

$$\varpi_m=\frac{a_m y_x}{a_m y_x+(s-a_m)y'_x}.$$

We have now to find y_x and y'_x in terms of x. Let v, v_1, v_2, &c. be the respective probabilities of T, T_1, T_2, &c. speaking the truth, then the probability of T_x speaking the truth is v_x, and the probability that he does not $1-v_x$, whether because he is dishonest, and intends to deceive, or because he has mistaken the statement of the preceding witness. Now there are two ways in which it may happen that A_m is announced by T_x. First, if he speaks the truth, and has been informed by the preceding narrator T_{x-1} that A_m was the index drawn; secondly, if he lies, and has been informed by T_{x-1} that a different index from A_m was drawn. Assuming y_{x-1} to have the same signification with respect to T_{x-1} that y_x has been assumed to have with respect to T_x, (that is to say, the probability of the assertion being made by T_{x-1} on the hypothesis that the ball actually drawn was A_m), the probability of the first of these combinations is $v_x y_{x-1}$. With respect to the second case, it is to be observed, that if T_x announces a different index from that which has been announced to him by T_{x-1}, the chance of his announcing A_m out of $n-1$ indexes different from that announced by T_{x-1} is $1\div(n-1)$; and on multiplying this by the probability $1-v_x$ that the testimony of T_x is false, and by the probability $1-y_{x-1}$ that T_{x-1} has announced a different index from A_m, we have, for the probability of the second combination $(1-v_x)(1-y_{x-1})\div(n-1)$. The whole probability of T_x testifying that A_m was drawn, is therefore, on the first hypothesis, given by the equation,

$$y_x=v_x y_{x-1}+(1-v_x)(1-y_{x-1}):\cdot(n-1).$$

This is an equation of finite differences of the first order, the complete integral of which is

$$y_x=\frac{1}{n}+\frac{C(nv_1-1)(nv_2-1)\ldots(nv_{x-1}-1)(nv_x-1)}{(n-1)^x}.$$ [1]

In order to determine the arbitrary constant C, it is to be observed, that, since $y_1, y_2 \ldots y_x$, as well as $v_1, v_2 \ldots v_x$ apply to the narrators $T_1, T_2 \ldots T_x$ respectively, if we suppose $x=o$ the resulting value of the integral will be the probability that A_m was announced by the eyewitness T, on the hypothesis that A_m was actually drawn. Let this probability be P_m; then the equation becomes $P_m=C+1\div n$ whence $C=(nP_m-1)\div n$. If, therefore, we make.

$$X=\frac{(nv_1-1)(nv_2-1)\ldots(nv_{x-1}-1)(nv_x-1)}{(n-1)^x}$$

we obtain, on the first hypothesis, for any value of x,

$$y_x=\{1+(nP_m-1)X\}\div n$$

In the same manner we find the probability y'_x of the testimony given by T_x, on the hypothesis that the ball actually drawn was A_i. The probability of the event, after being testified by the eyewitness, being on this hypothesis P_i, we have,

$$y'_x=\{1+(nP_i-1)X\}\div n.$$

Substituting these values of y_x and y'_x in the expression above found for ϖ_m, we obtain for the probability of the event observed by T, and narrated by T_x, the narration having passed from one to another in the manner supposed,

$$\varpi_m=\frac{a_m\{1+n(P_m-1)X\}}{a_m\{1+(nP_m-1)X\}+(s-a_m)\{1+(nP_i-1)X\}}.$$

74. Since $\dfrac{nv_x-1}{n-1}=v_x-\dfrac{1-v_x}{n-1}$, and since v_x is always less than unity, and n always greater than unity, each of the terms of the series represented by X, whether positive or negative, is a proper fraction, whence the value of X becomes smaller and smaller as x increases. Suppose x infinite, then $X=0$, and $\varpi_m=a_m\div s$, which is the *a priori* probability of the event. Hence we see that the probability of an event transmitted through a series of traditionary evidence becomes weaker at every step, and ultimately equal to the simple probability of the event, independent of any testimony.

75. When the urn is supposed to contain only n balls, each having a different index, the expression for ϖ_m is greatly simplified; for, in this case, $a_m=1$, $s=n$; therefore, (since $P_m+(n-1)P_i=1$) the denominator becomes n, and we have consequently $\varpi_m=\{1+(nP_m-1)X\}\div n$, which coincides with the value of y_x found above, that is to say, with the probability of the event being testified by T_x on the hypothesis that it actually happened. Laplace, in solving this particular case of the problem, (p. 456) assumes that the probabilities here denoted by y_x and ϖ_m are identical. They are, however, as is evident from the above analysis, quite distinct in their nature, and their values are only equal in the particular case in which $s-a_m$ is to a_m in the ratio of $m-1$ to 1. (Poisson, p. 112.)

76. The question of determining the probability that the verdict of a jury is correct, is precisely analogous to that of finding the probability of an event attested by one or more witnesses. Let us first take the case of a single juror, and assume $u=$ the probability that the juror gives a correct verdict, (that is, correct in respect of the facts), and $p=$ the probability that the accused is guilty before being put on his trial. Suppose the verdict guilty to be returned; two hypotheses may be made respecting the cause of the verdict, first, that the accused is guilty; secondly, that he is innocent. On the first hypothesis, the accused will be condemned if the juror gives a right verdict, the probability of which is u. On the second hypothesis, the accused will be condemned if the juror gives a wrong verdict, the probability of which is $1-u$. But the *a priori* probabilities of these causes (the guilt or innocence of the accused) being respectively p and $1-p$, we have by (49)

$$\varpi_1=\frac{up}{up+(1-u)(1-p)},\qquad \varpi_2=\frac{(1-u)(1-p)}{up+(1-u)(1-p)},$$

ϖ_1 being the probability of the first hypothesis, or the probability that the accused is guilty after the verdict has been given, and ϖ_2 the probability resulting from the verdict that the accused is innocent.

77. Suppose the verdict not guilty to be given, and let ϖ'_1 and ϖ'_2 be the probabilities after the verdict of the two hypotheses. On the first hypothesis, namely, that the accused is guilty, this verdict will be given if the juror gives a wrong verdict, of which the probability is $1-u$; and on the second hypothesis, the verdict will be given if the juror gives a right verdict, of which the probability is u; and the

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[1] This is easily verified; for on changing x into $x-1$ in the integral, and forming the expression $v_x y_{x-1}+(1-v_x)(1-y_{x-1})\div(n-1)$, there results an identical equation.

probabilities of these hypotheses before the verdict being respectively p and $1-p$ as before, we have

$$\varpi'_1=\frac{(1-u)p}{(1-u)p+u(1-p)},\qquad \varpi'_2=\frac{u(1-p)}{(1-u)p+u(1-p)}.$$

From the above value of ϖ_1, we obtain $\varpi_1 - p = \frac{p(1-p)(2u-1)}{up+(1-u)(1-p)}$; a fraction which is positive or negative according as u is greater or less than $\frac{1}{2}$. Hence it appears that the guilt of the accused is only rendered more probable by the verdict guilty being pronounced, when the probability that the juror gives a correct verdict is greater than $\frac{1}{2}$. In like manner it is shewn that ϖ'_1 (the presumption of the guilt of the accused after a verdict of acquittal), is greater than p when u is less than $\frac{1}{2}$.

78. The *a priori* probability of the condemnation of the accused before he is put on his trial is $up+(1-u)(1-p)$; for there are two ways in which this condemnation may take place; first, if the accused be guilty, and the juror give a correct verdict, the probability of which concurrence is up; and, secondly, if the accused be innocent, and the juror give a wrong verdict, the probability of which is $(1-u)(1-p)$. Therefore, making $c =$ the probability of a verdict of condemnation, we have $c=up+(1-u)(1-p)$; and for a verdict of acquittal, $1-c=(1-u)p+u(1-p)$.

79. Let us next suppose that after the verdict of the first juror has been pronounced, the accused is put on his trial before a second juror, and let u_2 be the probability the second juror gives a correct verdict, and c_2 be the probability the accused will be pronounced guilty by him. After the verdict guilty has been pronounced by the first juror, the probability of the guilt of the accused is ϖ_1, and it is evident that c_2 will be found by substituting u_2 for u, and ϖ_1 for p in the above value of c, whence $c_2=u_2\varpi_1+(1-u_2)(1-\varpi_1)$. The probability of a verdict of condemnation by both jurors is cc_2; therefore, (observing that $\varpi_1=up\div c$), we have for this probability

$$cc_2=uu_2p+(1-u)(1-u_2)(1-p).$$

The probability of the guilt of the accused after a verdict of acquittal has been pronounced by the first juror being ϖ'_1, the probability of a verdict of acquittal being given by the second juror is $1-c_2=(1-u_2)\varpi'_1+u_2(1-\varpi'_1)$; therefore, (observing that $\varpi'_1=(1-u)p\div(1-c)$, we have for the probability of a verdict of acquittal by both jurors

$$(1-c)(1-c_2)=(1-u)(1-u_2)p+uu_2(1-p).$$

Adding the probability of a verdict of condemnation by both jurors, to that of acquittal by both, we have $uu_2+(1-u)(1-u_2)$ for the probability of both giving the same verdict. This result is independent of p, and is evidently true *a priori*, inasmuch as there are two ways in which the same verdict may be given, namely, when both jurors are right, and when both are wrong.

The probability of acquittal by the second juror, after a verdict of guilty by the first, is $1-c_2=(1-u_2)\varpi_1+u_2(1-\varpi_1)$; multiplying by c, and substituting for c and ϖ_1 their values, we have for the probability of a verdict of guilty by the first, and not guilty by the second,

$$c(1-c_2)=u(1-u_2)p+(1-u)u_2(1-p).$$

In like manner, if the accused has been acquitted by the first juror, the presumption of his guilt becomes ϖ'_1, and the probability of a verdict guilty by the second is $c_2=u_2\varpi'_1+(1-u_2)(1-\varpi'_1)$; therefore the probability of a verdict of not guilty by the first, and of guilty by the second is

$$(1-c)c_2=(1-u)u_2p+u(1-u_2)(1-p).$$

The sum of these two expressions gives for the probability of a discordant verdict, $u(1-u_2)+(1-u)u_2$.

80. If we now suppose $u=u_2$, and make $1-u=w$, the probability that the two jurors will agree in their verdict, whether they are both right or both wrong, is u^2+w^2; and the probability of a discordant verdict $uw+uw=2uw$. The sum of the two expressions is $u^2+2uw+w^2=(u+w)^2$; and therefore the probabilities of the different cases are respectively given by the development of the binomial $(u+w)^2$.

By pursuing this reasoning, it is easy to see that if there be any number h whatever of jurors, or voters on any question which admits only of simple affirmation or negation, all being supposed to possess the same integrity and knowledge, so that there is the same probability u of a correct decision in respect of each, the probablities of the different cases are found by the development of the binomial $(u+w)^h$. The probability of a correct verdict being pronounced unanimously is u^h; of an erroneous one being pronounced unanimously is w^h; and the probability that a correct verdict will be given by m of the jurors, and an erroneous one by n, is $\mathrm{U}u^mw^n$, where $\mathrm{U} = \frac{1.2.3\ldots\ldots h}{1.2.3\ldots m\times 1.2.3\ldots n}$.

81. The probability that the accused will be pronounced guilty by m jurors, and acquitted by n, on the supposition that the value of u is the same for each juror, is thus found. There are two ways in which this event may take place; 1st, if the accused be guilty (the probability of which is p), and m jurors decide correctly, and n wrongly (the probability of which is $\mathrm{U}u^mw^n$); the probability of the condemnation taking place in this way is therefore $\mathrm{U}u^mw^np$. 2d, If the accused be innocent (the probability of which is q) and n jurors decide rightly, and m wrongly (the probability of which is $\mathrm{U}u^nw^m$); the probability of the event taking place in this way is therefore $\mathrm{U}u^nw^mq$. Let G therefore denote the whole probability of the verdict, and we have

$$\mathrm{G}=\mathrm{U}(u^mw^np+u^nw^mq).$$

Hence the probability that the accused will be condemned unanimously by a jury consisting of h jurors is u^hp+w^hq; and the probability that he will be unanimously acquitted u^hq+w^hp.

82. Suppose the accused to have been pronounced guilty by m jurors, and not guilty by n jurors, the probability of the verdict of the majority being correct is found from the formula in (49). Two hypotheses may be made: 1st, the accused is guilty; 2d, he is innocent. The probability P_1 of the observed event (the condemnation by m, and acquittal by n jurors) on the first hypothesis is $\mathrm{U}u^mw^n$; and the *a priori* probabilities of the two hypotheses (or the probabilities denoted by λ_1 and λ_2 in (49), being p and q; therefore if ϖ_1 denote the probability of the verdict being correct, that is, the probability of the first hypothesis after the verdict has been pronounced, and ϖ_2 the probability of its being wrong, we shall have (49)

$$\varpi_1=\frac{u^mw^np}{u^mw^np+u^nw^mq},\qquad \varpi_2=\frac{u^nw^mq}{u^mw^np+u^nw^mq}.$$

If the verdict has been pronounced unanimously, then $m=h$ and $n=0$, and the formulæ become

$$\varpi_1=\frac{u^hp}{u^hp+w^hq},\qquad \varpi_2=\frac{w^hq}{u^hp+w^hq}.$$

If $p=q=\frac{1}{2}$, and $m-n=i$, we have then

$$\varpi_1=\frac{u^{n+i}w^n}{u^{n+i}w^n+u^nw^{n+i}}=\frac{u^i}{u^i+w^i}.$$

But this is the probability of a verdict being correct which has been pronounced unanimously by i jurors; whence it follows that the probability of a decision rendered by a given majority being correct, is the same as that of a decision rendered unanimously by a jury equal in number to the difference between the majority and minority, and is therefore independent of the total number of jurors. This, however, is only true on the supposition that the value of u is known *a priori*; for if u be not absolutely known, the weight of the verdict depends on the ratio of the majority to the whole number of jurors. This is in accordance with common notions, for it will readily be admitted that a verdict given unanimously by a jury of 10 will be entitled to much more weight than one pronounced by a jury consisting of a large number, as 100, in which 55 are of one opinion, and 45 of the opposite. In this case, the opinion of the minority throws great doubt on the correctness of the verdict. It is to be observed, however, that the probability of a verdict being given by a small majority becomes less and less as the number of jurors is increased.

83. When the number who dissent from the opinion of the majority is unknown, and we merely know that the majority exceeds the minority by *at least i* jurors, the probability of the verdict being correct is found as follows. Suppose the verdict to be guilty. On the hypothesis that it is correct, the probability of the accused being found guilty by $h-x$, and not guilty by x jurors, is by the formula in (80), $\mathrm{U}u^{h-x}w^{x}$. Now, if we give x successively all the values $0, 1, 2, \ldots n$, where $n=\frac{1}{2}(h-i)$, and assume U_0 to denote the value of U when $x=0$, U_1 its value when $x=1$, and so on; and also make W = the probability of the accused being pronounced guilty by $h-n$ *at least*, we shall have

$$\mathrm{W}=\mathrm{U}_0u^{h}+\mathrm{U}_1u^{h-1}w+\mathrm{U}_2u^{h-2}w^{2}\ldots\ldots+\mathrm{U}_nu^{h-n}w^{n}.$$

In like manner, if W′ denote the probability of a verdict guilty by $h-n$ jurors *at least*, on the hypothesis that the accused is not guilty, we shall have,

$$\mathrm{W}'=\mathrm{U}_0w^{h}+\mathrm{U}_1uw^{h-1}+\mathrm{U}_2u^{2}w^{h-2}\ldots\ldots+\mathrm{U}_nu^{n}w^{h-n};$$

whence, p and q being as above the *a priori* probabilities of the two hypotheses, the probability that the verdict guilty is correct, when pronounced by $h-n$ jurors at least, becomes $\mathrm{W}p\div(\mathrm{W}p+\mathrm{W}'q.)$

84. It is evident that no application can be made of these formulæ without assigning arbitrary values to u and p, unless, indeed, we have data for determining their mean values from experience. With respect to p, we may assume, for the sake of shewing the general consequences of the formulæ, its value to be $\frac{1}{2}$; for it cannot well be supposed less than $\frac{1}{2}$, or that a person brought before a jury is more likely to be innocent than guilty; and if it much exceeds $\frac{1}{2}$ and approaches to unity, a verdict of guilty may be expected from any jury, however constituted. When a mean value of u cannot be determined from experience, the only way of obtaining numerical results, is to suppose u to have all possible values within given limits, and to integrate the equations between those limits. As it seems unreasonable to suppose that a juror is more likely to give a wrong verdict than a right one, we may assume that u cannot be less than $\frac{1}{2}$. Suppose, then, that u increases by infinitely small increments from $u=\frac{1}{2}$ to $u=1$, and let it be proposed to determine the probability that a decision is correct when the accused has been pronounced guilty by m jurors, and not guilty by n. Here an infinite number of hypotheses may be made respecting the value of u, and we must therefore have recourse to the formulæ in (51.) Let $u=x$ be one of those hypotheses, $\mathrm{P}_x=$ the probability on that hypothesis of the event observed (that is, of the accused being pronounced guilty by m, and not guilty by n jurors,) $\varpi_x=$ the probability of the assumed hypothesis, and $\Pi=$ the mean probability of the correctness of the verdict from all the hypotheses. By the formulæ in (81) we have

$$\mathrm{P}_x=\mathrm{U}\left\{x^{m}(1-x)^{n}p+x^{n}(1-x)^{m}(1-p)\right\},$$

and as all the hypotheses are supposed equally probable, we have (45) $\varpi_x=\mathrm{P}_x\div\Sigma\mathrm{P}_i$. But between the proposed limits $\Sigma\mathrm{P}_x=p\int_{\frac{1}{2}}^{1}x^{m}(1-x)^{n}dx+(1-p)\int_{\frac{1}{2}}^{1}x^{n}(1-x)^{m}dx$; if, therefore, we make $p=\frac{1}{2}$, we shall have by reason of $\int_{\frac{1}{2}}^{1}x^{n}(1-x)^{m}dx=\int_{\frac{1}{2}}^{1}x^{m}(1-x)^{n}dx$, $\Sigma\mathrm{P}_x=\frac{1}{2}\int_{0}^{1}x^{m}(1-x)dx$, and therefore

$$\varpi_x=\frac{x^{n}(1-x)^{n}+x^{n}(1-x)^{m}}{\int_0^1x^{m}(1-x)^{n}dx},$$

for the probability of the hypothesis. But (82) the probability on this hypothesis of the accused being guilty, is $\frac{x^{m}(1-x)^{n}}{x^{m}(1-x)^{n}+x^{n}(1-x)^{m}}$; multiplying this by the probability of the hypothesis, ϖ_x, we obtain for the probability of the verdict being correct $x^{m}(1-x)^{n}\div\int_0^1x^{m}(1-x)^{n}dx$; and, therefore, for the probability of the verdict being correct on all the hypotheses from $x=\frac{1}{2}$ to $x=1$,

$$\Pi=\frac{\int_{\frac{1}{2}}^{1}x^{m}(1-x)^{n}dx}{\int_0^1x^{m}(1-x)^{n}dx}.$$

Hence the probability that a verdict given by a majority m out of $m+n=h$ jurors is wrong, is

$$1-\Pi=\frac{\int_0^{\frac{1}{2}}x^{m}(1-x)^{n}dx}{\int_0^1x^{m}(1-x)^{n}dx},$$

which, on effecting the integrations by the formula in (51) becomes after reduction

$$1-\Pi=\frac{1}{2^{h+1}}\left\{1+\frac{h+1}{1}+\frac{(h+1)h}{1\cdot2}+\frac{(h+1)h(h-1)}{1\cdot2\cdot3}\ldots\ldots+\frac{(h+1)h(h-1)\ldots\ldots(h-n+2)}{1\cdot2\cdot3\ldots\ldots\ldots\ldots\ldots n}\right\}.$$

Assuming h (the number of jurors) $=12$, and making n successively 0, 1, 2, 3, 4, 5, the series gives

$$\frac{1}{8192},\quad\frac{14}{8192},\quad\frac{92}{8192},\quad\frac{378}{8192},\quad\frac{1093}{8192},\quad\frac{2380}{8192},$$

for the respective probabilities of the error of a verdict when pronounced unanimously by 12 jurors, by a majority of 11 to 1, of 10 to 2, of 9 to 3, of 8 to 4, and of 7 to 5. In the last case the probability of the error is nearly $=\frac{2}{7}$.

85. From these results it appears that the chance of a verdict being wrong which has been pronounced unanimously by twelve jurors is very small; but it is to be remarked, that they have been deduced on the supposition that the unanimity proceeds from agreement in the same opinion, and that the jurors are unbiassed by each other. In this country, where unanimity is compelled by law, the mean probability of a correct verdict can scarcely be considered as greater than that of a verdict pronounced by a simple majority; for, though in most cases the verdict may be supposed to represent the opinion of a larger majority than seven, it may happen, not unfrequently, that a smaller number than five, possessing greater energy or perseverance, may persuade the others into a surrender of their judgment. In fact, unless the presumption of the guilt of the accused be very great, it would scarcely be possible, without concert, to procure an unanimous verdict in any case. It is also to be observed, that the assumption of all values of u from $\frac{1}{2}$ to 1 being equally probable, may lead to results widely different from the truth. The mean value of u, which depends on the general intelligence of the class of persons from amongst whom the lists of jurors are made up, can only be rightly determined from data furnished by experience. One of the elements, however, which require to be known for this purpose, is the number of jurors who concur in and dissent from, the verdict. The forced unanimity of the law renders it impossible to obtain this element from the records of the English courts; but in France and Belgium, where the majority and minority are known and recorded, the same obstacle does not exist, and the "*Comptes Généraux de l'Administration de la Justice Criminelle*," published by the French Government, have enabled Poisson to deduce mean values of u and p for that country, and consequently to obtain the necessary data for one of the most interesting applications of the theory of Probabilities. The general results were as follows: During

the six years from 1825 to 1830 inclusive, the system of criminal legislation in France underwent no change; the jury consisted of 12, and a simple majority was only required to concur, though when it happened that the majority was the least possible, the Court had power to overrule the verdict. On comparing, according to the rules of the theory, the verdicts given in the cases tried before the criminal courts during those six years, it was found that for the whole of France, the probability (u) of a juror giving a correct verdict was a little greater than $\frac{2}{3}$ with respect to crimes against the person, and nearly equal to $\frac{15}{17}$ with respect to crimes against property; without distinction of the species of crime, it was found to be a very little below $\frac{3}{4}$. The other element, the probability (p) of the guilt of the accused before the trial, was found not much to exceed $\frac{1}{2}$ (being between 0.53 and 0.54) with respect to crimes against the person, while it a little exceeded $\frac{2}{3}$ in respect of crimes against property. Without distinction of crime, its value was very nearly 0.64.

86. On substituting these values of u and p (namely $u=\frac{3}{4}$, $p=.64$, whence $w=\frac{1}{4}$, $q=.36$) in the formula in (81), and making $m=7$, $n=5$, and consequently $\mathrm{U}=\frac{1.2.3......12}{1.2.3...7\times1.2.3...5}=792$, we have $\mathrm{G}=\frac{792}{4^{12}}(3^7\times.64+3^5\times.36)=.07$ nearly. Hence it may be expected, that in a hundred trials it will happen only seven times that the accused will be pronounced guilty by the smallest possible majority. If $m=12$, and $n=0$, we shall have $u^hp+w^hq=.02027=\frac{1}{50}$ nearly, for the probability of an unanimous verdict of guilty, and $u^hq+w^hp=.0114$ for the probability of an unanimous verdict of not guilty.

Making the same substitutions in the formula in (82), we have for the probability of a verdict guilty being correct, from which 5 jurors out of 12 dissent, $\varpi_1=\frac{16}{17}$; and $\varpi_2=\frac{1}{17}$ for the probability of its being wrong.

Substituting the same values in the series represented by W and W′ in (83), and supposing n to have all values from $n=0$ to $n=5$, there results $\mathrm{W}=\frac{3^7}{4^{12}}\times7254$, $\mathrm{W}'=\frac{1}{4^{12}}\times239122$, whence $\frac{\mathrm{W}p}{\mathrm{W}p+\mathrm{W}q}=\frac{126915984}{127992033}=\frac{118}{119}$ nearly. This is the probability that a verdict guilty, pronounced by a majority of seven against five *at least*, is correct. The probability of the same verdict being wrong, is therefore $\frac{1}{119}$; so that out of 119 verdicts, respecting which we know nothing else, than that seven at least of the jury concurred in finding the accused guilty, we may expect one to be wrong, or that one person out of 119 so condemned will be innocent.

SECT. VIII. OF THE SOLUTION OF QUESTIONS INVOLVING LARGE NUMBERS.

87. The probabilities of the different compound events which can result from the combination of any number of simple events, E_1, E_2, E_3, &c. being (13) measured respectively by the several terms of the developement of the multinomial $(p+q+r+\&c.)^h$, the most probable of those compound events will be that which corresponds to the term having the greatest numerical value. Let us consider the case of two simple contrary events E and F, the probabilities of which are respectively p and q, and suppose the number of occurrences to be 4. Neglecting the order of occurrence, the different combinations, with their respective probabilities, are the following:

$$\begin{array}{ccccc}\mathrm{EEEE}, & \mathrm{EEEF}, & \mathrm{EEFF}, & \mathrm{EFFF}, & \mathrm{FFFF}, \\ p^4, & 4p^3q, & 6p^2q^2, & 4pq^3, & q^4.\end{array}$$

Now it is evident that the numerical values of these probabilities depend on the ratio of p to q, as well as on the coefficient by which they are multiplied, and that values may be given to p and q, such that any one of the terms may be made the greatest or the least in the series. If we suppose $p=q$, and consequently $p=\frac{1}{2}$, $q=\frac{1}{2}$, (since $p+q=1$) the probabilities of the different cases become respectively

$$\tfrac{1}{16},\quad \tfrac{4}{16},\quad \tfrac{6}{16},\quad \tfrac{4}{16},\quad \tfrac{1}{16};$$

whence it appears, that the most probable combination is that which corresponds to $6p^2q^2$, or in which each of the simple events occurs twice, the probability of this combination being $\frac{6}{16}$, while that of either of the simple events occurring four times in succession is only $\frac{1}{16}$.

When the number of trials is 5, the probabilities of the several cases are respectively

$$p^5,\quad 5p^4q,\quad 10p^3q^2,\quad 10p^2q^3,\quad 5pq^4,\quad q^5,$$

which, when $p=q$, become

$$\tfrac{1}{32},\quad \tfrac{5}{32},\quad \tfrac{10}{32},\quad \tfrac{10}{32},\quad \tfrac{5}{32},\quad \tfrac{1}{32},$$

so that there are two different combinations equally probable, namely, that in which E occurs three times and F twice, and that in which E occurs twice and F three times; and of the six possible combinations these two are the most probable, having in their favour a number of chances twice as great as the two cases in which one of the events occurs only once, and the other four times, and ten times greater than the two cases in which either of the simple events occurs in each of the five trials.

From these two instances it may be inferred in general, that when h is an even number, the most probable compound event is that of which the probability is represented by the middle term of the developement of $(p+q)^h$; and that when h is an odd number, there are two compound events equally probable, and more probable than any other, namely, those corresponding to the terms which occupy the middle of the series, supposing in both cases $p=q$. This supposition gives $(p+q)^h=(1+1)^h(\frac{1}{2})^h$; therefore in the case in which h is an even number, the general expression for the greatest term is

$$\frac{h(h-1)(h-2)......(h-\frac{1}{2}h+1)}{1.2.3\quad......\quad\frac{1}{2}h}(\tfrac{1}{2})^h;$$

and when h is odd, the general expression for either of the two equal terms, which are greater than any of the other terms, is

$$\frac{h(h-1)(h-2)......\{h-\frac{1}{2}(h+1)+1\}}{1.2.3\quad......\quad\frac{1}{2}(h+1)}(\tfrac{1}{2})^h.$$

88. When p and q are unequal, the greatest term of the expansion of $(p+q)^h$ will not occupy the middle of the series, but its place may be found by comparing two consecutive terms. Let $h=m+n$. The general term of the series then becomes

$$\frac{1.2.3.........h}{1.2.3......m\times1.2.3......n}p^mq^n;$$

and the term immediately preceding is

$$\frac{1.2.3.........h}{1.2.3......(m+1)\times1.2.3......(n-1)}p^{m+1}q^{n-1}.$$

Dividing the first of these by the second, we get for the quotient $(m+1)q\div np$, which, therefore, is the ratio of two consecutive terms taken at any part of the series. If this ratio be greater than 1, the term which has been taken as the dividend is greater than the preceding one which has been taken as the divisor; and it is evident that the terms must go on increasing, from the beginning of the series, so long as the ratio in question is greater than 1. But if the ratio be less than 1, the preceding term is greater than the succeeding, and the terms will become less and less as they are nearer the end of the series. Let $(m+1)q\div np=1$; then, since $p+q=1$, and $m+n=h$, we have $n=(h+1)q$, and consequently the ratio of any term to the next preceding is greater or less than 1 according as n is less or greater than $(h+1)q$. Now n is necessarily a whole number; therefore if $(h+1)q$ be a whole number, take $n=(h+1)q$, and the two terms of the series given by the expansion of $(p+q)^h$, in which the exponents of q are $n-1$ and n, will be equal to each other, and each greater than any other term of the series. But if $(h+1)q$ be not a whole number, let $(h+1)q-x$ be the nearest whole number *less* than $(h+1)q$, and make $n=(h+1)q-x$; then the greatest term of the developement will be that in which the exponent of q is n.

Since $n=(h+1)q-x$, we have $q=(n+x)\div(h+1)$, whence

$$p=1-\frac{n+x}{h+1}=\frac{m+1-x}{h+1}, \text{ and therefore } \frac{q}{p}=\frac{n+x}{m+1-x}.$$

Now x is by hypothesis less than 1, therefore if m and n are large numbers, we have, very nearly, $q:p=n:m$; or, since $m+n=h$, $m=hp$, $n=hq$. It follows therefore, that the greatest term of the developement of the binomial $(p+q)^h$ is that in which the exponents of p and q are to each other in the ratio of p to q, or more nearly in that ratio than are any other two numbers whose sum is h. In other words, the most probable combination of two simple events, E and F, in any number of trials, is that in which the number of occurrences of E is to the number of occurrences of F in the ratio of their respective probabilities.

89. In the same manner it may be shewn, that when there are more than two simple events, of which one must occur in every trial, the most probable result of any number of trials is that combination in which the number of repetitions of each simple event is in proportion to its probability in a single trial. Thus, the probabilities of the simple events being respectively p, q, r, &c. the most probable compound event is that whose probability is expressed by that term of the expansion of $(p+q+r+\&c.)^h$, which has for its argument p^{hp}, q^{hq}, r^{hr}, &c.

90. Having determined the form of the greatest term of the series, we have next to find a method of approximating to its numerical value; for its coefficient containing the product of the natural numbers from 1 to h inclusive, its direct calculation becomes impracticable even when h is only a moderately large number. The theorem which gives the approximate value of this product is known by the name of *Stirling's Theorem*, having been discovered by that mathematician. As its investigation is a matter of pure analysis, we shall not stop to give it here, but refer the reader to the *Treatise on Differences and Series*, by Sir John Herschel, in the translation of Lacroix's *Elementary Treatise on the Differential and Integral Calculus*, p. 568.[1] The theorem is as follows: Let x be any number, then

$$1.2.3\ldots\ldots x=x^xe^{-x}\sqrt{2\pi x}\left(1+\frac{1}{12x}+\frac{1}{288x^2}+\&c.\right)$$

where e is the number of which the Napierean logarithm is unit, or the number 2·71828, and π the ratio of the circumference of a circle to the diameter, or 3·14159.

When x is a large number, the term divided by $12x$ becomes very small, and the series within the brackets may be considered as equal to unity. In this case, then, the formula becomes

$$1.2.3\ldots\ldots x=x^xe^{-x}\sqrt{2\pi x},$$

which gives a sufficient approximation in most cases. If, for example, $x=1000$, the result will be within a 12000th part of the truth.

Now, let E and F be two events of such a nature that the one or the other must happen in every trial; let p and q be their respective probabilities, and P the probability that in $m+n=h$ trials, E will happen m times and F n times; then by (12) we have

$$\mathrm{P}=\frac{1.2.3\ldots\ldots\ldots h}{1.2.3\ldots\ldots m\times1.2.3\ldots\ldots n}p^mq^n.$$

When m, n, and h are large numbers, the value of this coefficient may be computed from the above formula, which gives

$$1.2.3\ldots\ldots h=h^he^{-h}\sqrt{2\pi h},$$
$$1.2.3\ldots\ldots m=m^me^{-m}\sqrt{2\pi m},$$
$$1.2.3\ldots\ldots n=n^ne^{-n}\sqrt{2\pi n},$$

whence

$$\mathrm{P}=\frac{h^he^{-h}\sqrt{h}}{m^mn^ne^{-(m+n)}\sqrt{(2\pi mn)}}p^mq^n=\left(\frac{hp}{m}\right)^m\left(\frac{hq}{n}\right)^n\sqrt{\frac{h}{2\pi mn}}.$$

This expression represents any term of the series $(p+q)^h$. The greatest term, which corresponds to the most probable result, is (88) that in which m and n are to each other in the ratio of p to q, or when $m=hp$, and $n=hq$. Let the greatest term therefore be denoted by P_o, that is to say, let P_o be the chance of the most probable result of h trials, and we shall have

$$\mathrm{P}_o=\sqrt{(h\div2\pi mn)}, \text{ or } \mathrm{P}_o=\sqrt{(1\div2\pi hpq)}.$$

This last formula shews that the absolute probability of that combination which has the greatest number of chances in its favour becomes less and less as the number of trials is increased; for the fraction $1\div h$, to the square root of which the probability is proportional, diminishes as h is increased.

91. As an example, suppose a shilling to be tossed 100 times in succession. In this case $p=q=\frac{1}{2}$, $hp=50$, $hq=50$, and the most probable result of the trials is 50 times head and 50 times tail. We have then $h=100$, $m=50$, and $\sqrt{(h\div2\pi mn)}=1\div\sqrt{(50\pi)}$ for the measure of the probability that the event will happen in this way exactly. On calculation, this is found $=.07979$; whence it appears, that although 50 heads and 50 tails is a more probable result of 100 trials than any other combination which can be named, its absolute probability is measured by a very small fraction. The probability of the contrary event, or that there will not be thrown 50 heads and 50 tails exactly, is $1-.07979=.92021$, so that the odds against the event are about 92 to 8, or 23 to 2. Had the number of trials been 1000, the probability of 500 times head and 500 times tail exactly, though more likely to occur than any other combination, would have been found $1\div\sqrt{(500\pi)}$; that is to say, $\sqrt{10}$ times, or rather more than 3 times less than in the former case. In general, when the chances in favour of the simple events are equal, the probability of the combination which is more likely to happen than any other, is inversely proportional to the square root of the number of trials.

92. The formulæ in (90) enable us also to determine the ratio of the greatest term of the developement of $(p+q)^h$ to any other term of the series, and consequently the relation of the probabilities of the different compound events. Let $m:n::p:q$, whence $m=hp$ and $n=hq$, and let P_x denote the probability that in h trials the event E will occur $(m-x)$ times, and the event F $(n+x)$ times, the probabilities of the simple events E and F being respectively p and q. By (13) we have

$$\mathrm{P}_x=\frac{1.2.3\ldots\ldots\ldots h}{1.2.3\ldots\ldots(m-x)\times1.2.3\ldots\ldots(n+x)}p^{m-x}q^{n+x},$$

which by (90) becomes

$$\mathrm{P}_x=\frac{h^he^{-h}\sqrt{(2\pi h)}}{(m-x)^{m-x}e^{-(m-x)}\sqrt{2\pi(m-x)}\times(n+x)^{n+x}e^{-(n+x)}\sqrt{2\pi(n+x)}}$$

$\times p^{m-x}q^{n+x}$; whence, substituting $m\div h$ for p, and $n\div h$ for q, and leaving out the factors common to the numerator and denominator, we find,

$$\mathrm{P}_x=\sqrt{\left(\frac{h}{2\pi}\right)}(m-x)^{-m+x-\frac{1}{2}}(n+x)^{-n-x-\frac{1}{2}}m^{m-x}n^{n+x}.$$

---

[1] Stirling's investigation of the theorem, or rather of its equivalent, to find the sum of the logarithms of a series of numbers in arithmetical progression, is given in his *Methodus Differentialis*, p. 135.

Now $\log(m-x)^{-m+x-\frac{1}{2}}=(-m+x-\tfrac{1}{2})\log(m-x)$; and

$$\log(m-x)=\log m-\frac{x}{m}-\frac{x^2}{2m^2}-\&c.$$

therefore $\log(m-x)^{-m+x-\frac{1}{2}}=$

$$(-m+x-\tfrac{1}{2})\log m-(-m+x-\tfrac{1}{2})\left(\frac{x}{m}+\frac{x^2}{2m^2}+\&c.\right);$$

whence, neglecting terms divided by m^2, m^3, &c., m being supposed to be a large number in comparison with x,

$$\log(m-x)^{-m+x-\frac{1}{2}}=(-m+x-\tfrac{1}{2})\log m+x-\frac{x^2}{2m}+\frac{x}{2m};$$

therefore, on passing to numbers,

$$(m-x)^{-m+x-\frac{1}{2}}=m^{-m+x-\frac{1}{2}}\times e^{x-\frac{x^2}{2m}}\times e^{\frac{x}{2m}};$$

or, since $e^{\frac{x}{2m}}=1+\dfrac{x}{2m}+\dfrac{x^2}{2\,.\,4m^2}+\&c.$

$$(m-x)^{-m+x-\frac{1}{2}}=m^{-m+x-\frac{1}{2}}e^{x-\frac{x^2}{2m}}\left(1+\frac{x}{2m}\cdots\right).$$

In like manner, by changing m into n, and x into $-x$, we get

$$(n+x)^{-n-x-\frac{1}{2}}=n^{-n-x-\frac{1}{2}}e^{-x-\frac{x^2}{2m}}\left(1-\frac{x}{2n}\cdots\right).$$

Multiplying the first of these two expressions by m^{m-x}, and the second by n^{n+x}, we have

$$(m-x)^{-m+x-\frac{1}{2}}\times m^{m-x}=m^{-\frac{1}{2}}e^{x-\frac{x^2}{2m}}\left(1+\frac{x}{2m}\cdots\right)$$

$$(n+x)^{-n+x-\frac{1}{2}}\times n^{n+x}=n^{-\frac{1}{2}}e^{-x-\frac{x^2}{2n}}\left(1-\frac{x}{2n}\cdots\right),$$

whence, substituting these values in that of P_x, and neglecting the quantity divided by mn,

$$P_x=\sqrt{\left(\frac{h}{2\pi mn}\right)}\,e^{-\frac{x^2}{2m}-\frac{x^2}{2n}}=\sqrt{\left(\frac{h}{2\pi mn}\right)}\,e^{-\frac{hx^2}{2mn}}.$$

The term of the series $(p+q)^h$ which corresponds to this value of P_x is that which is x places to the right of the greatest term; and it has been shewn, (90), that the greatest term has for its expression $\sqrt{(h\div 2\pi mn)}$; therefore the greatest term being denoted, as before, by P_o, and the term which comes after it x places by P_x, we have

$$P_x=P_o e^{-hx^2\div 2mn},$$

that is to say, the probability the event E will happen m times and fail n times in $m+n$ trials, is to the probability of its happening $(m-x)$ times and failing $(n+x)$ times in the ratio of 1 to $e^{-hx^2\div 2mn}$.

Since the numbers m and n enter symmetrically into the expression $e^{-hx^2\div 2mn}$, it is evident that the result would have been the same if, instead of seeking the ratio of the greatest term to that which succeeds it by x places, we had sought the ratio of the greatest term to that which precedes it by x places. Hence if the most probable result of $m+n$ trials be that E will happen m times and fail n times, the probability that it will happen $m-x$ times and fail $n+x$ times is the same as the probability that it will happen $m+x$ times and fail $n-x$ times.

The following example will suffice to shew the application of the formula: A die is thrown 6000 times, required the probability that the number of aces turned up will be exactly 960?

Here p, the chance of throwing ace, is $\frac{1}{6}$, $q=\frac{5}{6}$, and $h=6000$; whence $m=hp=1000$, and $n=hq=5000$. We have first to find P_o, the chance of the most probable result, or of 1000 aces. By (90), $P_o=\sqrt{(h\div 2\pi mn)}$; whence, substituting the above values, $P_o=\sqrt{3}\cdot\sqrt{(5000\times 3.14159)}$. On performing the operation indicated by the logarithmic tables, we get $\log P_o=8.14050$, whence $P_o=.0138$.

The calculation of $e^{-hx^2\div 2mn}$ is as follows: Assume $t^2=hx^2\div 2mn$. We have $x=1000-960=40$.

$$\begin{array}{r}
\log 40=1.60206\\
2\\
\hline
3.20412\\
\log h=\log 6000=3.77815\\
\hline
\log hx^2=6.98227\\
\log 2mn=\log 10{,}000{,}000=7\\
\hline
\log t^2=9.98227\\
\log e=.43429,\ \log .43429=9.63778\\
\hline
\log(t^2\times .43429)=9.62005\\
t^2\times .43429=t^2\log e=\ .41692\\
-t^2\log e=9.58308\\
\text{add}\ \log P_o=8.14050\\
\hline
\log P_x=7.72358
\end{array}$$

therefore $P_x=.0053$, which is the chance of 960 aces exactly. The odds against this event are therefore 9947 to 53, or nearly 188 to 1.

93. When h, m, and n are large numbers, and x is small, the exponential $e^{-hx^2\div 2mn}$ differs little from unity, and it decreases slowly as x increases, so long as x is small in comparison of m and n. Suppose $m=n$ and $x=\sqrt{m}$, it becomes $e^{-1}=\dfrac{1}{e}=\dfrac{1}{2{\cdot}7182818}$; so that if we assume $m=100$, the 10th term before or after the greatest would still exceed the 3d part of the greatest. But when x becomes greater than $\sqrt{m}$ or $\sqrt{n}$ the exponential, and consequently also the terms which are multiplied by it, begin to diminish with great rapidity, and the diminution is more rapid as x increases. If $m=n=100$, and $x=50$, then the exponent $hx^2\div 2mn=25$, so that $e^{-hx^2\div 2mn}$, $=1\div e^{25}$, a quantity which is altogether insensible. We may therefore conclude generally that when h is a large number, the principal terms of the developement of $(p+q)^h$ are those which are near the greatest term, and that h may be taken so large that the terms towards the beginning or end of the series may at length become smaller than any assignable quantity.

94. From the proposition which has now been demonstrated it follows, that although the probability of that particular compound event which has the greatest number of chances in its favour is very small when the number of trials is great, yet on account of the rapid diminution of the terms towards the beginning and end of the series, the sum of a comparatively small number of terms taken on both sides of the greatest, may be very much greater than all the remaining terms of the series; and, consequently, there will be a very great probability that the compound event will be represented by one or other of those terms. This consideration leads us to one of the most important questions in the theory, namely, to determine the probability that in a large number of trials, h, an event E, which must either happen or fail in each trial, and of which the chance of happening in any trial is p, will happen not less than $hp-l$ times, and not oftener than $hp+l$ times; or, making $hp=m$, $hq=n$, to determine the probability that the number of occurrences of E will be included between the limits $m\pm l$.

Let x be any number between 0 and l. Then (92) the probability that E will occur $(m-x)$ times and fail $(n+x)$ times is $P_x=P_o e^{-hx^2\div 2mn}$(where $P_o=\sqrt{(h\div 2\pi mn)}$. Now if in this expression we make x successively equal to each of the numbers 0, 1, 2,...l, we shall have the respective probabilities of E happening m, $m-1$, $m-2$,......$m-l$ times in h trials; and the sum of these probabilities will be the probability that E happens *not oftener* than m times, and *not seldomer* than $m-l$ times. The same suppositions with respect to x will give the probabilities of E happening $m, m+1, m+2, \ldots m+l$ times, the sum of which will be the probability that E happens *not seldomer* than m times, and *not oftener* than $m+l$ times. Adding, therefore, those two sums, and deducting P_0 the probility which corresponds to $x=0$, on account of its being included in each sum, and therefore having been counted twice, the result will be the sum of the terms of the binomial $(p+q)^h$ comprised between, and including, the two terms of which the first has for a factor p^{m+l}, and the last p^{m-l}, and will therefore express the probability that the number of occurrences of E will fall within the limits $m \pm l$. Let this probability be denoted by R, and let SP_x represent the sum of all the values of P_x obtained by substituting successively 0, 1, 2, 3,...l for x, we then have $R=2SP_x-P_0$, whence, writing for P_x and P_0, their values,

$$R=2S\sqrt{\left(\frac{h}{2\pi mn}\right)}e^{-\frac{hx^2}{2mn}}-\sqrt{\frac{h}{2\pi mn}}.$$

95. In order to find an approximate value of this expression we must have recourse to a formula first given by Euler for converting sums of the kind denoted by S into definite integrals (for which see Lacroix, *Traité du Calcul Différentiel et Intégral*, tom. iii. p. 136, or Herschel's *Treatise on Differences*, p. 513). Assuming u to denote a function of x, the formula is as follows:

$$Su=\int udx+\frac{1}{2}u+\frac{1}{1.2.6}\frac{du}{dx}+\text{\&c.}+\text{constant.}$$

On making $u=P_x=P_0e^{-hx^2\div 2mn}$, we find $\frac{du}{dx}=-\frac{P_0hx}{mn}e^{-hx^2\div 2mn}$; therefore, if we suppose x to be not greater than $\sqrt{m}$ or $\sqrt{n}$, this differential coefficient is of the order $1\div h$, (as may be easily shewn by substituting hp for m, and hq for n), and may be rejected, since h is supposed to be a very large number. The above equation therefore becomes

$$SP_x=P_0\int e^{-hx^2\div 2mn}dx+\tfrac{1}{2}P_0e^{-hx^2\div 2mn}+\text{constant};$$

and on supposing $x=0$ this gives $0=-\frac{1}{2}P_0+$ constant, therefore the constant is equal to $\frac{1}{2}P_0$, and we have

$$SP_x=P_0\int e^{-hx^2\div 2mn}dx+\tfrac{1}{2}P_0e^{-hx^2\div 2mn}+\tfrac{1}{2}P_0.$$

Assume $t=x\sqrt{(h\div 2mn)}$, whence $dt=dx\sqrt{(h\div 2mn)}$; substitute these in the above equation, and it becomes by reason of $P_0=\sqrt{(h\div 2\pi mn)}$,

$$SP_x=\frac{1}{\sqrt{\pi}}\int e^{-t^2}dt+\tfrac{1}{2}P_0e^{-t^2}+\tfrac{1}{2}P_0,$$

whence, from the equation $R=2SP_x-P_0$, we obtain

$$R=\frac{2}{\sqrt{\pi}}\int e^{-t^2}dt+P_0e^{-t^2}.$$

The integral in this expression must be taken between the limits $x=0$ and $x=l$. When $x=0$ we have also $t=0$, and when $x=l$, then $t=l\sqrt{(h\div 2mn)}$; therefore assuming τ for the limiting value of t, that is, making $\tau=l\sqrt{(h\div 2mn)}$, and therefore $l=\tau\sqrt{(2mn\div h)}$, there results

$$R=\frac{2}{\sqrt{\pi}}\int_0^\tau e^{-t^2}dt+P_0e^{-\tau^2}$$

for the probability that the number of occurrences of E will fall between $m\pm\tau\sqrt{(2mn\div h)}$; or, replacing m and n by hp and hq, the probability that the number of occurrences of E will fall within the limits $hp\pm\tau\sqrt{(2hpq)}$, or be equal to one of those limits.

This expression for R has been found by neglecting quantities of the order of smallness $1\div h$; consequently the greater the value of h the more nearly it approaches to accuracy, but it is only rigorously true when h is infinite.

96. The integral $\int e^{-t^2}dt$ is computed as follows. Developing the exponential e^{-t^2} in a series of the ascending powers of t^2, and integrating the successive terms between the limits $t=0$ and $t=\tau$, we find

$$\int_0^\tau e^{-t^2}dt=\tau-\frac{\tau^3}{1.3}+\frac{\tau^5}{1.2.5}+\frac{\tau^7}{1.2.3.7}+\text{\&c.};$$

a series which converges rapidly when τ is less than unity. In the contrary case, however, or when τ is greater than unity, the series is divergent, and it is necessary to proceed by a different method. Let the factor e^{-t^2} be multiplied and divided by t; we have then

$$\int e^{-t^2}dt=\int\frac{1}{t}e^{-t^2}tdt,$$

and on integrating by parts

$$\int\frac{1}{t}e^{-t^2}tdt=-\frac{e^{-t^2}}{2t}-\tfrac{1}{2}\int\frac{1}{t^2}e^{-t^2}dt.$$

Repeating the same process on the last integral, and so on with the last after each succeeding integration, the following series is obtained,

$$\int e^{-t^2}dt=-\frac{e^{-t^2}}{2t}\left\{1-\frac{1}{2t^2}+\frac{3}{2^2t^4}-\frac{3\cdot5}{2^3t^6}+\text{\&c}\right\}.$$

When $t=$ infinity the right hand side of this equation becomes 0; whence between the limits $t=\tau$ and $t=$ infinity, we have

$$\int_\tau^\infty e^{-t^2}dt=-\frac{e^{-\tau^2}}{2\tau}\left\{1-\frac{1}{2\tau^2}+\frac{3}{2^2\tau^4}-\frac{3\cdot5}{2^3\tau^6}+\text{\&c}\right\},$$

a series which converges very rapidly when τ is greater than unity. Now the value of a definite integral between 0 and infinity is obviously equal to its two parts, of which the first is taken between 0 and τ, and the second between τ and infinity; that is to say,

$$\int_0^\tau e^{-t^2}dt=\int_0^\infty e^{-t^2}dt-\int_\tau^\infty e^{-t^2}dt.$$

But $\int_0^\infty e^{-t^2}dt$ is well known[1] to have for its expression $\frac{1}{2}\sqrt{\pi}$, therefore

$$\int_0^\tau e^{-t^2}dt=\tfrac{1}{2}\sqrt{\pi}-\int_\tau^\infty e^{-t^2}dt,$$

so that the integral may be computed from either of the above series, according as τ is less or greater than 1.

The integral $\int e^{-t^2}dt$ is of great importance in the higher mathematics. It occurs in the investigation of the path of a ray of light through the atmosphere, and of the law of the diffusion of heat in the interior of solid bodies, as well as in the determination of the degree of reliance that may be placed on the results of astronomical observations, and generally in most of the more difficult and important applications of the theory of probabilities. A table of its values from $t=0$ to $t=3$, for intervals each $=\cdot01$, was given by Kramp, at the end of his *Analyse des Refractions Astronomiques*, Strasburg, 1799. In the *Berliner Astronomisches Jahrbuch* for 1834, there is also a table of its values from $t=0$ to $t=2$ (for the same intervals) multiplied by $2\div\sqrt{\pi}$, with their first and second differences for the purpose of facilitating interpolation. This last table, which appears to have been derived from that of Kramp, and which is immediately applicable in the calculation of the probability R, we have extended to $t=3$, and given at the end of the present article. As the function which is thus tabulated will occur frequently in what follows, we shall in future, for convenience in printing, denote it by Θ, that is to say, we shall assume

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[1] The formula $\int_0^\infty e^{-t^2}dt=\frac{1}{2}\sqrt{\pi}$ is ascribed by Gauss (*Theoria Motus Corporum Cœlestium*, p. 212,) to Laplace. On making $e^{-t^2}=z$, the integral is transformed into $\frac{1}{2}\int dz\left(\log\frac{1}{z}\right)^{-\frac{1}{2}}$ between the limits $z=0$ and $z=1$, the value of which $=\frac{1}{2}\sqrt{\pi}$, had been given by Euler, long before, in the *Petersburg Memoirs*. See Legendre, *Exercises du Calcul Intégral*, tom. i. p. 301.

$$\Theta = \frac{2}{\sqrt{\pi}}\int_0^{\tau} e^{-t^2}dt = 1 - \frac{2}{\sqrt{\pi}}\int_{\tau}^{\infty} e^{-t^2}dt,$$

the two forms being equivalent in consequence of the above equation.

97. Some very important conclusions follow immediately from the formula in (95). The quantity R denotes the probability that in a very great number of trials h, the event E, of which the *a priori* probability in any trial is p, will occur not seldomer than $hp-l$ times, and not oftener than $hp+l$ times, or that the number of its occurrences will be included between the limits $hp\pm l$, or at least be equal to one of those limits. Hence R also denotes the probability that the ratio of the occurrences of E to the whole number of trials, will be included within the limits $p\pm l\div h$. We have assumed $\tau=l\sqrt{(h\div 2mn)}$; but $m=hp$ and $n=hq$; therefore $\tau=l\div\sqrt{(2hpq)}$, whence $l=\tau\sqrt{(2hpq)}$, and consequently $l\div h=\tau\sqrt{(2pq\div h)}$. Now, if we suppose τ to be constant, so that the probability expressed by R may remain the same, then p and q being given, l is proportional to the square root of h, and consequently the greater the number of trials the smaller will l be in proportion to that number. Thus, if the number of trials be 1000, and we have a given probability R that the number of occurrences of E will not differ more than 10 from the number which is the most probable of all (that is, from $1000\,p$), then if we take 100,000 trials, we shall have the same probability R that the number of occurrences of E will not differ more than $10\times\sqrt{100}=100$ from the most probable number. But a difference of 10 in 1000 is 1-100th of the whole, whilst a difference of 100 in 100,000 is 1-1000th of the whole, and thus the ratio of l to h becomes smaller and smaller, or the ratio of the occurrences of E to the whole number of trials approaches nearer and nearer to p, as the number of trials is increased; and the experiments may be repeated until the difference between p and $p\pm l\div h$, in respect of a given probability R which may be as great as we please, shall be less than any assignable quantity.

If, on the other hand, we suppose $l\div h$ to be constant, then τ is proportional to the square root of the number of trials. But as τ increases, Θ, and consequently R, approaches nearer and nearer to unity, (and it may be seen, by referring to the table, that it is only necessary to have $\tau=3$ in order to have $\Theta=\cdot 9999779$); whence the number of trials h may always be increased until we obtain a probability approaching as nearly to certainty as we please, that the number of occurrences of E will be comprised within the given limits $(hp\pm l)$; or, which is the same thing, that the ratio of the number of occurrences of E to the whole number of trials, shall not differ from p, the probability of E in a single trial, more than a given quantity $l\div h$ which may be less than any assigned fraction. This is the celebrated theorem which was demonstrated by James Bernoulli in the *Ars Conjectandi*.

98. The application of the preceding results to numerical examples, is rendered extremely easy by means of the table of the values of Θ. From the formula in (95) we have the probability

$$R=\Theta+P_0e^{-\tau^2},$$

that the occurrences of E in h trials will fall within the limits $hp\pm l$, the relation between l and τ being given by the equation $l=\tau\sqrt{(2hpq)}$. If, therefore, we suppose l to be given, τ becomes known, and the corresponding value of Θ is found from the table; and, conversely, if Θ be assumed, τ is given by the table, whence the corresponding limits l are deduced. With respect to the quantity $P_0e^{-\tau^2}$, we may observe that it denotes the probability that the number of occurrences of the event E will be $hp+l$ or $hp-l$ precisely (92), and is therefore always a very small fraction when h is a large number (90). It may be regarded as a correction of Θ, which in most cases might be omitted without sensibly affecting the result; but when h is not very large, or l is a small number, it becomes necessary to take it into account. In such cases its value may be computed directly as in the example in (92); but this labour may be avoided by increasing τ, so as to include it within the limits of the integral Θ. Thus, let R be the probability that the number of arrivals of E will be included within the limits $hp\pm x$, and R′ the probability of the limits being $hp\pm(x+1)$, and let Θ and Θ' be respectively the corresponding values of the integral. We have then, giving P_x the same signification as in (92), the two equations

$$R=\Theta+P_x,\quad R'=\Theta'+P_{x+1},$$

and the difference $R'-R$ of these two probabilities is obviously the double of the probability that the result of the trials will be either $(hp+x+1)$ times E, or $(hp-x-1)$ times E, exactly. But the chance of either of these events being P_{x+1}, we have therefore $R'-R=2P_{x+1}$. Now, when h is large, P_x and P_{x+1} are very small, and very nearly equal to each other, (their difference is in fact of the order of quantities omitted); hence $R'-R=\Theta'-\Theta$, and also $2P_{x+1}=2P_x$, and consequently $\Theta'-\Theta=2P_x$, or $P_x=\frac{1}{2}(\Theta'-\Theta)$. Substituting this value of P_x in the equation $R=\Theta+P_x$, we get $R=\frac{1}{2}(\Theta'+\Theta)$; so that if we take from the table the values of Θ' and Θ corresponding to l and $l+1$, half their sum will give R. But as the interval between Θ' and Θ in the table is always small, half their sum will not differ sensibly from the value of Θ corresponding to $l+\frac{1}{2}$, whence this value of Θ is equal to R, and we have the following rule for determining the limits corresponding to a given probability, or *vice versa* :—

When the limits are assumed, find τ from the equation $l+\frac{1}{2}=\tau\sqrt{(2hpq)}$; then the value of Θ in the table, corresponding to τ is the probability that in h trials the number of occurrences of the event E, the chance of which in a single trial is p, will lie within the limits $hp\pm l$ both inclusive. Conversely, when Θ is assumed, find the corresponding value of τ in the table, by means of which the limit l will be given by the equation $l+\frac{1}{2}=\tau\sqrt{(2hpq)}$. It is obvious, that if the limit l and the probability Θ be both assumed, then h may be determined from the same equation.

99. We will now give some examples of the application of the preceding formulæ.

Suppose $p=q=\frac{1}{2}$, and $h=200$, and let it be proposed to assign the limits within which there is a probability $=\frac{1}{2}$ that the number of occurrences of E will fall. In this case the equation $l+\frac{1}{2}=\tau\sqrt{(2hpq)}$ becomes $l+\frac{1}{2}=\tau\sqrt{100}=10\tau$. Now, it is easily found from the table that for $\Theta=\frac{1}{2}$ we have $\tau=\cdot 4769$, whence $l+\frac{1}{2}=4\cdot 769$, and $l=4\cdot 269$. On tossing a shilling 200 times, it is therefore more than an even wager that head will turn up not seldomer than 95 times, and not oftener than 105 times.

Suppose $p=q=\frac{1}{2}$, $h=3600$, and let it be proposed to assign the probability that the number of occurrences of E will not exceed the limits 1800 ± 30. In this case the equation $l+\frac{1}{2}=\tau\sqrt{(2hpq)}$ becomes $30\cdot 5=\tau\sqrt{(2\times 900)}=30\tau\sqrt{2}$, whence $\tau=30\cdot 5\div 30\sqrt{2}=\cdot 7189$; and the table gives $\Theta=\cdot 6907=\frac{28}{41}$ nearly. Hence in tossing a shilling 3600 times, the odds are 28 to 13 that head will not turn up oftener than $1800+30=1830$ times, nor seldomer than $1800-30=1770$ times. Neglecting the second term of R (95) and taking simply $l=10\tau$, the table gives $\Theta=\cdot 6827$, which is the solution given by Demoivre, p. 245.

Suppose $p=\frac{1}{6}$, $q=\frac{5}{6}$, and let it be proposed to determine how many trials must be made in order that it may be one to one that the number of occurrences of E will not differ more than 10 from the most probable number.

For $\Theta = \frac{1}{2}$ we have $\tau = {\cdot}4769$; therefore the equation $l + \frac{1}{2} = \tau\sqrt{(2hpq)}$ becomes $10{\cdot}5 = {\cdot}4769\sqrt{(10h \div 36)}$, whence $h = 3{\cdot}6(10{\cdot}5 \div {\cdot}4769)^2$. On computing this formula h is found $= 1745{\cdot}2$. Say 1746, $\frac{1}{6}$ of which is 291; and it follows that if a die be thrown 1746 times it is an even wager that the number of aces will fall between 291 ∓ 10, that is, between 281 and 301, or be equal to one of those numbers.

In (92) we found the probability to be ·0053, that in 6000 throws of a die the number of aces will be exactly 960. Let it now be proposed to assign the probability Θ, that in 6000 throws the number of aces will lie between 960 and 1040, that is, between 1000 ∓ 40. Here $h = 6000$, $p = \frac{1}{6}$, $q = \frac{5}{6}$, and $l = 40$; the equation of the limits therefore becomes $40{\cdot}5 = \tau\sqrt{(10000 \div 6)}$, whence $\tau = {\cdot}405\sqrt{6} = {\cdot}992$, corresponding to which the table gives $\Theta = {\cdot}8394$.

The following question is discussed by Nicolas Bernoulli in the Appendix to Montmort's *Analyse des Jeux de Hazard*, and is noticed by Demoivre and Laplace. From the observations of the births of both sexes in London during 82 years (from 1629 to 1711) it was found that the average number of children annually born in London, was about 14,000, and the ratio of the number of males to that of females, was nearly as 18 to 17, the average number of male births being 7200, and of female births 6800. In the year in which the greatest difference from this ratio took place, the actual numbers were 7037 males and 6963 females, so that the difference from the average amounted to 163. Assuming, then, the comparative facility of male and female births to be as 18 to 17, required the probability that out of 14000 children born, the number of males shall not be greater than 7363, nor less than 7037.

This question is evidently equivalent to the following:—Let 14000 dice, each having 35 faces, 18 white and 17 black, be thrown; what is the probability that the number of white faces turned up, will be comprised between the limits 7200 ± 163. We have therefore $h = 1400$, $p = \frac{18}{35}$, $q = \frac{17}{35}$. $l = 163$, and the formula $l + \frac{1}{2} = \tau\sqrt{(2hpq)}$ becomes $163.5 = \tau\sqrt{(2 \times 14000 \times 18 \times 17)} \div 35$, whence $\tau = 1{\cdot}955$. The corresponding value of Θ is found from the table $= {\cdot}9943$, which is the probability that the number of white faces shall not be greater than 7363, nor less than 7037. The odds in favour of the event are therefore 9943 to 57, or about 175 to 1.

100. We now proceed to consider the case in which the probabilities of the simple events are not known, *a priori*, but inferred from the results of experience. It was shewn in (52) that the probability Π of an event happening m' times, and failing n' times in h' trials, $(h' = m' + n')$, when it has been observed to happen m times, and fail n times in h previous trials, is expressed by this equation

$$\Pi = U' \frac{[m+m'][n+n'][h+1]}{[m][n][h+h'+1]}.$$

Now, when m, n, m', n', are large numbers, an approximate value of Π, more accurate in proportion as those numbers become larger, is obtained from Stirling's theorem (90), which for any number x gives $[x] = x^x e^{-x}\sqrt{(2\pi x)}$. Applying the theorem therefore to the expressions within the brackets in the above equation, and assuming

$$K = \frac{h+1}{h+h'+1}\sqrt{\frac{(m+m')(n+n')(h+1)}{mn(h+h'+1)}},$$

we obtain, in consequence of $m + n = h$,

$$\Pi = U'K \frac{(m+m')^{m+m'}(n+n')^{n+n'}(h+1)^h}{m^m n^n (h+h'+1)^{h+h'}}.$$

Let $m' = \theta m$, $n' = \theta n$, and consequently $h' = \theta h$; then taking $\frac{h^h}{(h+h')^{h+h'}}$ for $\frac{(h+1)^h}{(h+h'+1)^{h+h'}}$ (which may be done without sensible error, since h is by supposition a large number,) the equation becomes

$$\Pi = U'K \frac{m(1+\theta)^{m+m'} n(1+\theta)^{n+n'} h^h}{m^m n^n (1+\theta)^{h+h'}};$$

or, since $m + n = h$, $m' + m' = h'$,

$$\Pi = UK\ \frac{m^{m'} n^{n'} (1+\theta)^{h+h'}}{h^h (1+\theta)^{h+h'}} = UK\left(\frac{m}{h}\right)^{m'}\left(\frac{n}{h}\right)^{n'}.$$

Making the same substitutions in the expression denoted by K, we get, after reduction, $K = 1 \div \sqrt{(1+\theta)}$; whence,

$$\Pi = \frac{U'}{\sqrt{1+\theta}}\left(\frac{m}{h}\right)^{m'}\left(\frac{n}{h}\right)^{n'}.$$

The value of Π now found, is the probability that in a future series of trials the ratio of the occurrences of E to those of F will be the same as in the preceding trials, which are supposed to have been very numerous. If the chances of E and F had been given *a priori* equal to $m \div h$ and $n \div h$ respectively, the probability of m' times E, and n' times F in $m' + n'$ future trials would have been $P = U'\left(\frac{m}{h}\right)^{m'}\left(\frac{n}{h}\right)^{n'}$ by (12); hence (since $m' \div h' = m \div h$ and $n' \div h' = n \div h$), the relation between the probability P_o of that combination of simple events which has the greatest number of chances in its favour, when the chances of the simple events are known *a priori*, and the probability of the same combination when the chances of the simple events are only presumed from previous trials, is expressed by this equation,

$$\Pi = P_o \div \sqrt{(1+\theta)}.$$

101. When h' is very small in comparison of h, θ becomes a very small fraction, and may be neglected, and we have then $\Pi = P_o$. But when h' is a number comparable with h, Π is less than P_o; and it diminishes rapidly when θ exceeds 1. The reason of this is obvious. If the contents of the urn are not known *a priori*, however numerous the trials may have been there is only a presumption that the chance of drawing a white ball in a single trial is measured by $m \div h$; whereas, in the case of the ratio of the balls being previously known, the measure of the probability is certain. As an instance of the manner in which the probability of an assigned series of future events diminishes, when the probabilities of the simple events are inferred from experience, let us suppose $h' = h$, whence $\theta = 1$, and consequently $\Pi = P_o \div \sqrt{2} = {\cdot}7071 \times P_o$. Now it was shewn in (91) that if a ball be drawn at random 100 times from an urn which contains an equal number of black and white balls, the probability P_o, that the result will be 50 white balls, and 50 black, precisely, is ·07979. It follows therefore, that if the contents of the urn be unknown, and we can only judge of the relative numbers of the two sorts of balls it contains from having observed that in 100 trials there have been drawn 50 white balls and 50 black, the probability Π of that combination in 100 future trials, becomes $\cdot07979 \times \cdot7071 = \cdot05642$.

102. The result obtained in (100) enables us to determine the probability that the number of occurrences of E in h' future trials, will not differ in excess or defect from the most probable number, by more than a certain given number l. It has been shewn (95) that in the case of the probabilities p and q of the simple events being given *a priori*, if we determine τ from the equation $l = \tau\sqrt{(2hpq)}$, the formula

$$R = \Theta + \sqrt{(1 \div 2\pi hpq)}\, e^{-\tau^2}$$

gives the probability R that m will be comprised within the limits $hp \pm \tau\sqrt{(2hpq)}$; or, dividing by h, the probability that the ratio of m to h will be comprised within the limits

$p \pm \tau\surd(2pq \div h)$. Conversely[1], when p and q are not known, but the event E has been observed to happen m times in h trials, then

$$\mathrm{R} = \Theta + \surd(h \div 2\pi mn)e^{-\tau^2}$$

gives the probability R that p is comprised within the limits

$$\frac{m}{h} \pm \frac{\tau}{h}\sqrt{\frac{2mn}{h}}.$$

These limits approach more nearly to each other as h increases; and when h is a large number, the ratios $m \div h$, $n : h$ may be assumed, without sensible error, as the chances of E and F in computing the probable result of a future series of h' trials, provided, however, that h' (though absolutely a large number) be small relatively to h. When this condition is not fulfilled, the assumption of $m \div h$ and $n \div h$ as the *a priori* chances of E and F, might lead to considerable error; but an approximation to the limits corresponding to a given value of R may be obtained from the following considerations:—

Suppose a large number h of events to have been observed, and that the result of the observation gave m times E and n times F. Let a new series of h' trials be made, and *suppose* that in this new series p is the real chance of E and q of F; we have then a given probability R that the number of occurrences of E will fall within the limits $h'p \pm \tau\surd(2h'pq)$. Now, for p and q substitute the ratios observed in the first set of experiments, namely, $m \cdot h$ and $n \div h$, and the limits corresponding to R become

$$\frac{mh'}{h} \pm \frac{r}{h}\surd(2h'mn),$$

which, therefore, are the true limits on the hypothesis that the chance of E in a single trial is $m \div h$. But as this chance is not certain, but only presumed, the limits require to be extended in order that R may preserve the same value. Confining our attention to Θ, the first term of the expression for R (the second may be disregarded in the present approximation), let $h' = m' + n'$ and $m' : n' = m : n$, then Θ is the sum of the terms of the binomial $(p+q)^{h'}$ from that in which the exponent of p is $m' + l$ to that in which the exponent is $m' - l$. Now, when p and q are given *a priori*, the chance of m' times E and n' times F in h' trials is P_o; and when p and q are only presumed from the results of previous trials, the chance of the same combination is Π; and (100) Π is less than P_o in the ratio of 1 to $\surd(1+\theta)$. In like manner, the chance of each of the other combinations of E and F included in the integral Θ will be less in the case of p and q presumed, than in the case of p and q given, in the same ratio of 1 to $\surd(1+\theta)$. But it has been seen (93) that when h' is a large number, the terms of the developement of $(p+q)^{h'}$ which are nearest the greatest term, diminish at first very slowly; and, further, that only a small number of terms on each side of the greatest are required to be taken, since l is less than $\surd m'$ or $\surd n'$ (95); we may therefore, without sensible error, assume Θ to be proportional to the number of terms included in the summation, or that the value of Θ will not be changed if we include in the summation a number of terms greater in proportion as the value of each individual term is less. Hence it follows that the limits must be increased in the ratio of $\surd(1+\theta)$ to 1, and the value of Θ corresponding to τ will give the probability that the number of events E, in h' future trials, will be included between

$$\frac{mh'}{h} \pm \frac{\tau}{h}\surd(2h'mn(1+\theta)).$$

103. The following question may be proposed as an example of the application of the last formula. Out of a given number h of individuals taken at the age A, it has been observed that m are alive at the age $\mathrm{A}+a$; required the probability that out of h' other individuals taken at the same age A the number who survive at the age $\mathrm{A}+a$ will be included between $m' \pm l$, the ratio of m' to h' being the same as that of m to h.

To solve this question, we have to find τ from the equation $l = \frac{\tau}{h}\surd(2h'mn(1+\theta))$; and the corresponding value of Θ in the table, will give the required probability.

From the table given in the article MORTALITY, vol. xv. p. 555, it appears that out of 5642 individuals taken at the age 30, the number surviving at the age 50, according to the Carlisle Table, is 4397. Taking those numbers as an example, we have $h=5642$, $m=4397$, $n=1245$; and assuming also $h'=5642$, whence $\theta=1$ and $\surd(1+\theta)=\surd 2$, the equation of the limits becomes $l = \tau \times 62{\cdot}30$, Let it be proposed to determine l from the condition $\Theta = \frac{1}{2}$. In this case the table gives $\tau = {\cdot}4769$, and we have consequently $l = 29{\cdot}7$. Hence it appears, that if it has been observed that of 5642 individuals taken at the age of 30, 1245 die before reaching the age of 50, it is an even wager that out of 5642 other individuals also taken at the age of 30, and subjected to the same chances of mortality, the number who die before reaching the age of 50 will lie between 1245±30, that is, between 1215 and 1275.

104. The following experiment recorded by Buffon, in his *Arithmetique Morale*, affords an example of the application of the preceding formulæ to the determination of the probable existence of a physical cause from the results of a large number of observations. A piece of money was tossed 4040 times successively, and the result was head 2048 times, and tail 1992 times. Supposing the piece to have been perfectly symmetrical, the most probable result would have been the same number of heads and tails. Let it now be proposed to assign the probability afforded by the experiment that the piece was not symmetrical, and that its form or physical structure was such as to render head an event, *a priori*, more probable than tail.

In this case $h=4040$, $m=2048$, $n=1992$; and by (102) we have the probability R (or Θ, neglecting the correction) that p, the unknown chance of head, is comprised between the limits $\frac{m}{h} \pm \frac{\tau}{h}\sqrt{\frac{2mn}{h}}$. Now $\frac{m}{h} = \frac{2048}{4040}$ $= .50693$, and $\frac{\tau}{h}\sqrt{\frac{2mn}{h}} = \tau \times .011124$, therefore if we assume $\tau \times .011124 = .00693$, we shall have the probability Θ that p is comprised between the limits $.50693 \pm .00693$, that is, between two limits of which the least is .5, or one-half. This assumption gives $\tau = .00693 \div .011124 = .623$; and the corresponding value of Θ is found from the table $=.62170$. Now if p lie between the above limits, its value is evidently greater than $\frac{1}{2}$; but the probability of its lying between those limits is not the whole probability that p is greater than $\frac{1}{2}$; for there is a chance of its exceeding the greatest limit, in which case also its value will be greater than $\frac{1}{2}$. The probability that p is *not* comprised between the assumed limits is $1-.62170=.37830$; and if it is not comprised between these limits, there is an equal chance of its being greater than the greatest limit, or less than the least; the probability of its exceeding the greatest limit is consequently $\frac{1}{2}\times .37830=.18915$. Hence the whole probability that p is greater than .5, or that the chance of head is greater than that of tail is $.62170+.18915=.81085$; and the odds are therefore 81 to 19, or rather more than 4 to 1 that the piece was not perfectly symmetrical.

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[1] This inference, though admitted by both Laplace and Poisson, is not strictly correct. In a paper published in the *Transactions of the Cambridge Philosophical Society*, (vol. vi. part iii.) Mr. De Morgan has shewn by a direct analysis that in the case of p and q not being known *a priori*, but made equal to the observed ratios $m \div h$, $n \div h$, the presumption of the true value of p lying within the limits stated in the text is not, as there inferred, $\Theta + \frac{1}{\surd(2\pi hpq)} e^{-\tau^2}$, but $\Theta - \frac{13p^2 - 13p + 1}{6hpq\surd\pi} e^{-\tau^2}$. The last correction to Θ is smaller than the former, and being divided by h, is of the order of quantities that have been rejected in the approximations. It is right to state that the method of simplifying the calculation of R in the direct case, by taking the integral Θ between limits corresponding to $l+\frac{1}{2}$ instead of l, is noticed, for the first time so far as we are aware, by Mr. De Morgan in the same paper.

105. The formulæ which have been demonstrated in the present section are immediately applicable to the determination of the probable limits of the gain or loss which may arise from undertaking a great number of risks with a given expectation in respect of each. The following question has important practical applications. A is interested in a great number of similar enterprises, in each of which E or F must necessarily happen. When E happens he receives the sum α, and when F happens he pays the sum β; required the probability that his gain or loss shall be comprised within given limits?

Let p be the chance of the event E, q that of F, and h the number of enterprises. Suppose E happens m times, and F n times; the sum to be received will be $m\alpha$, and the sum to be paid will be $n\beta$, and therefore his gain will be $m\alpha-n\beta$. Let $m=hp$, $n=hq$, then m times E and n times F is the most probable result, and in this case the gain $m\alpha-n\beta$ becomes $h(v\alpha-q\beta)$. Find τ from $l+\frac{1}{2}=\tau\sqrt{(2hpq)}$, then (98) Θ is the probability that the number of occurrences of E will lie between the limits $hp\mp l$. But if E happens $hp-l$ times, and consequently F $hq+l$ times, the corresponding benefit is $(hp-l)\alpha-(hq+l)\beta=h(p\alpha-q\beta)-l(\alpha+\beta)$; and if E happens $hp+l$ times, and F $hq-l$ times, the benefit is $(hp+l)\alpha-(hq-l)\beta=h(p\alpha-q\beta)+l(\alpha+\beta)$; whence Θ is the probability that his gain, that is, the difference between what he receives and what he pays, will be included within the limits $h(p\alpha-q\beta)\mp l(\alpha+\beta)$ both inclusive.

106. The following conclusions follow immediately from this solution.

(1). If $p\alpha$ be greater than $q\beta$, so that A has a mathematical advantage (however small) in each risk, the risk may be repeated a sufficient number of times, or h may be taken a sufficiently high number, to give a probability as nearly equal to certainty as we please, that A's gain shall exceed any given sum, however great.

(2). Let there be two players A and B, whose chances of gaining a game are respectively p and q, and let β be the sum staked upon each game by A, and α the sum staked by B, then $p\alpha$ is the mathematical expectation of A in respect of a single game, and $q\beta$ that of B; and if $p\alpha$ be greater than $q\beta$ (however small the difference) the game may be repeated so often as to give rise to a probability approaching as nearly to certainty as we please, that A's gain shall become equal to the whole of B's capital, and, consequently, that B will be ruined.

(3). If the mathematical expectations of the two players be equal, then $p\alpha-q\beta=0$, and the most probable individual result of a large number of games, is that the gains and losses on either side shall be the same. But if l be supposed constant, then τ is inversely proportional to $\sqrt{h}$, and consequently the game may be repeated until Θ, the probability that the gain or loss $l(\alpha+\beta)$ shall be comprised within given limits, shall become as small as we please. Hence $1-\Theta$, the probability that the gain or loss shall *not* be comprised within given limits, may be rendered as great as we please; and it follows that although the play may be on terms of perfect equality, it may be continued until a probability shall be obtained, approaching as nearly to certainty as we please, that one of the two players shall be ruined.

(4). The number of games which must be played, to afford a given amount of probability that one of the parties shall lose the whole of his fortune, depends on the magnitude of the stakes $(\alpha+\beta)$; but whether the stakes be large or small, the final result is the same. When the stakes are small, a greater number of games must be played.

107. As an example of this class of problems, we may take the following question: A and B engage in play with equal chances of winning, and stake five sovereigns on each game; how many games must they undertake to play in order that it may be two to one that one of them shall lose *at least* 100 sovereigns?

Here $p=\frac{1}{2}$, $q=\frac{1}{2}$, $\alpha=5$, $\beta=5$, and $l(\alpha+\beta)=100$, whence $l=10$. The equation $l+\frac{1}{2}=\tau\sqrt{(2hpq)}$ therefore becomes $10{\cdot}5=\tau\sqrt{(h\div 2)}$, whence $h=2\times(10{\cdot}5)^2\div\tau^2$. Now, the odds being 2 to 1 against the limits of the gain or loss not exceeding 100, the probability Θ of the limits not exceeding 100 is $\frac{1}{3}={\cdot}33333$, corresponding to which the table gives by interpolation $\tau={\cdot}30458$; substituting which in the above equation we find $h=2376{\cdot}8$; so that if 2377 games are played, the odds are 2 to 1 that one of the players shall have gained at least 10 games more than half that number, and, consequently, that the other shall have gained at least 10 less than half, or that one of them shall have gained at least 20 games more than the other, and consequently have gained at least 100 sovereigns.

It is to be carefully observed that this question supposes the account between A and B not to be balanced until 2377 games have been played. If the condition of the play had been that it should cease as soon as A or B should have lost 100 sovereigns, the question would have been of an entirely different kind, and a much smaller number of games would have given the same probability of an equal loss.

108. The question just alluded to belongs to a class of problems connected with the *Duration of Play*, of extreme difficulty, and which have given rise to some of the most abstruse and refined researches in the modern analysis. In order to give an idea of the subject, we may take the following question, which has been frequently considered.

A and B, whose chances of winning a game are respectively p and q, play on these terms: A has m counters, and B has n counters; when A loses a game he gives a counter to B, and when B loses a game he gives a counter to A, and the play is to cease when one of them has lost all his counters. What is the probability that the play, which may go on for ever, shall be finished before more than h games shall have been played.

To take a simple case, suppose each to have three counters, and let the probability be required that the play shall be concluded with or before the ninth game. As the play cannot end with less than three games, let the binomial $(p+q)^3$ be developed, and the terms

$$p^3+3p^2q+3pq^2+q^3$$

give the respective probabilities of all the cases which can arise in three games. The first term is the probability of A gaining all the three games, the last term is the probability of B gaining them, and the sum of the remaining two terms is the probability that neither will win all the games, or the chance that a fourth will be played. Now, if the fourth game be played, p is A's chance of winning it, and q B's chance; but these chances will only exist in respect of the fourth game, provided the play be not concluded with the previous one, the probability of which is $3p^2q+3pq^2$. Multiplying, therefore, $3p^2q+3pq^2$ by $p+q$, the product

$$3p^3q+6p^2q^2+3pq^3$$

gives the respective probabilities of the different ways in which the four games may be gained by A and B, excepting the two ways in which the play would have terminated with the third game. But the play cannot end in any of these ways; for, taking the first term for example, if B gains a counter before A gains three, the play cannot terminate until A gain back that counter, and three others besides, so that five games must be played. In fact, it is obvious that there is no way of gaining an odd number of counters in an even number of games, or *vice versa*. The last product therefore expresses the chance of the 5th game being played; and by reason of $p+q=1$ it is equal to $3p^2q+3pq^2$, the chance of the 4th being played, as it obviously ought to be, since the play cannot terminate with the 4th. Again, if the 5th game be played, p is A's chance of gaining it, and q B's chance of gaining it; multiplying therefore the last product by $p+q$, the different terms of the result, namely,

$$3p^4q+9p^3q^2+9p^2q^3+3pq^4$$

give the respective probabilities of all the cases which can arise by the 5th game. The first term is the probability of A gaining 4 games and B gaining 1, and the last term is the probability of B gaining 4 and A gaining 1. These terms therefore are the probabilities of the play ending in favour of A and B respectively with the 5th game, and the sum of the other two terms is the probability that the play will not terminate with the 5th game, or the chance of another game being played.

By pursuing the same reasoning it will be evident that on rejecting the two extreme terms of the above product, and multiplying the remainder by $p+q$, there will result the probabilities of the different ways in which six games may be played without the one player gaining all the counters of the other. But as the play cannot termimate with the 6th game, multiply again by $p+q$, and the result

$$9p^5q^2+27p^4q^3+27p^3q^4+9p^2q^5$$

will indicate the probability of the different cases that can arise out of the 7th game. Rejecting the two extreme terms, which give the respective probabilities of the play being concluded in favour of A or B, and multiplying the remaining two first by $p+q$ to obtain the different probabilities in respect of the 8th game, and again by $p+q$, as the play cannot terminate with the 8th, we have the product

$$27\,p^6q^3+81\,p^5q^4+81\,p^4q^5+27\,p^3q^6,$$

of which the first and last terms give the respective chances of A and B winning at the 9th game, and the sum of the other two terms the probability that the play will not be concluded by the 9th.

If we now collect the terms which have been set aside in the successive products, and denote by a and b the respective probabilities of A and B gaining at the 9th game, *or sooner*, we shall have

$$a=p^3+3\,p^4q+9\,p^5q^2+27\,p^6q^3,$$
$$b=q^3+3\,q^4p+9\,q^5p^2+27\,q^6p^3,$$

where the law of the series is evident.

It is easy to see that this process may be applied whatever be the number of counters which A and B have at the commencement, and whatever be the number, h, of games to which the play is limited. The general rule is as follows: of the two numbers m and n, let m be that which is not less than the other. Raise $p+q$ to the power n, and reject the first term (which gives the chance of A winning n games in succession), and also the last if $m=n$. Multiply the remainder $(h-n)$ times in succession by $(p+q)$, rejecting at each multiplication the first or last term of the product when it gives a combination which would terminate the play in favour of A or B; the sum of the terms rejected from the left-hand side of the different products gives the probability in favour of A, and the sum of the terms rejected from the right-hand side the probability in favour of B. As the coefficients of the successive products are obviously formed by adding the coefficient of the corresponding term in the preceding product to that of the term immediately before it, the products may be written down at once without the trouble of multiplication; but it is evident that when m, n, and h are large numbers, it would be quite impracticable to sum the series formed of the rejected terms by the ordinary methods. From the manner in which the series are derived, they are called *recurring* series; a general theory of which was first given by Demoivre in his *Doctrine of Chances*, and forms the most remarkable portion of that work.

109. The general problem is reduced to an equation of finite differences as follows: Let $y_{x,t}$ represent A's expectation when x games have been played, and he has still t counters to win, or B has t counters in his hand. If A gain the next game the value of his expectation will become $y_{x+1,t-1}$, and the chance of his gaining it is p; therefore his expectation in respect of that event is $py_{x+1,t-1}$. On the other hand, if A loses the next game his expectation will become $y_{x+1,t+1}$, and the chance of losing it is q; therefore his expectation in respect of that event is $qy_{x+1,t+1}$. Hence, according to the principles laid down in (32),

$$y_{x,t}=py_{x+1,t-1}+qy_{x+1,t+1}$$

a linear equation of finite differences, with three independent variables. It is therefore on the integration of an equation of this kind that the problem of the duration of play ultimately depends, but the subject is of much too complicated a nature to admit of its being satisfactorily explained in this place. We must therefore content ourselves with referring the reader to the treatise on generating functions, which forms the first part of the *Théorie Analytique* of Laplace.[1]

SECT. IX. OF THE MOST PROBABLE MEAN RESULTS OF NUMEROUS DISCORDANT OBSERVATIONS, AND THE LIMITS OF PROBABLE ERROR.

110. In the preceding section we have considered a class of questions which apply to events depending on constant causes, and supposed to be of such a nature that they necessarily happen or fail in each experiment, and have given formulæ by which approximate results can be obtained when the numbers involved are so large that they cannot be conveniently treated, or cannot be treated at all, by the ordinary methods of calculation. We come now to a more difficult problem, namely, to investigate the probable result of a large number of observations which have reference not to the simple occurrence or failure of a certain event, but to the magnitude of a thing, susceptible, within certain limits, of a very great or an infinite number of different values, equally or unequally probable, the chance of any particular value being also supposed to vary in each experiment. On account of its immediate application to the determination of the most probable values of astronomical and physical elements from the results of observation, this is, perhaps, in reference to practical utility, the most important question in the theory.

111. Let A represent a thing of any sort (as a line, or an angle, or a function of any quantity) which may have

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[1] Lagrange, in vol. i. of the *Memoirs of the Society of Turin*, was the first who shewed that the investigation of the general term of a recurring series depends on the integration of a linear equation of finite differences. In vols. vi. and vii of the *Memoires présentés à l'Academie des Sciences* of Paris, Laplace proposed a general method for the summation of recurring series by the integration of such equations, and in the latter volume gives a number of examples of their use in the more complicated questions in the theory of chances, amongst which is the problem enunciated in (108). The subject was afterwards resumed by Lagrange in the volume of the *Berlin Memoirs* for 1775, where he has given a more direct method than that of Laplace, for the integration of the class of equations in question, and also applied it to the solution of the principal problems proposed in the works of Montmort and Demoivre. A general solution of the problem in the text is given by Ampère in a Tract entitled *Considérations sur la Théorie Mathématique du Jeu*, (Lyons, 1802.)

every possible value within given limits, or which may be constant in itself, but of such a nature that its real magnitude can only be observed within certain limits of accuracy, and suppose a great number of observations to be made. The object is, in the first place, to assign the probability that the sum of the observed values shall fall within given limits, supposing the chances of the different values of A to be known *a priori*; and, in the second place, when the law of the chances is unknown, to determine from the observations themselves the most probable mean value of A, and also the limits within which there is a given amount of probability that the difference between such mean value, and the true but unknown value of A. shall be contained.

112. Let a and b be the limits of the possible values of A, x a value of A between a and b, and P the probability that the sum of the values of A given by h observations will be s exactly, s being a given quantity between ha and hb. Assume the values of A to be equidifferent, and multiples of a certain constant ϵ, and make

$$\alpha\epsilon = a,\ \beta\epsilon = b,\ \sigma\epsilon = s,\ i\epsilon = x,$$

where α, β, and σ are whole numbers (which may be positive or negative), and i is also a whole number proportional to x, and varying between the limits $i=\alpha$, and $i=\beta$, and which, therefore, may be positive or negative, or zero. If the different values of A are supposed to be equally probable, the chance of obtaining any given one of them, as x, in a single trial is unit divided by the number of possible values, or equal to $1\div(\beta-\alpha+1)$; and if we assume an indeterminate quantity w, then (20) the number of combinations which give the sum of h values of A equal to $\sigma\epsilon$ is the coefficient of that term of the multinomial

$$(w^{\alpha} + w^{\alpha+1} + w^{\alpha+2} \ldots\ldots + w^{\beta})^h,$$

(or of the developement of $(\Sigma w^i)^h$ from $i=\alpha$ to $i=\beta$) in which the exponent of w is σ; and consequently the probability P that the sum of the values of A will be s exactly is that coefficient divided by $(\beta-\alpha+1)^h$.

113. If the chances of the different values of A are unequal, and also vary in each trial, let p_1 be the probability of the observed value of A being x in the first trial, p_2 the probability of its being x in the second, p_3 that of its being x in the third, and so on. Now when $h=1$, or when there is only a single trial, then $s=x=i\epsilon$, and we have $P=p^1$. If $h=2$, then, assuming $i\epsilon$ to be the value of A in the first trial, and $i'\epsilon$ its value in the second, (i and i' being any two numbers between α and β), the two observations may give the sum of the two values equal to $\sigma\epsilon$ in as many different ways as it is possible to satisfy the equation $i+i'=\sigma$; and consequently, according to the theory of combinations, P is the coefficient of that term of the product (arranged according to the powers of w) of the two series represented by $\Sigma p_1 w^{i\epsilon}$ and $\Sigma p_2 w^{i\epsilon}$, in which the exponent of w is equal to $\sigma\epsilon$. In like manner, if $h=3$, then the sum of the observed values of A may be equal to $\sigma\epsilon$ in as many different ways as the equation $i+i'+i''=\sigma$ admits of different solutions, and consequently P is the coefficient of the term of the developement of the product $\Sigma p_1 w^{i\epsilon} . \Sigma p_2 w^{i\epsilon} . \Sigma p_3 w^{i\epsilon}$, in which the exponent of w is equal to $\sigma\epsilon$. Generally, when the number of observations is h, the probability P of the sum of the observed values of A being s, or $\sigma\epsilon$, exactly, is the coefficient of $w^{\sigma\epsilon}$ in the developement of the product

$$\Sigma p_1 w^{i\epsilon} . \Sigma p_2 w^{i\epsilon} . \Sigma p_3 w^{i\epsilon} \ldots\ldots\ldots \Sigma p_h w^{i\epsilon},$$

the sums Σ including all values of i from $i=\alpha$ to $i=\beta$.

Assume $w^{\epsilon} = e^{\theta\sqrt{-1}}$ (e being the base of the Napierean logarithms), and let the above product be denoted by X. We shall then have

$$X = \Sigma p_1 e^{i\theta\sqrt{-1}} . \Sigma p_2 e^{i\theta\sqrt{-1}} . \Sigma p_3 e^{i\theta\sqrt{-1}} \ldots\ldots \Sigma p_h e^{i\theta\sqrt{-1}}.$$

Now since P is the coefficient of the term of the developement of this product which contains the factor $e^{\sigma\theta\sqrt{-1}}$, if we conceive the developement effected we shall have

$$X = Pe^{\sigma\theta\sqrt{-1}} + P'e^{\sigma'\theta\sqrt{-1}} + \&c.$$

a series in which all the terms are of the same form. Multiplying both sides of the equation by $e^{-\sigma\theta\sqrt{-1}}$, we get

$$Xe^{-\sigma\theta\sqrt{-1}} = P + P'e^{(\sigma'-\sigma)\theta\sqrt{-1}} + \&c.$$

Now by a well known theorem in trigonometry, (ALGEBRA, art. 269), $e^{(\sigma'-\sigma)\theta\sqrt{-1}} = \cos(\sigma'-\sigma)\theta + \sqrt{-1}\sin(\sigma'-\sigma)\theta$; substituting therefore this value, and multiplying by $d\theta$, the equation becomes

$$Xe^{-\sigma\theta\sqrt{-1}}d\theta = Pd\theta + P'\left\{\cos(\sigma'-\sigma)\theta + \sqrt{-1}\sin(\sigma'-\sigma)\theta\right\}d\theta + \&c.$$

The factor which multiplies P′ in this equation will evidently become zero when integrated from $\theta=-\pi$ to $\theta=+\pi$, (π being the semicircumference to radius 1), the positive and negative elements of the integral being equal, and consequently destroying each other. The same thing also takes place with respect to the following terms, which are all of the same form. Integrating therefore between those limits, and observing that $\int d\theta = 2\pi$, we find

$$P = \frac{1}{2\pi}\int_{-\pi}^{+\pi} Xe^{-\sigma\theta\sqrt{-1}}d\theta.$$

114. This value of P denotes the infinitely small chance that the sum of the values of A in h trials will be s exactly. Let μ and ν be two integer numbers between $h\alpha$ and $h\beta$, and let Q denote the probability that s will be comprised between the two limits $\mu\epsilon$ and $\nu\epsilon$, (these limits being included between ha and hb); then Q will be found by substituting successively μ, $\mu+1$, $\mu+2, \ldots \nu$ for σ in the above value of P, and taking the sum of all the resulting terms. This substitution gives the following series multiplied by X under the sign of integration:

$$e^{-\mu\theta\sqrt{-1}} + e^{-(\mu+1)\theta\sqrt{-1}} + e^{-(\mu+2)\theta\sqrt{-1}} \ldots + e^{-\nu\theta\sqrt{-1}}$$

On multiplying the series now found by $e^{\frac{1}{2}\theta\sqrt{-1}} - e^{-\frac{1}{2}\theta\sqrt{-1}}$ $(=2\sqrt{-1}\sin\frac{1}{2}\theta)$, all the terms of the product, excepting the first and the last, destroy each other, and the sum of the terms becomes simply

$$e^{-(\mu-\frac{1}{2})\theta\sqrt{-1}} - e^{(\nu+\frac{1}{2})\theta\sqrt{-1}};$$

therefore on making the substitution, and performing the multiplication now indicated, and dividing by $2\sqrt{-1}\sin\frac{1}{2}\theta$, we obtain for the value of Q the equation Q=

$$\frac{1}{4\pi\sqrt{-1}}\int_{-\pi}^{+\pi} X\left\{e^{-(\mu-\frac{1}{2})\theta\sqrt{-1}} - e^{-(\nu+\frac{1}{2})\sqrt{-1}}\right\}\frac{d\theta}{\sin\frac{1}{2}\theta}.$$

115. In order to simplify the expression for Q, let the number of possible values of A within the given limits be conceived to be infinite, in which case the constant ϵ becomes infinitely small, and therefore, since the limits are finite, μ and ν infinitely great. Let the following substitutions also be made:

$$\mu\epsilon = \psi - \delta,\ \nu\epsilon = \psi + \delta,\ \theta = \epsilon z,$$

δ being positive in order that ν may be greater than μ, agreeably to what has already been assumed. On substituting these expressions in the above equation, the limits of the new variable z will be ± infinity; for ϵ having been supposed infinitely small, z must become infinitely great when $\theta=\pi$. Now since μ and ν are infinitely great, $\mu-\frac{1}{2}$ and $\nu+\frac{1}{2}$ become sensibly μ and ν, whence we have

$e^{-(\mu-\frac{1}{2})\theta\sqrt{-1}}-e^{-(\nu+\frac{1}{2})\theta\sqrt{-1}}=e^{-\psi z}(e^{\delta z\sqrt{-1}}-e^{-\delta z\sqrt{-1}})$ $=e^{-\psi z}2\sqrt{-1}\sin\delta z$. Again, by reason of $\theta=\epsilon z$, we have $d\theta=\epsilon dz$; and ϵ being infinitely small, θ must be a very small arc, therefore $\frac{1}{2}\theta$ may be taken for $\sin\frac{1}{2}\theta$, whence $d\theta\div\sin\frac{1}{2}\theta=2dz\div z$. By means of these transformations the expression for Q becomes

$$Q=\frac{1}{\pi}\int_{-\infty}^{+\infty}Xe^{-\psi z\sqrt{-1}}\sin\delta z.\frac{dz}{z},$$

and denotes the probability that the sum of the h values of A will lie between $\psi\mp\delta$.

116. It is now necessary to assign a value to the product denoted by X. Since the number of possible values of A between a and b has been supposed infinite, the chance of obtaining any given one of them, as x, in a single trial, is infinitely small. Assuming this chance to be a function of x, and to vary in the different trials, let it be represented by $\phi_n x$ in respect of the nth trial. In order to preserve continuity in the values of A, this must be understood as signifying that $\phi_n x dx$ is the infinitely small chance that the value of A given by the nth observation will lie between x and $x+dx$. The function $\phi_n x$, therefore, represents the *law of the facility* of the different values of A. It is positive for all values of x between a and b, and vanishes for all values of x less than a or greater than b; and it is important to remark, that whatever number n may be, the integral $\int\phi_n x dx$ taken from $x=a$ to $x=b$ is always equal to unity; for since every observation gives a value of A between a and b, the sum of all the probabilities in respect of each observation must be unity or certainty. From this assumption, then, we have $\phi_1 x dx=p_1$, $\phi_2 x dx=p_2$...... $\phi_h x dx=p_h$, whence the sums $\Sigma p_n e^{i\theta\sqrt{-1}}$ (113) are changed into definite integrals; and therefore, since $\theta=\epsilon z$, $x=i\epsilon$, and consequently $i\theta=xz$, we obtain for the value of X,

$$X=\int e^{zx\sqrt{-1}}\phi_1 x dx.\int e^{zx\sqrt{-1}}\phi_2 x dx....\int e^{zx\sqrt{-1}}\phi_h x dx,$$

the limits of the integrals being $x=a$ and $x=b$.

By reason of $e^{zx\sqrt{-1}}=\cos zx+\sqrt{-1}\sin zx$, each of these integrals may be expressed in terms of the cosine and sine of zx. The nth, for instance, becomes $\int\phi_n x\cos zx.dx+\sqrt{-1}\int\phi_n x\sin zx.dx$. Now since $\int\phi_n dx=1$, (from $x=a$ to $x=b$), and $\phi_n x$ can have only positive values, each of the integrals is less than 1; whence we may assume

$$\int\varphi_n x\cos zx.dx=R_n\cos r_n;\ \int\varphi_n x\sin zx.dx=R_n\sin r_n;$$

R_n being a positive quantity, and r_n an angle having always a real value. This gives

$$\int e^{zx\sqrt{-1}}\phi_n x dx=R_n(\cos r_n-\sqrt{-1}\sin r_n)=R_n e^{r_n\sqrt{-1}};$$

whence substituting successively for n the numbers 1, 2, 3...h, and for the sake of brevity making

$$Y=R_1\times R_2\times R_3.........\times R_h,$$
$$y=r_1+r_2+r_3............+r_h,$$

we get $X=Ye^{y\sqrt{-1}}$; and the expression for Q becomes

$$Q=\frac{1}{\pi}\int_{-\infty}^{+\infty}Ye^{(y-\psi z)\sqrt{-1}}\sin\delta z.\frac{dz}{z}.$$

117. The integral in this last expression is equivalent to two others, namely

$$\int Y\cos(y-\psi z)\sin\delta z.\frac{dz}{z}+\sqrt{-1}\int Y\sin(y-\psi z)\sin\delta z.\frac{dz}{z}.$$

Now, on attending to the nature of the quantities represented by Y and y, it will be manifest that according as z is positive or negative, r_n, and consequently y is positive or negative, while Y is positive in all cases, since R_n is always positive. Hence $\cos(y-\psi z)$ is always positive, and the elements of the first of the above integrals having thus the same value and the same sign for the same value of z, whether z be positive or negative, the value of the integral from $-\infty$ to $+\infty$ is the double of its value from 0 to ∞. On the other hand, since y and z have both the same sign, $\sin(y-\psi z)$ is positive or negative according as z is positive or negative, and the elements of the integral into which it enters being equal for $-z$ and $+z$, but having contrary signs, destroy each other, and the integral from $x=-\infty$ to $x=+\infty$ vanishes. The expression for Q is therefore transformed into

$$Q=\frac{2}{\pi}\int_0^\infty Y\cos(y-\psi z)\sin\delta z.\frac{dz}{z}.$$

118. The formula now found cannot in general be integrated by any of the known methods, but in the present case the quantities denoted by Y and y are such that an approximate value of Q may be obtained, which will always be more nearly equal to the true value as h, the number of observations, is increased. On adding the squares of the two quantities represented by $R_n\cos r_n$ and $R_n\sin r_n$ we get

$$R_n^2=(\int\phi_n x\cos zx.dx)^2+(\int\phi_n x\sin zx.dx)^2.$$

If $z=0$, this becomes $R_n=\int\phi_n x dx$, whence by (116), $R_n=1$. When z has a real value, then it may be shewn that R_n is less than 1; for let x' be any value of A different from x, then as x' can only vary from as a to b, we have obviously,

$\int\varphi_n x'\cos zx'.dx'=\int\varphi_n x\cos zx.dx$, and $\int\varphi_n x'\sin zx'.dx'=\int\varphi_n x\sin zx.dx$,

and the above equation may be put under this form,

$R^2_n=\int\varphi_n x\cos zx.dx.\int\varphi_n x'\cos zx'dx'+\int\varphi_n x\sin zx.dx.\int\varphi_n x'\sin zx'.dx$,

whence

$$R^2_n=\iint\phi_n x\phi_n x'\cos z(x-x')dxdx'.$$

Now, excepting the case in which $z=0$, this double integral is always less than $\iint\phi_n x\phi_n x'dxdx'$, or less than $(\int\phi_n x dx)^2$, and consequently R_n is less than $\int\phi_n x dx$, that is, less than unity. Since, then, it has been shewn that R_n is equal to unity when $z=0$, and less than unity for all other values of z, and since Y is a quantity of the order R_n^h, it follows that Y must diminish with great rapidity when z, or its equal $\theta\div\epsilon$ differs sensibly from 0, and even for very small values of z becomes insensible when h is a large number. We may therefore assume $Y=e^{-\theta^2}$, an expression which is equal to unity when $\theta=0$, and diminishes rapidly as θ is increased, and becomes zero when θ is infinite.

119. For the sake of abridging let us assume

$$k_n=\int x\phi_n x dx,\ k'_n=\int x^2\phi_n x dx,\ k''=\int x^3\phi_n x dx,\ \&c.$$

(the integrals in respect of x being always from $x=a$ to $x=b$). From known formulæ we have

$$\cos zx=1-\frac{z^2x^2}{2}+\frac{z^4x^4}{2.3.4}-\&c.;\ \sin zx=zx-\frac{z^3x^3}{2.3}+\&c.;$$

substituting these series for $\cos zx$ and $\sin zx$ in the integrals $\int\phi_n x\cos zx.dx$ and $\int\phi_n x\sin zx.dx$, and also k_n, k'_n, k''_n, &c., for the values they have now been assumed to represent, then, from (116) we have

$$R_n\cos r_n=1-\frac{z^2}{2}k'_n+\frac{z^4}{2.4}k'''_n-\&c.$$

$$R_n\sin r_n=zk_n-\frac{z^3}{2.3}k''_n+\&c.$$

and it will be seen presently that all the terms involving higher powers of z than the cube may be neglected. Adding together the squares of these two equations, we get $R_n^2=1-z^2(k'_n-k^2_n)+z^4f-\&c.$; whence

$$R_n=1-\tfrac{1}{2}z^2(k'_n-k^2_n)+z^4f'-\&c.;$$

f' being independent of z. On dividing the second by the first, there results $\tan r_n = zk_n - \frac{1}{6}z^3k''_n + \frac{1}{2}z^3k_nk'_n -$ &c.; whence by reason of $r_n = \tan r_n - \frac{1}{3}\tan^3 r_n +$ &c.,

$$r_n = zk_n - \tfrac{1}{6}z^3(k''_n - 3k_nk'_n + 2k_n^3) + \text{\&c.}$$

If, therefore, we make

$$c_n = \tfrac{1}{2}(k'_n - k^2_n),\ g_n = \tfrac{1}{6}z^3(k''_n - 3k_nk'_n + 2k_n^3),$$

the values of R_n and r_n become respectively

$$R_n = 1 - z^2c_n + z^4f' - \text{\&c.};\ r_n = zk_n - z^3g_n + \text{\&c.}$$

Now, by hypothesis (116) $Y = R_1 \times R_2 \times R_3 \ldots\ldots R_h$; therefore $\log Y = \Sigma \log R_n = \Sigma \log(1 - z^2c_n + z^4f' - \text{\&c.}) = -\Sigma\{z^2c_n - z^4(f' - \frac{1}{2}c_n) - \text{\&c.}\}$ (by reason of the formula $\log R_n = R_n - 1 - \frac{1}{2}(R_n - 1)^2 +$ &c.) But we have also assumed (117) $Y = e^{-\theta^2}$; hence $\log Y = -\theta^2$, and consequently $\theta^2 = \Sigma\{z^2c_n - z^4(f' - \frac{1}{2}c_n) - \text{\&c.}\}$ In like manner, since $y = r_1 + r_2 + r_3 \cdots + r_h = \Sigma r_n$, therefore $y = \Sigma zk_n - \Sigma z^3g_n +$ &c. Now, the sums Σ include all values of c_n, k_n, g_n, from $n = 1$ to $n = h$; let the mean values of those quantities, therefore, be denoted by c, k, g, that is to say, let

$$\Sigma c_n = hc,\ \Sigma k_n = hk,\ \Sigma g_n = hg,$$

and make also $hf'' = \Sigma(f' - \frac{1}{2}c_n)$, and we have $\theta^2 = z^2hc - z^4hf'' +$ &c. By reverting the series the value of z is found in terms of θ; namely $z = \dfrac{\theta}{\sqrt{(hc)}} + \dfrac{f''\theta^3}{2hc^2\sqrt{(hc)}} +$ &c.

But the second term of this series, being divided by $h\sqrt{h}$, and h being by supposition a large number, is very small in comparison of the first, and may be neglected as insensible. All the succeeding terms of the series are divided by higher powers of h, and may therefore be rejected *a fortiori*. Confining the approximation, therefore, to terms of the order $1 \div \sqrt{h}$, and rejecting all those into which h or its powers enters as a divisor, we have $z = \theta \div \sqrt{(hc)}$, and likewise $dz \div z = d\theta \div \theta$.

From (116) we have also $y = \Sigma r_n = z\Sigma k_n - z^3\Sigma g_n +$ &c., therefore in consequence of the above transformations, $y = zhk - z^3hg +$ &c.; and on substituting for z its value just found in terms of θ, $y = k\theta\sqrt{(h \div c)} - g\theta^3 \div c\sqrt{(hc)}$, and consequently $y - \psi z = (hk - \psi)\theta \div \sqrt{(hc)} - g\theta^3 \div c\sqrt{(hc)}$. In order to deduce from this an expression for $\cos(y - \psi z)$, let u and v denote any two arcs, then by trigonometry, $\cos(u - v) = \cos u \cos v + \sin u \sin v$. Suppose v to be small, and let its cosine and sine be developed in series and substituted in this equation; it will become

$$\cos(u - v) = \cos u - \frac{v^2}{1.2}\cos u + \text{\&c.} + v\sin u - \frac{v^3}{2.3}\sin u + \text{\&c.}$$

whence, making $u = (hk - \psi)\theta \div \sqrt{(hc)}$, $v = g\theta^3 \div c\sqrt{(hc)}$, and rejecting as before terms of the order $1 \div h$, we have

$$\cos(y - \psi z) = \cos\left\{(hk - \psi)\frac{\theta}{\sqrt{(hc)}}\right\} + \frac{g\theta^3}{c\sqrt{(hc)}}\sin\left\{(hk - \psi)\frac{\theta}{\sqrt{(hc)}}\right\}.$$

If we now substitute the values of Y, z, dz, $\cos(y - \psi z)$ found in the last three paragraphs in the value of Q (117) we obtain the following expression in which the largest terms omitted are of the order $1 \div h$, and which therefore is more accurate as h is a higher number, viz.

$$Q = \frac{2}{\pi}\int_0^\infty e^{-\theta^2}\cos\left\{(hk - \psi)\frac{\theta}{\sqrt{(hc)}}\right\}\sin\frac{\delta\theta}{\sqrt{(hc)}} \cdot \frac{d\theta}{\theta}$$
$$+ \frac{2g}{\pi c\sqrt{(hc)}}\int_0^\infty e^{-\theta^2}\sin\left\{(hk - \psi)\frac{\theta}{\sqrt{(hc)}}\right\}\sin\frac{\delta\theta}{\sqrt{(hc)}}.\theta^2 d\theta.$$

120. As no restriction has yet been made with respect to the value of ψ, excepting that it is a mean between $\mu\epsilon$ and $\nu\epsilon$, and therefore included between ha and hb (115), let us now assume $\psi = hk$. This gives $\cos(hk - \psi) = 1$, and $\sin(hk - \psi) = 0$; and the equation becomes

$$Q = \frac{2}{\pi}\int_0^\infty e^{-\theta^2}\sin\frac{\delta\theta}{\sqrt{(hc)}} \cdot \frac{d\theta}{\theta},$$

which is the probability that the sum of the observed values of A will fall between $hk \mp \delta$.

121. The last step in this investigation is to reduce the integral now found to a known form, which may be accomplished as follows: Let u be a new variable, then by means of the trigonometrical formula $\cos u = \frac{1}{2}e^{u\sqrt{-1}} + \frac{1}{2}e^{-u\sqrt{-1}}$,

$$\int e^{-\theta^2}\cos u\theta.d\theta = \tfrac{1}{2}\int e^{-\theta^2 + u\theta\sqrt{-1}}d\theta + \tfrac{1}{2}\int e^{-\theta^2 - u\theta\sqrt{-1}}d\theta.$$

But $-\theta^2 + u\theta\sqrt{-1} = -\frac{1}{4}u^2 - (\theta - \frac{1}{2}u\sqrt{-1})^2$; assume therefore, $v = \theta - \frac{1}{2}u\sqrt{-1}$ (whence $dv = d\theta$), then

$$\tfrac{1}{2}\int e^{-\theta^2 + u\theta\sqrt{-1}}d\theta = \tfrac{1}{2}\int e^{-\frac{1}{4}u^2 - v^2}dv = \tfrac{1}{2}e^{-\frac{1}{4}u^2}\int e^{-v^2}dv.$$

When $\theta = 0$, then $v = -\frac{1}{2}u\sqrt{-1}$, and when θ is infinite, v is infinite; therefore, if the integral in respect of θ be taken from $\theta = 0$ to $\theta = \infty$, the integral in respect of v must be taken from $v = -\frac{1}{2}u\sqrt{-1}$ to $v = \infty$.

If we now suppose u to be negative, we shall have in like manner $\frac{1}{2}\int e^{-\theta^2 - u\theta\sqrt{-1}}d\theta = \frac{1}{2}e^{-\frac{1}{4}u^2}\int e^{-v^2}dv$, the limits in this case being from $v = +\frac{1}{2}u\sqrt{-1}$ to $v = \infty$. Hence

$$\int e^{-\theta^2}\cos u\theta.d\theta = \tfrac{1}{2}e^{-\frac{1}{4}u^2}\left(\int e^{-v^2}dv + \int e^{-\;^2}dv\right).$$

But the sum of the two integrals on the right-hand side of this equation, the first being taken from $v = -\frac{1}{2}u\sqrt{-1}$ to infinity, and the second from $v = +\frac{1}{2}u\sqrt{-1}$ to infinity, is obviously the double of $\int e^{-v^2}dv$ from $v = 0$ to $v = \infty$, or (96) equal to $\sqrt{\pi}$; and we have therefore

$$\int_0^\infty e^{-\theta^2}\cos u\theta.d\theta = \tfrac{1}{2}\sqrt{\pi}.e^{-\frac{1}{4}u^2}.$$

Let both sides of the equation be multiplied by du, and integrated from $u = 0$ to $u = \delta \div \sqrt{(hc)} = u'$; then observing that $\int \cos(u\theta)d\theta = \sin(u\theta) \div \theta$, we shall have

$$\int_0^\infty e^{-\theta^2}\sin\frac{\delta\theta}{\sqrt{(hc)}}.\ \frac{d\theta}{\theta} = \tfrac{1}{2}\sqrt{\pi}\int_0^{u'} e^{-\frac{1}{4}u^2}du.$$

Comparing this equation with that in (110), we find $Q = (1 \div \sqrt{\pi})\int_0^{u'} e^{-\frac{1}{4}u^2}du$. Now, let $u = 2t$, and let τ be what t becomes when $u = u' = \delta \div \sqrt{(hc)}$; then $\frac{1}{4}u^2 = t^2$, $du = 2dt$, $\delta \div \sqrt{(hc)} = 2\tau$, or $\delta = 2\tau\sqrt{(hc)}$, and we have, finally,

$$Q = \frac{2}{\sqrt{\pi}}\int_0^\tau e^{-t^2}dt, \text{ or, } Q = 1 - \frac{2}{\sqrt{\pi}}\int_\tau^\infty e^{-t^2}dt,$$

for the probability that s, the sum of the observed values of A, will be comprised between the limits $\psi - \delta$ and $\psi + \delta$, that is, between $hk \mp 2\tau\sqrt{(hc)}$; or, that the arithmetical mean of all the observations, namely $s \div h$, will lie between $k \mp 2\tau\sqrt{(c \div h)}$.

122. The expression now found for Q is that which in (96) was denoted by Θ, and of which the table gives the values corresponding to the different values of τ. The general result of the investigation is, therefore, that whatever be the nature of the function $\phi_n x$ which represents the law of the facility of the different values of A, if a large number of observations be made, the sum of the values of A, divided by the number of observations, approaches continually to a certain special quantity k (which is the true mean value of A) as the number of observations is increased, and that by multiplying the number of observations, a probability Θ may always be obtained, approaching as nearly to certainty as we please; that the difference between the arith-

metical mean or average of the observations and the true mean value of A, will be comprised within limits which may be made as small as we please.

The analysis employed in the preceding articles, (113 to 121), for the purpose of establishing this very important result, belongs to Poisson, and is given in nearly the same form in the *Recherches sur la Probabilité des Jugements*, chap. iv., and in the *Additions* to the *Connaissance des Tems* for 1832. We have preferred it to the method followed by Laplace in the *Théorie Analytique*, as being somewhat simpler and also more general.

123. In order that the limits $2\tau\sqrt{(hc)}$ may be real, it is necessary that the special quantity c be positive, a condition which has hitherto been assumed. Now, since $c=\Sigma c_n \div h$, it is obvious that c will be positive if $c_n=\frac{1}{2}(k'_n-k^2_n)$ be positive. On writing for k'_n and k_n their values (119) we have

$$2c_n=\int x^2\phi_n x dx-(\int x\phi_n x dx)^2,$$

the limits of the integrals being always from $x=a$ to $x=b$. But it is evident that no change will be made in the values of these definite integrals (the limits continuing the same), by substituting in them any other of the possible values of A, as x'. We have therefore $\int x'\varphi_n x' dx'=\int x\phi_n x dx$, and since in all cases $\int \phi_n x' dx'=1$, the above equation may be otherwise written

$$2c_n=\int x^2\phi_n x dx \int \varphi_n x' dx'-\int x\varphi_n x dx \int x'\varphi_n x' dx,$$

whence $2c_n=\iint \varphi_n x\varphi_n x'(x^2-xx')dxdx'$,

or $\quad 2c_n=\iint \varphi_n x\phi_n x'(x'^2-x'x)dxdx'$.

Adding together the two last equations, there results

$$4c_n=\iint \varphi_n x\phi_n x'(x-x')^2 dxdx',$$

a quantity which is necessarily positive, and can never be zero so long as x can have different values.

124. The special quantity k to which the average of the values of A continually approaches, is connected with the centre of gravity of the area of a curve by the following relation. Let x and y be the co-ordinates of a curve, of which the equation is $y=\phi_n x$; then the element of the area is $\phi_n x dx$. But (116) $\varphi_n x dx$ is the infinitely small probability that the value of A in the nth observation will lie between x and $x+dx$; therefore the element of the area of the curve represents this probability, and the curve itself represents the law of the probability of the different values of A in respect of the nth trial. In like manner, the curve whose co-ordinates are x and $(1\div h)\Sigma\varphi_n x$, represents the law of the mean probability of A in respect of the whole series of observations. Now, if x_1 be the absciss of the centre of gravity of any curve whose co-ordinates are x and y, the well known formula of mechanics gives $x_1=\int yx dx \div \int y dx$; therefore, applying this formula to the curve of the mean probability, and making the whole area ($\int y dx$ from $x=a$ to $x=b)=1$, the absciss of the centre of gravity is $x_1=(1\div h)\Sigma\int x\varphi_n x dx$. But this is the quantity denoted by k (119); hence the special quantity to which the average of a large number of observations indefinitely approaches is the absciss of the centre of gravity of the area of the curve which represents the law of the mean chances of A.

125. It has been assumed in the foregoing analysis that A is susceptible of an infinite number of values, increasing continuously from a to b. The results, however, are easily adapted to those cases in which the number of possible values of A is finite. Suppose A to be a thing susceptible of only λ different values, represented by $a_1, a_2, a_3 \ldots\ldots a_\lambda$, and let the chances of these values, which may be different in the different trials, be respectively $\gamma_1, \gamma_2, \gamma_3 \ldots\ldots \gamma_\lambda$ in respect of the nth trial. Now, suppose $\varphi_n x$ to be a discontinuous function, which vanishes for all values of x, of which the difference from one or other of the above values of A exceeds an infinitely small quantity ϵ; then the whole integral $\int\varphi_n x dx$ from $x=a$ to $x=b$, will be made up of a series of λ partial integrals $\int\varphi_n x dx$ taken between the limits $a_i \pm \epsilon$, the sum of which will be unity, since one or other of the values of A must necessarily be given by the trial. But the integral $\int\varphi_n x dx$ between the limits $a_i \pm \epsilon$ is the expression of the chance that the value of A given in the nth trial will lie between $a_i \pm \epsilon$; whence for those limits $\int\varphi_n x dx=\gamma_i$. Now the difference $x-a_i$ must be infinitely small, since it cannot exceed ϵ; we may therefore substitute a_i for x, and a_i^2 for x^2 under the sign of integration, when the limits are $a_i \pm \epsilon$, so that for those limits we have $\int x\varphi_n x dx=a_i\int\varphi_n x dx=\gamma_i a_i$. On writing for i all the different numbers $1, 2, 3 \ldots\ldots \lambda$, and observing that the λ partial integrals thus formed make up the whole integral $\int x\varphi_n x dx$ from $x=a$ to $x=b$, and that therefore their sum is k_n, we have, in respect of the nth trial,

$$k_n=\gamma_1 a_1+\gamma_2 a_2+\gamma_3 a_3 \ldots\ldots +\gamma_\lambda a_\lambda.$$

In like manner, for $k'_n=\int x^2\varphi_n x dx$ (from a to b), we have

$$k'_n=\gamma_1 a_1^2+\gamma_2 a_2^2+\gamma_3 a_3^2 \ldots\ldots +\gamma_\lambda a_\lambda^2;$$

so that the two special quantities k and k' become

$$k=(1\div h)\Sigma(\gamma_1 a_1 +\gamma_2 a_2 +\gamma_3 a_3 \ldots\ldots +\gamma_\lambda a_\lambda),$$
$$k'=(1\div h)\Sigma(\gamma_1 a_1^2+\gamma_2 a_2^2+\gamma_3 a_3^2 \ldots\ldots +\gamma_\lambda a_\lambda^2),$$

the sums Σ extending to all the h values of n, or to all the trials, the chances denoted by γ_1, γ_2, &c. being supposed to vary in the different trials.

126. When the chances of the different values of A are equal and constant, then $\gamma_i=1\div\lambda$, and the above values of k and k' become

$$k=(1\div\lambda)(a_1 +a_2 +a_3 \ldots\ldots +a_\lambda),$$
$$k'=(1\div\lambda)(a_1^2+a_2^2+a_3^2 \ldots\ldots +a_\lambda^2),$$

so that k is the arithmetical mean of the possible values of A, and k' the mean of the squares of those values. On this hypothesis, therefore, k and k' may be computed *a priori*, and consequently the limits determined within which there is a given probability Θ that the average of h observations will fall, the limits being $k \mp 2\tau\sqrt{(c\div h)}$, where $c=\frac{1}{2}(k'-k^2)$.

When the chances of the different values of A are unequal, but constant in the different trials, then $k=k_n$, and $k'=k'_n$, and we have

$$k=\gamma_1 a_1 +\gamma_2 a_2 +\gamma_3 a_3 \ldots\ldots +\gamma_\lambda a_\lambda,$$
$$k'=\gamma_1 a_1^2+\gamma_2 a_2^2+\gamma_3 a_3^2 \ldots\ldots +\gamma_\lambda a_\lambda^2.$$

In this case the special quantity k to which the average of the observed values continually approaches, is the sum of the possible values, each multiplied into its respective probability; and k' is the sum of the products of the squares of those values into their respective probabilities.

127. Resuming the consideration of the general formula in (121), we shall now give an example of its application when the function which represents the law of facility of the different values of A is supposed to be known *a priori*.

Of all the hypotheses which may be made respecting the law of facility, the simplest is that which supposes the chances of all the possible values of the thing observed to be equal, and to remain constant during the series of trials. This supposes $\varphi_n x=\varphi x=$ a constant; whence $\int\varphi x dx$, between the limits $x=a$ and $x=b$, becomes $(b-a)\varphi x$. But between those limits we have also $\int\varphi x dx=1$; therefore $\varphi x=1\div(b-a)$. From this value of φx it is easy to deduce the special quantities k and k'. On the present hypothesis $k=k_n$ and $k'=k'_n$; therefore, the limits of the integral being $x=a$ and $x=b$, we have $k=\int x\varphi x dx=\int\frac{x dx}{b-a}=\frac{b^2-a^2}{2(b-a)}=\frac{1}{2}(b+a)$, whence $k^2=\frac{1}{4}(b+a)^2$. In like manner $k'=\int x^2\varphi x dx$ becomes $\int\frac{x^2 dx}{b-a}=\frac{1}{3}(b^2+ba+a^2)$; whence $c=\frac{1}{2}(k'-k^2)$

$=\frac{1}{6}(b^2+ba+a^2)-\frac{1}{8}(b+a)^2$. Hence by (121) we have the probability Θ that the average value of A given by h observations, or the sum of the values of A divided by their number, will lie between

$$\tfrac{1}{2}(b+a) \mp 2\tau\sqrt{\{\tfrac{1}{6}(b^2+ba+a^2)-\tfrac{1}{8}(b+a)^2\}} \div \sqrt{h}.$$

128. This formula may be applied to the following question. Of the comets which have been observed since the year 240 of our era, the parabolic elements of 138 have been computed, and the mean inclination of their orbits to the ecliptic is found to be 48° 55′. Now, supposing every possible inclination of an orbit to be equally probable, let the probability be demanded that the mean inclination of 138 orbits will not differ from 45° (the mean of the possible inclinations) more than 5° in excess or defect.

In this case the limits of the possible values of the phenomenon are 0 and 90°. We have therefore $a=0$, $b=90°$, $h=138$, and the above limits of the error of the average, become $45° \mp \tau \times 90° \div \sqrt{(6 \times 138)}$. In order that the limits may not exceed 5°, we have to determine τ from the equation $\tau \times 90° \div \sqrt{(6 \times 138)} = 5°$, which gives $\tau=\frac{1}{3}\sqrt{23}$; whence $\tau=1{\cdot}6$ very nearly. The tabular value of Θ corresponding to $\tau=1{\cdot}6$ is $\cdot97635$, or nearly $\frac{41}{42}$; and the odds are therefore 41 to 1 that on the supposition of all inclinations being equally probable, the mean inclination of 138 comets would fall between $45° \mp 5°$, that is, between 40° and 50°. The mean of the inclinations actually computed falls within those limits (being 48° 45′); there is therefore a very great probability that whatever may be the nature of the unknown causes which determine the positions of the cometary orbits, it is not such as to render different inclinations unequally probable.

If the question had been to assign the limits within which it is as probable that the mean of the inclinations will fall as not, we should have had $\Theta=\frac{1}{2}$, and consequently (from the table) $\tau=\cdot476936$, and the limits would have been $45° \mp 90° \times \cdot476936 \div \sqrt{(6 \times 138)}$, which is found on calculation to be $45° \mp 1°{\cdot}5$. On the supposition, therefore, that all inclinations are equally probable, it is one to one that the mean of 138 inclinations will fall between $43\frac{1}{2}°$ and and $46\frac{1}{2}°$, or at least not exceed those limits.

129. On the same hypothesis of an equal probability of all possible values, if we suppose the mean value of A to be 0, we have then $a=-b$, and φx becomes $1 \div 2a$, whence the limits corresponding to a given value of Θ (127) become $0 \mp 2\tau b : \sqrt{(6h)}$. Let $\Theta=\frac{1}{2}$, whence $\tau=\cdot476936$, and suppose $h=600$. With these values the limits become $0 \mp \cdot016b$ nearly; that is to say, it is an even wager that the average of 600 observations will not differ from the true mean value of A more than the sixteen-thousandth part of a or b, what is the greatest possible difference.

130. As a second hypothesis, suppose the chance of a given value of A to decrease uniformly as the magnitude increases from 0 to $\pm a$; then φx will be found as follows: Let $\varphi x=\beta$ when $a=0$; we have then by the hypothesis $\varphi x : \beta=(a-x) : a$, whence $\varphi x=(a-x)\beta \div a$, and consequently $\int \varphi x dx=\beta x-\beta x^2 \div 2a$, which, from $x=0$ to $x=+a$, becomes $\frac{1}{2}\beta a$. But $\int \phi x dx$ from $x=-a$ to $x=+a$ is 1 (errors beyond those limits being supposed impossible), therefore from $x=0$ to $x=+a$, $\int \phi x dx=\frac{1}{2}$, and consequently $\frac{1}{2}\beta a=\frac{1}{2}$, or $\beta=1 \div a$. Hence $\phi x=(a-x) \div a^2$, from which the value of c is easily deduced, that of k being 0, as in the former case.

131. Although the function φx which represents the law of facility of the different values of A is in general unknown, its form may be assigned if we assume that it is subject to certain conditions, which, from the nature of the thing, must be very nearly, if not absolutely true, in most practical cases: 1st, That the chance of an error diminishes as the magnitude of the error increases, and for errors beyond a certain limit vanishes altogether; and, 2d, that positive and negative errors, of equal magnitude, are equally probable. The last condition is equivalent to the assumption that the average of the observed values is the true mean value. For simplification, we suppose the chance of an error of a given magnitude to remain constant in all the trials.

132. Let x, x', x'', &c. be a series of values of A, the sum of which is s, and the number h, and make $m=s \div h$, then m is the arithmetical mean or average, which by hypothesis is the true value of the phenomenon A. Let $x-m=\Delta$, $x'-m=\Delta'$, $x''-m=\Delta''$, &c., so that Δ, Δ', Δ'', &c. are the errors of x, x', x'', &c. Now, the most probable single error is 0; and the probability of obtaining an error of a given magnitude Δ in any observation is obviously the same as that of obtaining a given value of x; therefore $\varphi x=\varphi(x-m)=\varphi\Delta$; so that $\varphi\Delta$ is the probability of a single error being exactly Δ. In like manner, the probability of an error ror $=\Delta'$ is $\varphi\Delta'$; and if we take P to denote the probability of a given system of errors, Δ, Δ', Δ'', &c., then the errors being supposed independent of each other, we have (7)

$$P=\varphi\Delta \cdot \varphi\Delta' \cdot \varphi\Delta'', \text{ \&c.}$$

Let this system be assumed to be the most probable result of the observations, then P is a maximum, and its differential co-efficient zero. Taking the logarithms of both sides of the equation, differentiating, and making $d \log. \varphi\Delta=\varphi'\Delta d\Delta$, and $dP \div d\Delta=0$, we obtain

$$0=\varphi'\Delta+\varphi'\Delta'+\varphi'\Delta''+, \text{ \&c.},$$

an equation which may be otherwise written

$$0=\Delta\frac{\varphi'\Delta}{\Delta}+\Delta'\frac{\varphi'\Delta'}{\Delta'}+\Delta''\frac{\varphi'\Delta''}{\Delta''}+, \text{ \&c.}$$

This is the conditional equation of the most probable system of errors. But the hypothesis of the average being the true value, furnishes this other equation,

$$0=(x-m)+(x'-m)+(x''-m)+, \text{ \&c.}$$

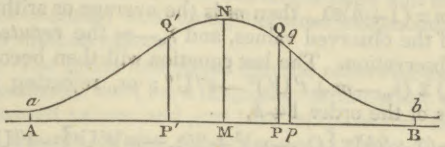
or, which is the same, $0=\Delta+\Delta'+\Delta''+$, &c.; and on comparing this with the above conditional equation, it is evident that they can only be both true simultaneously on the supposition of $\frac{\varphi'\Delta}{\Delta}=\frac{\varphi'\Delta'}{\Delta'}=\frac{\varphi'\Delta''}{\Delta''}=$, &c. Hence it follows that $\varphi'\Delta \div \Delta$ is independent of any particular value of Δ, or is equal to a constant, which we shall call K. We have then

$$\frac{\varphi'\Delta}{\Delta}=\frac{d \,.\, \log. \varphi\Delta}{\Delta d\Delta}=K.$$

The integral of this expression is $\log. \varphi\Delta=\frac{1}{2}K\Delta^2+$ const., which, making the last constant $=\log. H$, and passing to numbers, gives $\varphi\Delta=He^{\frac{1}{2}K\Delta^2}$. It now only remains to determine the two constants H and K. With respect to K, as we suppose the most probable value of Δ to be 0, and that $\varphi\Delta$ diminishes as Δ increases, it is obvious that K must be negative. Assume $\frac{1}{2}K=-\gamma$, and the formula becomes $\varphi\Delta=He^{-\gamma\Delta^2}$. For the determination of H we have the equation $\int\varphi\Delta d\Delta=1$, the limits of the integral being $-a'$ and $+a'$, where $a'=\frac{1}{2}(b-a)$, a and b being the limiting values of x. But it is to be observed, that as all values of Δ exceeding the limits $\pm a'$ are supposed to be impossible, or at least to be so improbable that it is unnecessary to take account of them, the value of the integral $\int\varphi\Delta d\Delta$ from $\Delta=-a'$ to $\Delta=+a'$ will not be altered by extending the limits from − infinity to + infinity. We have therefore $\int_{-\infty}^{+\infty}\varphi\Delta d\Delta=1$. Let $\Delta=t \div \sqrt{\gamma}$, then $d\Delta=dt \div \sqrt{\gamma}$, and $\varphi\Delta=He^{-\gamma\Delta^2}=He^{-t^2}$, on substituting which in the las equation, and observing that from $t=-\infty$ to $t=+\infty$ we have $\int e^{-t^2}dt=\sqrt{\pi}$ (96), we find $(H \div \sqrt{\gamma})\sqrt{\pi}=1$, and $H=\sqrt{(\gamma \div \pi)}$. Whence, finally, $\varphi\Delta=\sqrt{(\gamma \div \pi)}e^{-\gamma\Delta^2}$.

133. The general properties of the function now found

may be illustrated by means of a curve line. Let aNb be



a curve of which $\varphi\Delta$ is the ordinate corresponding to the absciss Δ. Let AB be its axis, and MN its greatest ordinate. Suppose the origin to be placed at M, draw PQ an ordinate at any point P, and pq indefinitely near to PQ, and make $MB = a'$, $MA = -a'$, $MP = \Delta$, and $PQ = \varphi\Delta$; then as was shewn in (124), PQqp, the element of the area, represents the chance of an error lying between Δ and $\Delta + d\Delta$, that is, of an error greater than MP but less than Mp. Now, if $\varphi\Delta = \sqrt{(\gamma \div \pi)}e^{-\gamma\Delta^2}$ the function will not be changed by changing Δ into $-\Delta$; therefore $\varphi\Delta = \varphi(-\Delta)$, and the curve is symmetrical on both sides of MN, as it obviously ought to be according to the hypothesis; for on making $MP' = MP$, then positive and negative errors of equal magnitude being equally probable, we must have $P'Q' = PQ$. Again, since $e^{-\gamma\Delta^2}$ diminishes rapidly as Δ increases, the curve at a short distance from MN must approach very near to its axis AB; but as the function only vanishes when Δ is infinite, the curve will not meet the axis at any finite distance from MN. This curve, therefore, can only represent approximately the law of facility, inasmuch as it is supposed that errors beyond a certain limit are impossible; but on account of the rapid diminution of the ordinate at a short distance from MN, the chance of an error exceeding a small value of Δ, as MB, becomes insensible. Hence the limits of the integrals in respect of Δ may be extended without sensibly altering their values from $\Delta = \pm a'$ to $\Delta = \pm\infty$.

134. It is now necessary to find the special quantities k, k', and c. Substituting Δ for x, and observing that as the law of the chances is here supposed to remain constant, we have $k = k_n$, $k' = k'_n$, the formulæ in (119) become $k = \int\Delta\varphi\Delta d\Delta$, $k' = \int\Delta^2\varphi\Delta d\Delta$. Hence on making $\varphi\Delta = \sqrt{(\gamma \div \pi)}e^{-\gamma\Delta^2}$, we have

$$k = \sqrt{\frac{\gamma}{\pi}}\int\Delta e^{-\gamma\Delta^2}d\Delta = \sqrt{\frac{\gamma}{\pi}}.\frac{1}{2\gamma}\int d.e^{-\gamma\Delta^2} = \frac{1}{2\sqrt{(\gamma\pi)}}e^{-\gamma\Delta^2}.$$

When Δ becomes infinite, this becomes 0, therefore from $\Delta = -\infty$ to $\Delta = +\infty$, $k = 0$. This is an obvious consequence of the symmetry of the curve, for the centre of gravity is necessarily in the straight line MN.

With respect to k' we may proceed thus. We have $k' = \int\Delta^2\phi\Delta d\Delta = \sqrt{(\gamma \div \pi)}\int\Delta^2 e^{-\gamma\Delta^2}d\Delta$. But from the principles of the differential calculus,

$$d\ .\ \Delta e^{-\gamma\Delta^2} = e^{-\gamma\Delta^2}d\Delta - 2\gamma\Delta^2 e^{-\gamma\Delta^2}d\Delta,$$

therefore, integrating and transposing,

$$\int\Delta^2 e^{-\gamma\Delta^2}d\Delta = -\frac{1}{2\gamma}\Delta e^{-\gamma\Delta^2} + \frac{1}{2\gamma}\int e^{-\gamma\Delta^2}d\Delta.$$

Now, from $\Delta = -\infty$ to $\Delta = +\infty$, the term of this equation which is not under the sign of integration vanishes, and $\int e^{-\gamma\Delta^2}d\Delta = \sqrt{(\pi \div \gamma)}$ (from (96), on substituting t^2 for $\gamma\Delta^2$), therefore $\int\Delta^2 e^{-\gamma\Delta^2}d\Delta = (1 \div 2\gamma)\sqrt{(\pi \div \gamma)}$; and consequently $k' = 1 \div 2\gamma$.

In (119) we assumed $c = \frac{1}{2}(k' - k^2)$; therefore in the present case $c = \frac{1}{2}k'$, whence $c = 1 \div 4\gamma$, or $\gamma = 1 \div 4c$.

135. The expressions which have now been found for the function which represents the probability of an error, and the limits corresponding to an assigned degree of probability, are given in terms of the indeterminate constant γ (or c), which depends on the nature of the observation, and therefore, where instruments are requisite, on the goodness of the instrument and the skill of the observer. This constant is called by Laplace the *modulus* of the law of facility. It cannot, in general, be assigned *a priori*; but if we assume that positive and negative departures from the mean are alike probable, which is the most plausible hypothesis the nature of the thing admits of, an approximation to its value, in respect of observations of a given kind, may be deduced with great probability from the results of a large series of observations of the same kind already made. We now proceed to give the analysis by which this is accomplished, following the method of Poisson. The approximation is carried only to quantities of the order $1 \div \sqrt{h}$; terms having h for a divisor are neglected on account of their smallness, h being supposed a large number.

136. In the expression for Q in (119), suppose $\psi = \delta$, and consequently $\psi - \delta = 0$, $\psi + \delta = 2\delta$, and write also z for $\theta \div \sqrt{(hc)}$; the equation then becomes

$$Q = \frac{2}{\pi}\int_0^\infty e^{-\theta^2}\cos(hkz - \delta z)\sin\delta z\ .\ \frac{\delta\theta}{\theta}$$

$$+ \frac{2g}{\pi c\sqrt{(hc)}}\int_0^\infty {}^{-\theta^2}\sin(hkz - \delta z)\sin\delta z\ .\ \theta^2 d\theta,$$

and Q is the probability that s, the sum of the values of A given by all the observations, will lie between 0 and 2δ. If therefore, we suppose δ to be variable, the differential of this expression taken with respect to δ, will express the infinitely small chance of the sum of the values being 2δ exactly. Differentiating, and observing that if u and v denote any two arcs, the trigonometrical formulæ give

$$\sin(u - v)\sin v + \cos(u - v)\cos v = \cos(2v - u),$$
$$-\cos(u - v)\sin v + \sin(u - v)\cos v = -\sin(2v - u),$$

we shall find

$$\frac{dQ}{d\delta}d\delta = \frac{2d\delta}{\pi}\int_0^\infty e^{-\theta^2}\cos(2\delta z - hkz)\frac{zd\theta}{\theta}$$

$$-\frac{2gd\delta}{\pi c\sqrt{(hc)}}\int_0^\infty e^{-\theta^2}\sin(2\delta z - hkz)z\theta^2 d\theta.$$

Let t be a variable quantity, and assume $2\delta = hk + 2t\sqrt{(hc)}$, whence $d\delta = dt\sqrt{(hc)}$, and let the corresponding value of $\frac{dQ}{d\delta}d\delta$ be denoted by qdt, we shall have, on substituting these values, and replacing z by $\theta \div \sqrt{(hc)}$, $qdt = \frac{2dt}{\pi}$

$$\int_0^\infty e^{-\theta^2}\cos(2t\theta)d\theta - \frac{2gdt}{\pi c\sqrt{(hc)}}\int_0^\infty e^{-\theta^2}\sin(2t\theta)\theta^3 d\theta.$$

The two integrals in this equation are found from the formula in (121). Writing $2t$ for u, that formula gives

$$\int_0^\infty e^{-\theta^2}\cos(2t\theta)d\theta = \tfrac{1}{2}\sqrt{\pi}\ .\ e^{-t^2};$$

and if this last equation be differentiated in respect of t, three times in succession, the result will be

$$\int_0^\infty e^{-\theta^2}\sin(2t\theta)\theta^3 d\theta = \tfrac{1}{4}\sqrt{\pi}(3te^{-t^2} - 2t^3 e^{-t^2});$$

whence, if we make $V = \frac{g}{2c\sqrt{(hc)}}(3t - 2t^3)$, we shall have

$$qdt = (1 \div \sqrt{\pi})(1 - V)e^{-t^2}dt,$$

where V is a quantity containing only uneven powers of t, and of the order $1 \div \sqrt{h}$, so that when multiplied by another of the same order, the product will be of the order $1 \div h$, and will therefore be rejected in the present approximation. This value of qdt is the probability that s will be precisely 2δ or $hk + 2t\sqrt{(hc)}$, or it is the infinitely small probability of the equation

$$s = hk + 2t\sqrt{(hc)}.$$

137. In order to apply this result to the determination of the probable limits in terms of observations actually

made, it is necessary to remark that the analysis by means of which it has been obtained is grounded on the very general supposition that the thing to be measured may be any function whatever of the quantity observed; for the infinitely small chance of a particular value of the function is evidently the same as that of the corresponding value of the quantity, and is consequently $\phi_n x dx$. Let X therefore be a function of x, and let K, C, T, be what k, c, t become when X is substituted for x, the above equation then becomes

$$\Sigma X = hK + 2T\sqrt{(hC)},$$

the symbol Σ including all the h values of X; and the probability of this equation is an expression of the same form as that which is represented by qdt.

138. Hitherto no restriction has been made with respect to ϕx; we now introduce the hypothesis that positive and negative departures from the mean of equal magnitude are equally probable, and consequently that the curve representing the law of facility is symmetrical, but shall suppose the chances of a particular value, or a particular error, to vary in the different trials. Let the origin be transferred to the centre of gravity, the absciss of which $=k$, and let $x-k = \Delta$, $x'-k = \Delta'$ &c. We have then by (132) $\phi x = \phi\Delta$, $\int x\phi x dx = \int \Delta\phi\Delta d\Delta$, $\int x^2\phi x dx = \int\Delta^2\phi\Delta d\Delta$, the integration in respect of Δ being from $-\infty$ to $+\infty$. The special quantities k and k' then become $k = (1\div h)\Sigma\int\Delta\phi_n\Delta d\Delta = 0$, $k' = (1\div h)\Sigma\int\Delta^2\phi_n\Delta d\Delta$, whence

$$c = (1\div 2h)\Sigma\int\Delta^2\phi_n\Delta d\Delta.$$

The object is now to eliminate $\phi_n\Delta$, and determine c in terms of the observations.

139. Let $\lambda_n = x$ be the observed value of A in the nth observation, then $\lambda_n - k = \Delta$ is the true error of the observation. Let the function denoted by X in (137) be $(\lambda_n - k)^2 = \Delta^2$, and the corresponding value of K (since in this case, $K = (1\div h)\Sigma\int X\phi_n x dx$) becomes $K = (1\div h)\Sigma\int\Delta^2\phi_n\Delta d\Delta$. Comparing this with the value of c found above, we have $K = 2c$; therefore on substituting these values of X and K in the equation (137), and assuming t' and c' to be the values of T and C when $X = (\lambda_n - k)^2$, we get $\Sigma(\lambda_n - k)^2 = 2hc + 2t'\sqrt{(hc')}$, whence

$$c = (1\div 2h)\Sigma(\lambda_n - k)^2 - t'U' \qquad (1)$$

(U being a quantity of the order $1\div\sqrt{h}$); and the probability of this equation is

$$q'dt' = (1\div\sqrt{\pi})(1 - V')e^{-t'^2}dt',$$

where V′ is a function containing only uneven powers of t', and of the order $1\div\sqrt{h}$.

In the equation (137) suppose $X = x = \lambda_n$, and let t'' and c'' be the corresponding values of T and C, then since on this supposition $K = k$, the equation becomes $\Sigma\lambda_n = hk + 2t''\sqrt{(hc'')}$, whence

$$k = (1\div h)\Sigma\lambda_n - t''U'', \qquad (2)$$

(U″ being of the order $1\div\sqrt{h}$); and the probability of this equation is

$$q''dt'' = (1\div\sqrt{\pi})(1 - V'')e^{-t''^2}dt'',$$

where V″, like V′ and V, contains only uneven powers of t'' and is of the order $1\div\sqrt{h}$.

140. The two equations (1) and (2) may be regarded as two distinct events, having the respective probabilities now assigned to them, and therefore the probability of their being true simultaneously is the product of their respective probabilities, and is accordingly (neglecting the product V′V″ which is a quantity divided by h),

$$q'q''dt'dt'' = (1\div\pi)(1 - V' - V'')e^{-t'^2}e^{-t''^2}dt'dt''.$$

Let the value of k given by equation (2) be substituted in (1), and the expression now given will accordingly be the probability of the resulting equation, namely,

$$c = \frac{1}{2h}\Sigma(\lambda_n - \frac{1}{h}\Sigma\lambda_n + t'U')^2 - t''U''.$$

Let $m = (1\div h)\Sigma\lambda_n$, then m is the average or arithmetical mean of the observed values, and $\lambda_n - m$ the *reputed* error of the observation. The last equation will then become $c = (1\div 2h)\Sigma(\lambda_n - m + t'U')^2 - t''U''$; or, rejecting $(t'U')^2$ which is of the order $1\div h$,

$$c = (1\div 2h)\Sigma\{(\lambda_n - m)^2 + 2(\lambda_n - m)t'U'\} - t''U''.$$

For the sake of abridging let us also assume

$$\mu = (1\div h)\Sigma(\lambda_n - m)^2,\ \nu = (1\div h)\Sigma(\lambda_n - m)t',$$

so that μ is the mean of the squares of the errors, or *mean square* of the errors, and the equation becomes

$$c = \tfrac{1}{2}\mu + \nu U' - t''U'', \qquad (3)$$

the probability of which is $q'q''dt'dt''$.

141. Now, by (121), we have the probability Θ that $s\div h$, or $\Sigma\lambda_n\div h = m$ the arithmetical mean of the observed values of A, will fall within the limits $k \mp 2\tau\sqrt{(c\div h)}$. Substituting in those limits the above value of c, and observing that $(\frac{1}{2}\mu + \nu U' - t''U'')^{\frac{1}{2}} = \sqrt{(\frac{1}{2}\mu)} + N(\nu U' - t''U'') + \&c.$, and that U′ and U″ being of the order $1\div\sqrt{h}$, when divided again by $\sqrt{h}$ are to be rejected, the limits become

$$k \mp 2\tau\sqrt{(\tfrac{1}{2}\mu\div h)},\ \text{or}\ k \mp \tau\sqrt{(2\mu\div h)},$$

and the probability of these being the true limits is Θ multiplied into the probability of the equation $c = \frac{1}{2}\mu + \nu U' - t''U''$; and is therefore (140)

$$(1\div\pi)\Theta(1 - V' - V'')e^{-t'^2}e^{-t''^2}dt'dt''.$$

142. The expression now obtained is the infinitely small probability of the limits $k \mp \tau\sqrt{(2\mu\div h)}$ of the average m, in respect of the particular value of s, for which we have deduced the equation (3). But for every value of s between the limits 0 and 2δ, there will be an equation corresponding to (3); therefore, in order to have the whole probability of those limits, the integral of the expression must be found for all values of t' and t''. From the nature of the expressions $e^{-t'^2}$ and $e^{-t''^2}$ as well as the consideration that errors beyond a certain magnitude, though possible, are wholly improbable, it is evident that the integration may be extended without sensible error from $-\infty$ to $+\infty$; and since the functions V′ and V″ contain only uneven powers of t' and t'', the terms into which they enter, disappear in the integrations between those limits (See Lacroix, *Calcul Diff. et Integral*, tom. iii. p. 506). Now, from $t' = -\infty$ to $t' = +\infty$ we have (96) $\int e^{-t'^2}dt' = \sqrt{\pi}$; and $\int e^{-t''^2}dt'' = \sqrt{\pi}$; therefore

$$\frac{1}{\pi}\Theta\iint(1 - V' - V'')e^{-t'^2}e^{-t''^2}dt'dt'' = \Theta.$$

The result of the preceding analysis is therefore that on the hypothesis of positive and negative errors of equal magnitude being equally probable, and on rejecting terms divided by h (the number of the observations may be always so great as to render such terms insensible), we may substitute $\frac{1}{2}\mu$ for c in the limits of the error to be apprehended, without sensibly altering the probability, and consequently there is the probability $\Theta = \frac{2}{\sqrt{\pi}}\int_0^\tau e^{-t^2}dt$ that the true mean value k of the phenomenon A will lie between the limits

$$m \pm 2\tau\sqrt{(\tfrac{1}{2}\mu\div h)},\ \text{or}\ m \pm \tau\sqrt{(2\mu\div h)},$$

which contain only quantities given by observation.

On this hypothesis we have also (138) $c = (1\div 2h)\Sigma\int\Delta^2\phi_n\Delta d\Delta$, or, supposing the law of facility to remain constant during the trials, $c = \frac{1}{2}\int\Delta^2\phi\Delta d\Delta$, therefore $\mu = \int\Delta^2\phi\Delta d\Delta$; that is to say, the mean of the squares of the actual errors may be taken for the sum of the products of the squares of the possible errors multiplied by their respective probabilities. It is important to remark that as the observations become more numerous, the quantity μ, the mean of the squares of the errors, converges more and more to a constant quantity, and finally becomes independent of the number of observations.

143. The limits now found may be otherwise expressed. By hypothesis, $m=(1\div h)\Sigma\lambda_n=$ the arithmetical mean of the observed values, and $\mu=(1\div h)\Sigma(\lambda_n-m)^2=$ the mean of the squares of the reputed errors. Now $(\lambda_n-m)^2=\lambda_n{}^2-2\lambda_n m+m^2$, and $(1\div h)\Sigma 2\lambda_n m=2m(1\div h)\Sigma\lambda_n=2m^2$; therefore $\mu=(1\div h)\Sigma\lambda_n{}^2-m^2$, that is to say, the mean of the squares of the observations minus the square of the mean. Hence the limits, corresponding to a given probability Θ, of the difference between the average of all the observations and the true value, are expressed by either of these formulæ

$$\pm\tau\surd\{(2\times \text{mean square of errors}\div h\},$$

$$\pm\tau\surd\{2\times \text{mean square of obs.}-(\text{mean of obs.})^2\}\div\surd h,$$

h being the number of observations, and the relation between Θ and τ being given by the table. Generally speaking, the first of these formulæ is the most convenient for calculation.

144. Let l be the limit of the error to be feared in taking the average of the observations as the true result, then $l=\tau\surd(2\mu\div h)$, and $\tau=l\surd(h\div 2\mu.)$ Now when τ is constant, that is, for a given probability Θ, the determination will be more exact in proportion as l is a smaller number, and the precision will therefore be proportional to $\surd(h\div 2\mu)$. Hence $\surd(h\div 2\mu)$ is called by Gauss the *measure of the precision* of the determination. Suppose two series of observations to have been made for the determination of an element, the comparative accuracy of the results will depend on two things, the number of observations in each series, and the amount of the squares of the errors in each. If the number of observations is the same in both series, the precision of each result will be inversely as the square root of the sum of the squares of the errors, and the presumption of accuracy is in favour of that result with respect to which the sum of the squares of the errors is less than in the other. On the other hand, if the mean square of the errors is the same in both series, then the observations are alike good in both, and their relative values of the two results are directly as the square roots of the number of observations in each series. Hence, in order that one determination may be twice as good as another, it must be founded on four times the number of equally good observations. These considerations are very important, in comparing tables of mean values of whatever kind, for example, of the probabilities of life at the different ages, and in estimating risks which depend upon them.

145. Astronomers employ the terms, *weight*, *probable error*, and *mean error*, of a result, to denote certain functions of μ, the mean square of the errors. The square of the quantity which measures the precision of the result, is called the *weight* of the determination. Denoting the weight by w, we have therefore

$$w=h\div 2\mu=h^2\div 2\Sigma(\lambda_n-m)^2,$$

or the weight is equal to the square of the number of observations divided by twice the sum of the squares of the errors. Substituting this in the expression of the limits, we have $l=\tau\div\surd w$, and $\tau=l\surd w$; that is to say, for a given probability Θ, the limits of the error to be apprehended in taking the average as the true result are reciprocally proportional to the square root of the weight. When observations of different kinds, or results deduced from observation, are compared with each other, their relative weights (supposing the number of observations the same) are inversely as μ, and are expressed numerically by taking the weight of a certain series of observations as the unit of weight.

146. The *probable error* of the determination is that which corresponds to the probability $\Theta=\frac{1}{2}$. For $\Theta=\frac{1}{2}$ we have $\tau=\cdot 476936$; whence $\tau\surd 2=\cdot 674489$, and the formula $m\pm\tau\surd(2\mu\div h)$ becomes $m\pm\cdot 674489\surd(\mu\div h)$; whence

$$\text{probable error }=\cdot 674489\surd(\mu\div h).$$

147. The *mean error* of the result of a large number of observations may be deduced from the general formula in (136) as follows. That formula gives $qdt=(1\div\surd\pi)(1-\text{V})e^{-t^2}dt$ for the probability that the sum of the observed values will be $2\delta=hk+2t\surd(hc)$ exactly. Dividing the sum by h, qdt is also the probability that the average value given by all the observations will be exactly $k+2t\surd(c\div h)$. Now, on the hypothesis that positive and negative departures from the mean are equally probable, and supposing the origin of the co-ordinates to be transferred to the centre of gravity of the curve of mean probability, we have $k=0$, and $qdt=(1\div\surd\pi)(1-\text{V})e^{-t^2}dt$ is the infinitely small chance of the average error being $2t\surd(c\div h)$ exactly. Multiplying therefore this error into the chance of its taking place, and integrating the product from $t=0$ to $t=\infty$, we shall have the *mean* error, or *mean risk* of all the possible average errors affected with the positive sign. Now, observing that V represents a quantity divided by $\surd h$, and therefore when multiplied by $2t\surd(c\div h)$ becomes of the order $1\div h$, and may consequently be rejected, the product of the average error $2t\surd(c\div h)$ into its probability is $2\surd(c\div\pi h)\times te^{-t^2}dt$; and since $\int te^{-t^2}dt=\frac{1}{2}\int d.e^{-t^2}=\frac{1}{2}e^{-t^2}$, which from $t=0$ to $t=\infty$ becomes simply $\frac{1}{2}$, the integral of the above product from $t=0$ to $t=\infty$ is $\surd(c\div\pi h)$. Substituting for c its value (142) $=\frac{1}{2}\mu$, this result becomes $\surd(\mu\div 2\pi h)$; whence on computing $\surd(1\div 2\pi)$ we obtain

$$\text{mean error of series }=.398942\surd(\mu\div h).$$

This is the mean error or mean risk in respect of positive errors alone, or on the supposition that negative errors are not taken into account. But as positive and negative errors are equally likely, the mean error in respect of negative errors is the same quantity, whence the mean error in respect of errors of both kinds is $.797884\surd(\mu\div h)$. This is usually called the *average* error. The mean error differs from the probable error in this respect, that it depends on the magnitude of individual errors, as well as on the proportion in which errors of different magnitudes occur. The probable error is independent of the magnitude.

148. When the quantity μ (the mean square of the errors) has been found from a series of observations, the precision, weight, probable error, and mean error, of a coming observation of the same kind are found by supposing $h=1$ in the above expressions, and are respectively

precision . . $=\surd(1\div 2\mu)$
weight . . $=1\div 2\mu$
probable error . $=.674489\surd\mu$
mean error . $=.398942\surd\mu$.

149. The preceding formulæ give the limits of the error to be feared in determining the value of a quantity from a series of observations, when the thing to be determined is that on which the observations are immediately made. We have now to apply the formulæ to the cases in which the quantity sought is not observed itself, but is a function of several others, which are separately determined by observation. The following problem is important:

Let u be a given function of a number of unknown quantitities, x, x', x'', &c.; it is required to assign the limits of the probable error in the determination of U, and the weight of the result, when values of x, x', x'', found from observations independent of each other, and respectively affected with the probable errors $\varrho\surd\mu$, $\varrho\surd\mu'$, $\varrho\surd\mu''$, &c. ($\varrho=.674489$) are adopted instead of the true but unknown values of those quantities.

Let $u=f(x, x', x'', \&c.)$ be the given function, λ, λ', λ'', &c. observed values of x, x', x'', &c. and make $\lambda-x=e$,

$\lambda' - x' = e'$, $\lambda'' - x'' = e''$, &c. so that e, e', e'', &c. are the errors of observation, supposed to be so small that their squares may be rejected. Make $\frac{du}{dx} = a$, $\frac{du}{dx'} = a'$, $\frac{du}{dx''} = a''$, &c., then a, a', a'', are given quantities; and on substituting $x+e$, $x'+e'$, $x''+e''$ for x, x', x'', respectively, in the equation $u = f(x, x', x'', \&c.)$, and supposing u to become $u + \mathrm{E}$ when the substitutions are made, so that E is the corresponding error of u, we have, on expanding u by Taylor's theorem,

$$\mathrm{E} = ae + a'e' + a'e'' + \&c.$$

in respect of a single observation of each of the quantities. Taking the square of both sides of the equation, we have

$$\mathrm{E}^2 = a^2e^2 + a'^2e'^2 + a''^2e''^2 + \&c. + 2aa'ee' + 2aa''ee'' + 2a'a''e'e'' + \&c.$$

Now since positive and negative errors are supposed equally probable, the sums of the products ee', ee'', e', e'', &c. or their mean values, become each $= 0$; therefore

$$\Sigma\mathrm{E}^2 = a^2\Sigma e^2 + a'^2\Sigma e'^2 + a''\Sigma e''^2 + \&c.$$

Taking the mean value of each of these sums, and observing that μ the mean value of Σe^2 is independent of the number of observations (142), and assuming M to be the mean value of $\Sigma\mathrm{E}^2$, we get

$$\mathrm{M} = a^2\mu + a'^2\mu' + a''^2\mu'' + \&c.$$

This equation contains the solution of the problem, for all the functions of the error are given in terms of M. The probable error is $\cdot 674489\sqrt{\mathrm{M}}$.

150. Let W be the weight of the determination, and w, w', w'', &c. the weights corresponding to μ, μ', μ'', &c. then by the definition of weight, w is reciprocally proportioned to μ, and W to M; and we have by substitution,

$$\mathrm{W} = 1 \div \left(\frac{a^2}{w} + \frac{a'^2}{w'} + \frac{a''^2}{w''} + \&c.\right)$$

If the weights are supposed all equal, this becomes

$$\mathrm{W} = \frac{w}{a^2 + a'^2 + a''^2 + \&c.}$$

Suppose the errors e, e' e'', &c. to be respectively multiplied by numbers proportional to the square roots of the weights, (which is equivalent to supposing all the observations to have the same degree of precision measured by $\sqrt{(\mu w)}$), then the value of M becomes

$$\mathrm{M} = a^2\mu w + a'^2\mu' w' + a''^2\mu'' w'' + \&c.$$

But w being reciprocally as μ, we have $\mu w = \mu' w' = \mu'' w''$, &c. $= 1$, therefore

$$\mathrm{W} = \frac{1}{a^2 + a'^2 + a''^2 + \&c.}$$

SECT. X. OF THE METHOD OF LEAST SQUARES.

151. In the determination of astronomical and physical elements from the data of observation, the thing which is actually observed is for the most part not the element which is sought to be determined, but a known function of that element. Thus, if V be a given function of X determined by the equation $\mathrm{V} = \mathrm{F}(\mathrm{X})$, the quantity observed may be a value of V, whilst the element sought to be determined is X. If the observation could give the value of V with absolute accuracy, then X would also be absolutely known; but as all observations are affected with certain errors of greater or less amount, owing to the imperfections of instruments or of sense, or the ever varying circumstances under which they are made, an exact value of X cannot be found from any single observation; and in order to obtain the utmost precision, it is necessary to employ a great number of observations, repeated under every variety of circumstance by which the result can be supposed to be affected.

152. The observed quantity V, instead of being a function of a single element X, may be a function of several elements X, Y, Z, &c.; for example, V may be the position of a planet, in which case it is a function of the six elements of the orbit, for the determination of which the observation is made. Each observation gives rise to an equation of this form, $\mathrm{V} = \mathrm{F}(\mathrm{X}, \mathrm{Y}, \mathrm{Z}, \&c.)$; therefore when the number of equations is just equal to the number of unknown quantities, the problem is determinate; and supposing F to be an algebraic function, the values of X, Y, Z, &c. may be found by the ordinary methods of elimination. If the number of equations is less than the number of unknown quantities, the problem is indeterminate; but if greater, it may be said to be more than determinate, inasmuch as the equations may be combined in an infinite number of ways, each distinct combination giving a different value of the elements. It therefore becomes a question of the utmost importance to the perfection of the sciences of observation, to assign the particular combination which gives the most advantageous results, or values of X, Y, Z, &c. affected with the smallest probable errors.

153. As approximate values of the elements are in all cases either already known, or can be easily found, the object of accumulating observations is the correction of the approximate values. Let V be the true value of the thing observed, V_o an approximate value, however found, X the true value of the element sought, X_o an approximate value, corresponding to V_o, so that we have the two equations $\mathrm{V} = \mathrm{F}(\mathrm{X})$, $\mathrm{V}_o = \mathrm{F}(\mathrm{X}_o)$; also, let the observed value of V in any observation be L, and make

$$v = \mathrm{V} - \mathrm{L}, \quad l = \mathrm{V}_o - \mathrm{L},$$

then v is the true but unknown error of the observation, and l its reputed error, that is to say, the difference between the computed value of the function and the result of the observation. Now if we assume x to represent the true correction of the approximate element, so that $\mathrm{X} = \mathrm{X}_o + x$, then, on substituting $\mathrm{X}_o + x$ for X in the function F, we get $\mathrm{V} = \mathrm{F}(\mathrm{X}_o + x)$; whence, expanding the function by Taylor's theorem, and rejecting terms multiplied by x^2 and higher powers of x, because x is a very small quantity

$$\mathrm{V} = \mathrm{V}_o + \frac{d\mathrm{V}_o}{d\mathrm{X}}x.$$

Let us now denote the differential coefficient, which is a known quantity, by a; then, observing that $\mathrm{V} - \mathrm{V}_o = v - l$, the equation becomes $v = l + ax$; that is to say, the true error of the observation is a linear function of the correction of the element.

154. In like manner, when there are several elements, X, Y, Z, &c.; on making $\frac{d\mathrm{V}_o}{d\mathrm{X}} = a$, $\frac{d\mathrm{V}_o}{d\mathrm{Y}} = b$, $\frac{d\mathrm{V}_o}{d\mathrm{Z}} = c$, &c. a single observation furnishes the equation

$$v = l + ax + by + cz + \&c.,$$

and a series of observations, whose errors are respectively v, v', v'', &c. gives a system of linear equations equal in number to the number of observations; namely,

$$\begin{aligned} v &= l + ax + by + cz + \&c. \\ v' &= l' + a'x + b'y + c'z + \&c. \\ v'' &= l'' + a''x + b''y + c''z + \&c. \\ &\&c. \end{aligned} \qquad (1)$$

and the object is to give such values to x, y, z, &c. that the errors v, v', v'', &c. in respect of the whole of the observations, shall be the least possible. The equations being supposed independent of each other, if their number is just equal to that of the unknown quantities, the errors v, v', v'', &c. can be made all zero; but if, as is usually the case, there are more equations than unknown quantities, it is impossible by any means whatever to annihilate the whole of them, and therefore all that can be accomplished is to find the system of values of x, y, z, &c. which most nearly, and with the greatest probability, satisfies the whole of the equations. If the observations are not all equally good, the equations are supposed to be each multiplied by a number proportional to the square root of the presumed weight of the observation on which it depends, in order that they may all have the same degree of precision.

155. As the question is to find the most probable values of x, y, z, &c. the first thing necessary is to express each of these elements in terms of the observations. Suppose k, k', k'', &c. to be a system of indeterminate quantities, independent of x y, z, &c. and let the first of the above conditional equations be multiplied by k, the second by k', the third by k'', and so on; then adding the products, if k, k', k'', &c. be determined so as to make the coefficient of x equal to unit, and those of y, z, &c. each equal to 0; that is to say, so as to satisfy the equations

$$\begin{aligned} &ka + k'a' + k''a'' + \text{\&c.} = 1 \\ &kb + k'b' + k''b'' + \text{\&c.} = 0 \\ &kc' + k'c' + k''c'' + \text{\&c} = 0 \\ &\text{\&c.} \end{aligned} \qquad (2)$$

we shall then have $x = \text{K} + kv + k'v' + k''v'' +$ &c. where K is a quantity independent of v, v', v'', &c. Hence x is found $=\text{K}$, with an error $= kv + k'v' + k''v' +$ &c.; and the *weight* of the determination, by the formula in (150), is $\dfrac{1}{k^2 + k'^2 + k''^2 + \text{\&c}}$. The weight of the determination is consequently greater in proportion as $k^2 + k'^2 + k''^2 +$ &c. is smaller; and hence of all the possible systems of indeterminate coefficients, k, k', k'', &c. which satisfy the equations (1), the system which gives the most probable value of x, or the most advantageous result, is that for which $k^2 + k'^2 + k''^2 +$&c. is an absolute minimum.

156. We have now to find, in terms of known quantities, values of the indeterminate coefficients k, k', k'', &c. which satisfy the condition of the minimum. For the sake of abridging, let us denote the aggregate of the products $aa + a'a' + a''a'' +$ &c, by $\text{S}(aa)$, that of $ab + a'b' + a''b'' +$ &c. by $\text{S}(ab)$, and so on, and also assume

$$\begin{aligned} \xi &= av + a'v' + a''v'' + \text{\&c.} \\ \eta &= bv + b'v' + b''v'' + \text{\&c.} \\ \zeta &= cv + c'v' + c''v'' + \text{\&c.} \end{aligned} \qquad (3)$$

On substituting in these equations the values of v, v', v'', &c. given by the equations (1), there results

$$\begin{aligned} \xi &= \text{S}(al) + x\text{S}(aa) + y\text{S}(ab) + z\text{S}(ac) + \text{\&c.} \\ \eta &= \text{S}(bl) + x\text{S}(ab) + y\text{S}(bb) + z\text{S}(bc) + \text{\&c.} \\ \zeta &= \text{S}(cl) + x\text{S}(ac) + y\text{S}(bc) + z\text{S}(cc) + \text{\&c.} \end{aligned} \qquad (4)$$

a system of equations equal in number to the number of elements x, y, z, &c. and from which, consequently, those elements would be determined absolutely if the observations were perfectly exact, that is, if the errrors v, v', v'', &c. were individually zero, and consequently ξ, η, ζ, &c., were each zero. On eliminating y, z, &c. from the last system, the value of x is given in terms of ξ, η, ζ, and known quantities by a linear equation of the following form:

$$x = \text{A} + f + g + h\zeta + \text{\&c.} \qquad (5)$$

where f, g, h, &c. are co-efficients independent of x, y, z, &c. and also of ξ, η, ζ, &c.

If we now substitute in equation (5) the values ξ, η, ζ, &c. given by equations (3), and also assume

$$\begin{aligned} \alpha &= fa + gb + hc + \text{\&c.} \\ \alpha' &= f'a' + g'b' + h'c' + \text{\&c.} \\ \alpha'' &= f''a'' + g''b'' + h''c'' + \text{\&c.}, \end{aligned} \qquad (6)$$

we shall have by addition

$$x = \text{A} + \alpha v + \alpha' v' + \alpha'' v'' + \text{\&c.};$$

whence it appears that $\alpha, \alpha', \alpha''$, &c. are a system of multipliers by which y, z, &c. are eliminated from equations (1); they must therefore satisfy the equations (2), whence

$$\begin{aligned} &\alpha a + \alpha' a' + \alpha'' a'' + \text{\&c.} = 1 \\ &\alpha b + \alpha' b' + \alpha'' b'' + \text{\&c.} = 0 \\ &\alpha c + \alpha' c' + \alpha'' c'' + \text{\&c.} = 0. \end{aligned} \qquad (7)$$

Subtracting these from the equations (2) we obtain

$$\begin{aligned} 0 &= (k - \alpha)a + (k' - \alpha')a' + (k'' - \alpha'')a'' + \text{\&c.} \\ 0 &= (k - \alpha)b + (k - \alpha)b' + (k'' - \alpha'')b'' + \text{\&c.} \\ 0 &= (k - \alpha)c + (k - \alpha)c' + (k'' - \alpha'')c'' + \text{\&c.}, \end{aligned}$$

on multiplying which respectively by f, g, h, and adding the products, we get by reason of the equations (6),

$$0 = (k - \alpha)\alpha + (k' - \alpha')\alpha' + (k'' - \alpha'')\alpha'' + \text{\&c.}$$

This equation may be put under the form $k^2 + k'^2 + k''^2 +$&c.

$$= \alpha^2 + \alpha'^2 + \alpha''^2 + \text{\&c.} + (k - \alpha)^2 + (k' - \alpha')^2 + (k'' - \alpha'')^2 + \text{\&c.}$$

from which it is evident that $k^2 + k'^2 + k''^2 +$ &c. will be a minimum when $k = \alpha$, $k' = \alpha'$, $k'' = \alpha''$, &c. Hence it follows that the most probable value of x which can be deduced from the equations (1), is $x = \text{A}$; and by (150) the weight of the determination is $1 \div (\alpha\alpha + \alpha'\alpha' + \alpha''\alpha'' + \text{\&c.}) = 1 \div \text{S}(\alpha\alpha)$.

This quantity $\text{S}(\alpha\alpha)$ is equal to f the co-efficient of ξ in the equation (5); for on multiplying the first of equations (7), by f, the second by g, and the third by h, and adding the products, we obtain by reason of equations (6),

$$\alpha\alpha + \alpha'\alpha' + \alpha''\alpha'' + \text{\&c.} = f.$$

157. The method explained in the two last paragraphs of determining the most advantageous combination of a system of linear equations, of the form of those in (154), is given by Gauss in his *Theoria Combinationis Observationum erroribus minimis obnoxiæ*, (Gottingen, 1823). The practical rule to which it leads is as follows: Having given a near value V of a function of several elements, X, Y, Z, &c. and also a series L, L′, L″, &c. of observed values of V, make $(\text{V} - \text{L})\sqrt{w} = v$, $(\text{V} - \text{L}')\sqrt{w'} = v'$, $(\text{V} - \text{L}'')\sqrt{w'}$, $= v''$, &c. and form the equations in (1). From these equations (4) are easily deduced; and from these, again, by elimination, arc found the values of x, y, z, &c. the corrections of the approximate elements X, Y, Z, &c., in equations of the form (5), which, for the sake of symmetry, may be thus written:

$$\begin{aligned} x &= \text{A} + (\alpha\alpha)\xi + (\alpha\beta)\eta + (\alpha\gamma)\zeta + \text{\&c.} \\ y &= \text{B} + (\alpha\beta)\xi + (\beta\beta)\eta + (\beta\gamma)\zeta + \text{\&c.} \\ z &= \text{C} + (\alpha\gamma)\xi + (\beta\gamma)\eta + (\gamma\gamma)\zeta + \text{\&c.} \end{aligned}$$

then the most probable values of x, y, z, &c. are repectively A, B, C, &c.; the weights of the determinations respectively $\dfrac{1}{(\alpha\alpha)}, \dfrac{1}{(\beta\beta)}, \dfrac{1}{(\gamma\gamma)}$, &c.; and the probable errors of the several determinations are $\rho\sqrt{(\alpha\alpha)}$, $\rho\sqrt{(\beta\beta)}$, $\rho\sqrt{(\gamma\gamma)}$, &c., where $\rho = {\cdot}476936$.

158. The values of x, y, z, &c. now deduced are obtained immediately, by supposing the sum of the squares of the errors of observation to be a minimum. Thus, forming the squares of the equations (1), and making $\Omega = v^2 + v'^2 + v''^2 +$ &c., the differentiation of Ω in respect of each of the variables x, y, z, &c. produces the quantities denoted in (156), by ξ, η, ζ, &c. that is to say, it gives

$$\frac{d\Omega}{dx} = 2\xi, \ \frac{d\Omega}{dy} = 2\eta, \ \frac{d\Omega}{dz} = 2\zeta, \ \text{\&c.}$$

therefore if Ω be a minimum, ξ, η, ζ, become severally zero, and the equations (4) give by elimination, $x = \text{A}$, $y = \text{B}$, $z = \text{C}$, where A, B, and C denote the same quantities as above. Now from equation (5) the general value of x is

$$x = \text{A} + (\alpha\alpha)\xi + (\alpha\beta)\eta + (\alpha\gamma)\zeta,$$

and the most probable value being $x=A$, it follows that the most probable values of the corrections x, y, z, are found by making the differential coefficients of Ω equal to zero, that is, by making $v^2+v'^2+v''^2+$ &c. an absolute minimum. Hence this method of combining equations of condition is called the *method of least squares;* and it follows from the preceding analysis, that it gives the most probable values of the corrections, or the most advantageous results.

159. As an example, let us suppose there is only one unknown element X, of which X_o is known to be an approximate value, and L, L′, L″, &c. are observed values, the weights of which are respectively proportional to w, w', w'', &c. and that it is required to determine the most probable value of X from the observations, and also the weight of the determination. Make $(X-L)\sqrt{w}=v$, $(X_o-L)\sqrt{w}=l$, and let x be the correction of X, so that $X=X_o-x$. On substituting this in $(X-L)\sqrt{w}=v$, we have $(X_o-x-L)\sqrt{w}=v$, or $v=l\sqrt{w}-x\sqrt{w}$. Each observation gives a similar equation, and the equations (1) in (154) consequently become

$$v=l\sqrt{w}-x\sqrt{w}$$
$$v'=l'\sqrt{w'}-x\sqrt{w'}$$
$$v''=l''\sqrt{w''}-x\sqrt{w''},\ \text{\&c.}$$

therefore, multiplying each by the coefficient of its own x, we have $\xi=S(lw)-xS(w)$, whence consequently $x=S(lw)\div S(w)-\xi\div S(w)$, that is to say, the most probable value of x is

$$x=\frac{lw+l'w'+l''w''+\text{\&c.}}{w+w'+w''+\text{\&c.}},$$

and the weight of the determination is proportional to the reciprocal of $w+w'+w''+$ &c.

Since $X-L=x-l$, we have also

$$X=\frac{Lw+L'w+L''w+\text{\&c.}}{w+w'+w''+\text{\&c.}},$$

whence this proposition: If a series of values of an element are found from observations which have not all the same degree of precision, the most probable value of the element is found by multiplying each observation by a number proportional to its weight, and dividing the sum of the products by the sum of the weights; and the comparative weight of the result is unit divided by the sum of all the weights.

If the weights be all equal, and the number of the observations be h, then $X=(L+L'+L''+\text{\&c.})\div h$; that is to say, the average of a series of equally good observations gives the most probable value. The average may, therefore be considered as a particular case of the method of least squares.

160. To illustrate the method of proceeding when there are several elements to be corrected from the observations, we shall take the following numerical example from Gauss (*Theoria Motus).* Suppose there are three elements, and that three observations, of equal weight, have given the equations $x-y+2z=3$, $3x+2y-5z=5$, $4x+y+4z=21$; and that a fourth observation, of which the relative weight is one-fourth, or its precision one-half, of that of the others has given $-2x+6y+6z=28$. The first step is to reduce this last equation to the same standard of weight with the others, for which purpose it must be multiplied by $\frac{1}{2}$; it then becomes $-x+3y+3z=14$. Now, as x, y, and z cannot be determined so as to satisfy four independent equations, we suppose each observation, or equation, to be affected with an error v, and accordingly obtain the following system of equations, corresponding to equations (1), viz.:

$$v=-3+x-y+2z$$
$$v'=-5+3x+2y-5z$$
$$v''=-21+4x+y+4z$$
$$v'''=-14-x+37+3z,$$

from which the most probable values of x, y, and z are to be deduced. Let each equation be multiplied by the coefficient of its own x, taken with its proper sign, namely, the first by 1, the second by 3, the third by 4, and the fourth by -1; the results added together give the value of ξ, namely, $\xi=-88+27x+6y$. In like manner, let the first be multiplied by -1, the second by 2, the third by 1, and the fourth by 3, the sum of the products will give η. Lastly, let the equations be multiplied respectively by the coefficients of z, and the sum of the products made equal to ζ; we have then the following equations corresponding to the equations (4)

$$\xi=-88+27x+6y+0$$
$$\eta=-70+6x+15y+z$$
$$\zeta=-107+0+y+54z.$$

From these we get by elimination

$$19899x=49154+809\xi-324\eta+6\zeta$$
$$737y=2617-12\xi+54\eta-\zeta$$
$$39798z=76242+12\xi-54\eta+1473\zeta,$$

whence (157) A, B, C, the most probable values of x, y, z, are respectively

$$A=\frac{49154}{19899}=2{\cdot}470,\ B=\frac{2617}{737}=3{\cdot}551,\ C=\frac{76242}{39798}=1{\cdot}916;$$

and the relative weights w, w', w'', are respectively

$$w=\frac{19899}{809}=24{\cdot}6,\ w'=\frac{737}{54}=13{\cdot}6,\ w''=\frac{39798}{1473}=27{\cdot}0,$$

whence the probable errors $({\cdot}476936\div\sqrt{w})$ are respectively ·096, ·129, ·092.

The method of least squares, to which modern astronomy is indebted for much of its precision, was first proposed by Legendre, in his *Nouvelles Méthodes pour la Determination les Orbites des Comètes*, (Paris, 1806,) merely as means of avoiding inconvenience and uncertainty arising from the want of a uniform and determinate method of combining numerous equations of condition, and without reference to the theory of probability. The same method, however, had previously been discovered by Gauss, and a demonstration of it, deduced from the general theory of chances, was given by him in his *Theoria Motus*, (1809.) It may be shewn in various ways, that this method of combination gives values of the unknown quantities affected with the smallest probable errors; but it is to be observed, that all the demonstrations are subordinate to the hypothesis, that positive and negative errors of equal magnitude are equally probable, or that the average of a large number of results gives the most probable value, and consequently that the function which represents the probability of an error has the form assigned to it in (132).

The limits of this article will not permit us to enter into further details respecting the applications of the method of least squares. On the general theory of the probable errors of results deduced from observation, and the most advantageous methods of combining equations of condition, the reader may consult the *Théorie Analytique des Probabilités* of Laplace; the *Theoria Motus* of Gauss; the *Theoria Combinationis Observationum*, and the *Supplementum Theoriæ Combinationis*, &c. (Göttingen, 1828) of the same author; the *Recherches sur la Probabilité des Jugements*, with the two Memoirs of Poisson in the *Connaissance des Tems* for 1827 and 1832; and three masterly papers, by Mr. Ivory, in the *Philosophical Magazine* for 1825. In the volumes of the *Berliner Astronomisches Jahrbuch* for 1833, 1834, and 1835, M. Encke has treated the subject at great length, and given a number of formulæ calculated to facilitate the labours of the computer. We may also refer, in conclusion, to a very recent and remarkable disquisition on the theory of probable errors, by the celebrated astronomer Bessel, forming Nos. 358 and 359 of Schumacher's *Astronomische Abhandlungen*, Altona, October 1838.

(s.)

TABLE of the Values of the Integral $\Theta=\frac{2}{\sqrt{\pi}}\int_0^\tau e^{-t^2}dt=1-\frac{2}{\sqrt{\pi}}\int_\tau^\infty e^{-t^2}dt$, for intervals each =·01, from $\tau=0$ to $\tau=3$, with their first and second differences.

τ	Θ	Δ	Δ^2	τ	Θ	Δ	Δ^2	τ	Θ	Δ	Δ^2	τ	Θ	Δ	Δ^2
0·00	0·0000000	112833	22	0·75	0·7111556	63811	962	1·50	0·9661052	11716	349	2·25	0·9985373	698	30
0·01	·0112833	112811	45	0·76	·7175367	62849	961	1·51	·9672768	11367	340	2·26	·9986071	668	30
0·02	·0225644	112766	67	0·77	·7238216	61888	957	1·52	·9684135	11027	332	2·27	·9986739	638	29
0·03	·8338410	112699	90	0·78	·7300104	60931	956	1·53	·9695162	10695	325	2·28	·9987377	609	27
0·04	·0451109	112609	112	0·79	·7361035	59975	952	1·54	·9705857	10370	316	2·29	·9987986	582	26
0·05	·0563718	112497	135	0·80	·7421010	59023	948	1·55	·9716227	10054	309	2·30	·9988568	556	25
0·06	·0676215	112362	158	0·81	·7480033	58075	945	1·56	·9726281	9745	301	2·31	·9989124	531	24
0·07	·0788577	112204	179	0·82	·7538108	57130	941	1·57	·9736026	9444	294	2·32	·9989655	507	23
0·08	·0900781	112025	201	0·83	·7595238	56189	936	1·58	·9745470	9150	286	2·33	·9990162	484	23
0·09	·1012806	111824	224	0·84	·7651427	55253	931	1·59	·9754620	8864	279	2·34	·9990646	461	20
0·10	·1124630	111600	246	0·85	·7706680	54322	926	1·60	.9763484	8585	273	2·35	·9991107	441	21
0·11	·1236230	111354	267	0·86	·7761002	53396	921	1·61	.9772069	8312	264	2·36	·9991548	420	19
0·12	·1347584	111087	288	0·87	·7814398	52475	916	1·62	·9780381	8048	259	2·37	·9991968	401	19
0·13	·1458671	110799	310	0·88	·7866873	51559	909	1·63	·9788429	7789	251	2·38	·9992369	382	18
0·14	·1569470	110489	331	0·89	·7918432	50650	904	1·64	·9796218	7538	245	2·39	·9992751	364	17
0·15	·1679959	110158	352	0·90	·7969082	49746	897	1·65	·9803756	7293	238	2·40	·9993115	347	16
0·16	·1790117	109806	372	0·91	·8018828	48849	891	1·66	·9811049	7055	231	2·41	·9993462	331	16
0·17	·1899923	109434	393	0·92	·8067677	47958	883	1·67	·9818104	6824	226	2·42	·9993793	315	15
0·18	·2009357	109041	414	0·93	·8115635	47075	877	1·68	·9824928	6598	220	2·43	·9994108	300	14
0·19	·2118398	108627	434	0·94	·8162710	46198	870	1·69	·9831526	6378	212	2·44	·9994408	286	14
0·20	·2227025	108193	453	0·95	·8208908	45328	861	1·70	·9837904	6166	208	2·45	·9994694	272	12
0·21	·2335218	107740	473	0·96	·8254236	44467	855	1·71	·9844070	5958	201	2·46	·9994966	260	14
0·22	·2442958	107267	492	0·97	·8298703	43612	846	1·72	·9850028	5757	196	2·47	·9995226	246	11
0·23	·2550225	106775	512	0·98	·8342315	42766	839	1·73	·9855785	5561	190	2·48	·9995472	235	12
0·24	·2657000	106263	529	0·99	·8385081	41927	830	1·74	·9861346	5371	185	2·49	·9995707	223	10
0·25	·2763263	105734	549	1·00	·8427008	41097	822	1·75	·9866717	5186	179	2·50	·9995930	213	11
0·26	·2868997	105185	567	1·01	·8468105	40275	813	1·76	·9871903	5007	175	2·51	·9996143	202	10
0·27	·2974182	104618	584	1·02	·8508380	39462	805	1·77	·9876910	4832	168	2·52	·9996345	192	9
0·28	·3078800	104034	601	1·03	·8547842	38657	796	1·78	·9881742	4664	165	2·53	·9996537	183	10
0·29	·3182834	103433	619	1·04	·8586499	37861	786	1·79	·9881406	4499	159	2·54	·9996720	173	8
0·30	·3286267	102814	636	1·05	·8624360	37075	777	1·80	·9890905	4340	154	2·55	·9996893	165	8
0·31	·3389081	102178	652	1·06	·8661435	36297	768	1·81	·9895245	4186	150	2·56	·9997058	157	8
0·32	·3491259	101526	667	1·07	·8697732	35529	760	1·82	·9899431	4036	144	2·57	·9997215	149	8
0·33	·3592785	100859	684	1·08	·8733261	34769	749	1·83	·9903467	3892	141	2·58	·9997364	141	6
0·34	·3693644	100175	698	1·09	·8768030	34020	740	1·84	·9907359	3751	136	2·59	·9997505	135	8
0·35	·3793819	99477	714	1·10	·8802050	33280	731	1·85	·9911110	3615	133	2·60	·9997640	127	6
0·36	·3893296	98763	729	1·11	·8835330	32549	721	1·86	·9914725	3482	127	2·61	·9997767	121	6
0·37	·3992059	98034	742	1·12	·8867879	31828	712	1·87	·9918207	3355	124	2·62	·9997888	115	6
0·38	·4090093	97292	755	1·13	·8899707	31116	701	1·88	·9921562	3231	120	2·63	·9998003	109	6
0·39	·4187385	96537	769	1·14	·8930823	30415	691	1·89	·9924793	3111	116	2·64	·9998112	103	5
0·40	·4283922	95768	782	1·15	·8961238	29724	682	1·90	·9927904	2995	112	2·65	·9998215	98	5
0·41	·4379690	94986	795	1·16	·8990962	29042	672	1·91	·9930899	2883	108	2·66	·9998313	93	5
0·42	·4474676	94191	807	1·17	·9020004	28370	661	1·92	·9933782	2775	106	2·67	·9998406	88	4
0·43	·4568867	93384	817	1·18	·9048374	27709	652	1·93	·9936557	2669	101	2·68	·9998494	84	5
0·44	·4662251	92567	830	1·19	·9076083	27057	642	1·94	·9939226	2568	99	2·69	·9998578	79	4
0·45	·4754818	91737	840	1·20	·9103140	26415	631	1·95	·9941794	2469	95	2·70	·9998657	75	4
0·46	·4846555	90897	853	1·21	·9129555	25784	622	1·96	·9944263	2374	91	2·71	·9998732	71	4
0·47	·4937452	90046	861	1·22	·9155339	25162	611	1·97	·9946637	2283	89	2·72	·9998803	67	4
0·48	·5027498	89185	869	1·23	·9180501	24551	602	1·98	·9948920	2194	85	2·73	·9998870	63	2
0·49	·5116683	88316	878	1·24	·9205052	23949	591	1·99	·9951114	2109	84	2.74	·9998933	61	4
0·50	·5204999	87438	888	1·25	·9229001	23358	581	2·00	·9953223	2025	78	2·75	·9998994	57	3
0·51	·5292437	86550	896	1·26	·9252359	22777	571	2·01	·9955248	1947	79	2·76	·9999051	54	3
0·52	·5378987	85654	903	1·27	·9275136	22206	561	2·02	·9957195	1868	73	2·77	·9999105	51	3
0·53	·5464641	84751	910	1·28	·9297342	21645	552	2·03	·9959063	1795	72	2·78	·9999156	48	2
0·54	·5549392	83841	917	1·29	·9318987	21093	541	2·04	·9960858	1723	69	2·79	·9999204	46	3
0·55	·5633233	82924	923	1·30	·9340080	20552	532	2·05	·9962581	1654	67	2·80	·9999250	43	2
0·56	·5716157	82001	930	1·31	·9360632	20020	522	2·06	·9964235	1587	65	2·81	·9999293	41	3
0·57	·5798158	81071	935	1·32	·9380652	19498	511	2·07	·9965822	1522	61	2·82	·9999334	38	1
0·58	·5879229	80136	940	1·33	·9400150	18987	502	2·08	·9967344	1461	61	2·83	·9999372	37	3
0·59	·5959365	79196	945	1·34	·9419137	18485	493	2·09	·9968805	1400	57	2·84	·9999409	34	1
0·60	·6038561	78251	949	1·35	·9437622	17992	482	2·10	·9970205	1343	55	2·85	·9999443	33	2
0·61	·6116812	77302	953	1·36	·9455614	17510	474	2·11	·9971548	1288	54	2·86	·9999476	31	2
0·62	·6194114	76349	955	1·37	·9473124	17036	463	2·12	·9972836	1234	51	2·87	·9999507	29	2
0·63	·6270463	75394	959	1·38	·9490160	16573	455	2·13	·9974070	1183	50	2·88	·9999536	27	1
0·64	·6345857	74435	962	1·39	·9506733	16118	445	2·14	·9975253	1133	47	2·89	·9999563	26	2
0·65	·6420292	73473	963	1·40	·9522851	15673	435	2·15	·9976386	1086	47	2·90	·9999589	24	1
0·66	·6493765	72510	965	1·41	·9538524	15238	427	2·16	·9977472	1039	45	2·91	·9999613	23	1
0·67	·6566275	71545	966	1·42	·9553762	14811	418	2·17	·9978511	994	40	2·92	·9999636	22	1
0·68	·6637820	70579	968	1·43	·9568573	14393	409	2·18	·9979505	954	41	2·93	·9999658	21	2
0·69	·6708399	69611	967	1·44	·9582966	13984	399	2·19	·9980459	913	41	2·94	·9999679	19	1
0·70	·6778010	68644	968	1·45	·9596950	13585	391	2·20	·9981372	872	37	2·95	·9999698	18	1
0·71	·6846654	67676	968	1·46	·9610535	13194	382	2·21	·9982244	835	36	2·96	·9999716	17	...
0.72	·6914330	66708	966	1·47	·9623729	12812	374	2.22	·9983079	799	35	2·97	·9999733	...	...
0·73	·6981038	65742	966	1·48	·9636541	12438	365	2·23	·9983878	764	33			...	...
0·74	·7046780	64776	965	1·49	·9648979	12073	357	2·24	·9984642	731	33	3·00	·9999779	...	...

PROBATE of a will or testament, in *Law*, is the exhibiting and proving of last wills and testaments before the ecclesiastical judge delegated by the bishop, who is ordinary of the place where the party died.

PROBATION, in the universities, is the examination and trial of a student who is about to take his degrees.

PROBATIONER, in the Church of Scotland, a student in divinity, who, upon bringing certain certificates and testimonials, is admitted to undergo several trials; and, on his acquitting himself properly in these, is provided with a license to preach.

PROBLEM, in *Logic*, is a proposition that appears neither absolutely true nor absolutely false; and, consequently, may be asserted either in the affirmative or negative.

Problem, in *Geometry*, is a proposition, in which some operation or construction is required; as to divide a line or angle, erect or let fall perpendiculars.

PROBOLINGO, the capital of a district of Java, occupied by a native of China, who purchased it from the former government. He was called the China Major, and on the 18th of June 1813, was unfortunately murdered along with two British officers, Colonel Fraser of the 78th Regiment, and Captain Macpherson, who, on their way to disperse a band of insurgents, fell into an ambuscade.

PROBY'S ISLAND, a small island in the South Pacific Ocean, so called by Captain Edwards in 1791. The natives call it Onoo-afou. Long. 175. 51. W. Lat. 15. 53. S.

PROCESS, in *Law*, denotes the proceedings in any cause, real or personal, civil or criminal, from the original writ to the conclusion of the suit.

Process, in *Chemistry*, the whole course of an experiment or series of operations, tending to produce something new.

Process, in *Anatomy*, denotes any protuberance or eminence in a bone.

PROCESSION, a ceremony in the Catholic church, consisting of a formal march of the clergy and people, putting up prayers, and in this manner visiting some church, or other holy place.

PROCLAMATION, a public notice given of any thing of which the king thinks proper to advertise his subjects.

Proclamations form a branch of the king's prerogative, and they have a binding force, when they are grounded upon and enforce the laws of the realm. For though the making of laws is entirely the work of a distinct part, the legislative branch of the sovereign power, yet the manner, time, and circumstances of putting those laws in execution, must frequently be left to the discretion of the executive magistrate; and therefore his constitutions or edicts, concerning those points, which we call *Proclamations*, are binding upon the subject, where they do not either contradict the old laws, or tend to establish new ones, but only enforce the execution of such laws as are already in being, in such manner as the king shall judge necessary.

PROCLUS, surnamed Diadocus, a Greek philosopher and mathematician, was born in Lycia, and lived about the year 500. He was the disciple of Syrianus, and the friend of the Emperor Anastasius. It is said, that when Vitalian laid siege to Constantinople, Proclus burned his ships with large brazen specula. This philosopher was a Pagan, and wrote against the Christian religion. There are still extant his Commentaries on some of Plato's books, and other of his works, written in Greek.

PROCONSUL, a Roman magistrate, sent to govern a province with consular authority.

The proconsuls were appointed out of the body of the senate; and commonly, when the year of any one's consulate expired, he was sent as proconsul into some province. The proconsuls decided cases of equity and justice, either privately in their palace, where they received petitions, heard complaints, and granted writs under their seal; or publicly, in the common hall, with the usual formalities observed in the court of judicature at Rome. Their office lasted only a year.

PROCOPIUS, a Greek historian, born in Cæsarea. He acquired great reputation by his works in the reign of Justinian, and was secretary to Belisarius during all the wars carried on by that general in Persia, Africa, and Italy. Having at length became senator, he obtained the title of *illustrious*, and was made prætor of Constantinople.

PROCTOR, a person commissioned to manage another person's cause in any court of the civil or ecclesiastical law.

Proctor, in the English universities. See Universities.

PROCURATION, an act or instrument by which one person is empowered to treat, transact, or receive, in the name of another.

PROCYON, in *Astronomy*, a fixed star of the second magnitude, situated in canis minor, or the little dog.

PRODICUS, a celebrated sophist, was a native of Julis in the island of Ceos, and flourished about B.C. 432. He was the contemporary of Democritus of Abdera, and Gorgias of Leontium, and he was the disciple of Protagoras, whom he rivalled in eloquence. His talents were so highly appreciated by his fellow-citizens, that he was employed on various embassies, and on his arrival at Athens, he opened a school where he was attended by the most distinguished men of the age, Euripides, Socrates, Theramenes, and Isocrates. Xenophon has preserved an apologue of Prodicus, which is considered as one of the most precious fragments of antiquity: it is Hercules between virtue and vice. In the Axiochus of Plato there is also the analysis of a harangue which Prodicus composed to dissipate all fears of death. He was at last accused of being a corrupter of youth, and condemned to drink the fatal bowl of hemlock.

PRODUCT, in *Arithmetic* and *Geometry*, the factum of two or more numbers, or lines, into one another. Thus $5\times4=20$, the product required.

PROEDRI, amongst the Athenians, were magistrates, who had the first seats in the public assemblies, and whose office it was to propose at each assembly the things to be deliberated on and determined. Their office always ended with the meeting.

PROFESSOR, in the universities, a person who teaches or reads public lectures in some art or science. See Universities.

PROFILE, in *Architecture*, the draught of a building, fortification, or other structure, in which are expressed the several heights, widths, and thicknesses, such as they would appear were the building cut down perpendicularly from the roof to the foundation.

Profile, in this sense, amounts to the same with *elevation*, and stands opposed to *plan* or *ichnography*.

Profile is also used for the contour or outline of a figure, building, member of architecture, or the like; as a base, a cornice, and the like. Hence *profiling* is sometimes used for designing, or describing the member with rule, compass, and other instruments.

Profile, in *Sculpture* and *Painting*. A head, or a portrait, is said to be in *profile*, when either is represented sidewise, or in a side-view; as, when in a portrait there is but one side of the face, one eye, one cheek, &c. shown, and nothing of the other. On almost all medals, the faces are represented in *profile*.

PROGRAMMA, anciently signified a letter sealed with the king's seal. Programma is also an university term for a billet issued by way of invitation to an oration, and containing the argument, or as much of it as is necessary for understanding the same.

PROGRESSION, in general, denotes a regular advancing, or going forwards, in the same course or manner.

Progression, in *Mathematics*, is either arithmetical or geometrical. Continued arithmetical proportion is, where the terms increase and decrease by equal differences, and is called *arithmetical progression*. *Geometrical progression* is when the terms increase or decrease by equal ratios.

PROJECTILES.

THE term *Projectiles* is applied to that part of mechanical philosophy which treats of the motion of bodies anyhow projected from the surface of the earth, and influenced by the action of terrestrial gravity.

It is demonstrated in the physical part of astronomy, that a body so projected must describe a conic section, having the centre of the earth in one focus; and that it will describe round that focus areas proportional to the times. It follows also from the principles of that science, that if the velocity of projection exceed 36,700 feet in a second, the body (if not resisted by the air) would describe a hyperbola; if the velocity be just 36,700 feet in a second, the body would describe a parabola; and a body projected with a smaller velocity than this would describe an ellipse. In the first case, if projected directly upwards, it would never return, but proceed for ever, its velocity continually diminishing, but never becoming less than an assignable portion of the excess of the initial velocity above 36,700 feet in a second. In the second case it would never return; its velocity would diminish without end, but never be extinguished. In the third case it would proceed till its velocity was reduced to an assignable portion of the difference between 36,700 feet and its initial velocity, and would then return, regaining its velocity by the same degrees and in the same places as it lost it. These are necessary consequences of a gravity directed to the centre of the earth, and inversely proportional to the square of the distance. But in the greatest projections that we are able to make, the gravitations are so nearly equal, and in directions so nearly parallel, that it would be ridiculous affectation to pay any regard to the deviations from equality and parallelism. A bullet rising a mile above the surface of the earth loses only $\frac{1}{2000}$ of its weight, and a horizontal range of 4 miles makes only 4′ of deviation from parallelism.

Let us therefore assume gravitation as equal and parallel. The errors arising from this assumption are quite insensible in all the uses which can be made of this theory.

Gravity must be considered by us as a constant or uniform accelerating or retarding force, according as it produces the descent, or retards the ascent, of a body. A constant or invariable accelerating force is one which produces an uniform acceleration; that is, which in equal times produces equal increments of velocity, and therefore produces increments of velocity proportional to the times in which they are produced. Forces are of themselves imperceptible, and are only sensible in their effects; and they have no measure but the effect, or what *measures* the effect; and every thing which we can discover with regard to those measures, we may affirm with regard to the things of which we assume them as the measures. Hence this proposition:—

The motion of a falling body, or of a body projected directly downwards, is uniformly accelerated; and that of a body projected directly upwards is uniformly retarded; that is, the acquired velocities are as the times in which they are acquired by falling, and the extinguished velocities are as the times in which they are extinguished. The following consequences are readily deduced from the proposition now enunciated:

1. If bodies simply fall, not being projected downwards by an external force, the times of the falls are proportional to the final velocities; and the times of ascents, which terminate by the action of gravity alone, are proportional to the initial velocities.

2. The spaces described by a heavy body falling from rest are as the squares of the acquired velocities; and the differences of these spaces are as the differences of the squares of the acquired velocities; and, on the other hand, the heights to which bodies projected upwards will rise, before their motions are extinguished, are as the squares of the initial velocities.

3. The spaces described by falling bodies are proportional to the squares of the times from the beginning of the fall; and the spaces described by bodies projected directly upwards are as the squares of the times of the ascents.

4. The space described by a body falling from rest is one-half of the space which the body would have uniformly described in the same time, with the velocity acquired by the fall. And the height to which a body will rise, in opposition to the action of gravity, is one-half of the space which it would uniformly describe in the same time with the initial velocity.

In like manner, the difference of the spaces which a falling or rising body describes in any equal successive parts of its fall or rise, is one-half of the space which it would uniformly describe in the same time with the difference of the initial and final velocities.

The last proposition will be more conveniently expressed for our purpose as follows:

A body moving uniformly during the time of any fall with the velocity acquired thereby, will in that time describe a space double of that fall; and a body projected directly upwards will rise to a height which is one-half of the space which it would describe in the time of its ascent with the initial velocity of projection, if the motion continued uniform.

It is a matter of observation and experience, that a heavy body falls 16 feet and one inch English measure in a second of time; and therefore acquires the velocity of 32 feet 2 inches per second. This cannot be ascertained directly, with the precision that is necessary. A second is too small a portion of time to be exactly measured and compared with the space described; but the observation is made with the greatest accuracy by comparing the motion of a falling body with that of a pendulum. The time of a vibration is to the time of falling through half the length of the pendulum, as the circumference of a circle is to its diameter. The length of a pendulum can be ascertained with great precision; and in this way the space fallen through in a second has been accurately measured.

As all forces are ascertained by the accelerations which they produce, they are conveniently measured by comparing their accelerations with the acceleration of gravity. This therefore has been assumed by all the later and best writers on mechanical philosophy as the unit by which every other force is measured. It gives us a perfectly distinct notion of the force which retains the moon in its orbit, when we say it is the 3600th part of the weight of the moon at the surface of the earth. We mean by this, that if a bullet were weighed at the surface of the earth by a spring steelyard, and pulled the spring out to the mark 3600; if the body were then taken to the distance of the moon, it would pull the spring out only to the mark 1. And we make this assertion on the authority of our having observed that a body at the distance of the moon falls from that distance $\frac{1}{3600}$th part of 16 feet in a second. We do not therefore compare the *forces*, which are imperceptible things; we compare the accelerations, which are at the same time their effects and their measures.

Philosophers have therefore been at great pains to determine with precision the fall of heavy bodies, in order to have an exact measure of the accelerating power of terrestrial gravity. Now we must here observe, that this measure may be taken in two ways; we may take the space through which the heavy body falls in a second; or we may take the velocity which it acquires in consequence of gravity having acted on it during a second. The last is the proper measure, for it is the immediate effect on the body. The action of gravity has changed the state of the body by giving it a determination to motion downwards; and this both points out the nature, and the degree or intensity, of the force of gravity. The space described in a second by falling, is not an invariable measure; for, in the successive seconds, the body falls through 16, 48, 80, 112, &c. feet, but the changes of the body's state in each second is the same. At the beginning it had no determination to move with any appreciable velocity; at the end of the first second it had a determination by which it would have gone on for ever (had no subsequent force acted on it) at the rate of 32 feet per second. At the end of the next second, it had a determination by which it would have moved for ever, at the rate of 64 feet per second. At the end of the third second, it had a determination by which it would have moved for ever, at the rate of 96 feet per second, &c. The differences of these determinations are constant, and amount to 32 feet per second. This is therefore the indication and proper measure of the constant or invariable force of gravity. The space fallen through in the first second is of use only as it is one-half of the measure of this determination; and as halves have the proportion of their wholes, different accelerating forces may be safely affirmed to be in the proportion of the spaces through which they uniformly impel bodies in the same time. But we should always recollect, that this is but one-half of the true measure of the accelerating force.

We now proceed to investigate the formulæ of rectilinear motion.

Let x be the space described by a moving body in a certain time t, and v the velocity acquired at the end of the time t. When the motion is uniform, the space described is in the compound ratio of the velocity and the time, therefore $x=vt$. In the case of accelerated or retarded motion, the velocity varies by infinitely small degrees, and we may therefore assume it to be uniform during an infinitely small portion of time dt. But the space over which the body moves in the time dt, with the uniform velocity v, is vdt; therefore the increment of the space in the time dt being dx, we have $dx=vdt$, whence $v=\frac{dx}{dt}$.

Let $\varphi =$ the force which accelerates or retards the moving body at the end of the time t. The force φ is supposed to act in the straight line in which the body is moving at the instant; and as an accelerating force becomes a retarding force by changing the sign from positive to negative, it is usually called, in both cases, the *accelerating force*. In order to obtain the measure of φ, we must consider the effect it produces. Since the motion may be regarded as uniform during an infinitely small portion of time dt, if v be the velocity at the end of the time t, then $v+dv$ will be the velocity at the end of the time $t+dt$, so that dv is the augmentation of velocity produced by the accelerating force φ in the time dt. Assume F to be a constant force, which produces a velocity $=$ V in the portion of time which is taken as unit; then the velocity produced by the force F in the time dt is Vdt, and we have this proportion,

$$\varphi : \mathrm{F} :: dv : \mathrm{V}dt,$$

the forces being measured by the velocities which they communicate to a given body in the same time. Now, suppose F to be the unit of force, and V the unit of velocity, the proportion becomes $\varphi : 1 :: dv : dt$, whence $\varphi=\frac{dv}{dt}$.

On differentiating the equation $v=\frac{dx}{dt}$, we get $\frac{dv}{dt}=\frac{d^2x}{dt^2}$, whence $\varphi=\frac{d^2x}{dt^2}$. The relations between the velocity, the space described, the time, and the accelerating force, are consequently given by the three following equations, of which the last is a consequence of the other two, viz.

$$v=\frac{dx}{dt},\ \varphi=\frac{dv}{dt},\ \varphi=\frac{d^2x}{dt^2}. \tag{1}$$

Suppose the accelerating force to be terrestrial gravity, and let it be denoted by g. We have then, from the third of the above equations $\frac{d^2x}{dt^2}=g$; the integral of which is $\frac{dx}{dt}=gt$, or $v=gt$ (which requires no correction, since v and t vanish together). We have also $dx=gtdt$; whence by a second integration $x=\frac{1}{2}gt^2$, which is also the complete integral, since x and t vanish together. This last equation gives $2gx=g^2t^2=v^2$; whence $v=\surd(2gh)$. We have therefore the following expressions for the velocity, the time, and the space described, or height from which a body must fall *in vacuo* to acquire a given velocity, and which we shall denote by h, viz.

$$\text{I. } v = gt = \surd(2gh),$$
$$\text{II. } t = \frac{v}{g} = \sqrt{\frac{2h}{g}},$$
$$\text{III. } h = \frac{v^2}{2g} = \tfrac{1}{2}gt^2.$$

It is found by experiment that the height through which a heavy body descends by the force of gravity in a vacuum, in a second of time, is $16\frac{1}{12}$ English feet. For convenience, we shall call this 16 feet. Assuming, therefore, one second as the unit of time, the last equation gives $g=2h=32$ feet; and the three equations become, in respect of any time t, and height h,

$$\text{I. } v = 32t = \surd(64h)=8\surd h,$$
$$\text{II. } t = \frac{v}{32} = \tfrac{1}{4}\surd h,$$
$$\text{III. } h = \frac{v^2}{64} = 16t^2.$$

To give some examples of the use of these formulæ, let it be required,

1. To find the time of falling through 256 feet. Here $h=256$, $\surd 256=16$, and $16\div 4=4$. Therefore $t=4$ seconds.

2. To find the velocity acquired by falling four seconds. Here $t=4$, $32\times 4=128$ feet per second.

3. To find the velocity acquired by falling 625 feet. Here $h=625$, $\surd h=25$, $8\surd h=200$ feet per second,

4. To find the height to which a body will rise when projected with the velocity of 56 feet per second, or the height through which a body must fall to acquire this velocity. In this case we have

$v=56$, $56\div 8=7$, $=\surd h$, $7^2=h$, $=49$ feet.
or $56^2=3136$, $3136\div 64=49$ feet.

5. Suppose a body projected directly downwards with the velocity of 10 feet per second; what will be its velocity after four seconds? In four seconds it will have acquired, by the action of gravity, the velocity of 4×32, or 128 feet, and therefore its whole velocity will be 138 feet per second.

6. To find how far it will have moved, compound its mo-

tion of projection, which will be 40 feet in four seconds, with the motion which gravity alone would have given it in that time, which is 256 feet; and the whole motion will be 296 feet.

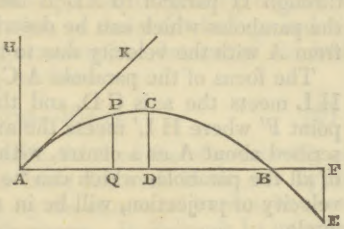
7. Suppose the body projected, as in the 5th example, and that it is required to determine the time it will take to pass through 296 feet, and the velocity it will have acquired.

Find the height h, through which it must fall to acquire the velocity of projection, 10 feet, and the time t of falling from this height. Then find the time t' of falling through the height $296+h$, and the velocity v acquired by this fall. The time of describing the 296 feet will be $t'—t$, and v is the velocity required.

These examples will suffice for the perpendicular ascents or descents of heavy bodies, abstracting from the resistance of the air. We now proceed to consider the motions of bodies projected obliquely. The subject is one of considerable interest, as it forms the foundation of the theory of gunnery.

Let a body be projected from the point A (fig. 1.) in any direction AK not perpendicular to the horizon, and with a given velocity $=a$; it is required to determine the path of the body, and all the circumstances of its motion.

Fig. 1.



Since gravity acts only in the vertical direction, and the body, after being projected, is acted on by no other accelerating force, it is evident, in the first place, that the whole of the trajectory, or path described by the projectile, must be contained in the vertical plane which passes through AK. In the second place, since the action of gravity is constant, the projectile must describe a continuous curve, to which AK is a tangent at A. Through A draw AB horizontal, and AH vertical, and let these lines be taken as the axes of the rectangular co-ordinates to which the different points of the curve are referred. Let P be the place of the projectile at the end of the time t; draw PQ perpendicular to AB, and make $AQ=x$, $PQ=y$. The object is now to find the equation of the trajectory by establishing a relation between the co-ordinates x and y.

Let the angle KAB, which the initial direction of the projectile makes with the horizon, be denoted by A. As we abstract from the resistance of the air, the motion in the direction AK is uniform, and proportional to the time t; and the velocity of projection being a, the velocity in the direction AB (which is not affected by gravity) is also uniform, and equal to a cos A, therefore the space passed over being equal to the product of the time by the velocity, we have $x=a \cos A$. To find y, we must consider that the motion in the vertical direction is made up of two parts; first, that which is due to the velocity of projection; and, second, that which arises from the action of gravity. The velocity in the direction AH, independent of gravity, is $a \sin A$; and therefore the space described in that direction in the time t, is $ta \sin A$. But by the formula III. the space through which the body is carried in the time t by the accelerating force of gravity is $\frac{1}{2}gt^2$; and as this is in the direction opposite to the former, it must be taken with the negative sign. We have therefore $y=ta \sin A—\frac{1}{2}gt^2$. The values of x and y are thus given in terms of the time; and on eliminating t between the two equations, viz.

$$x=ta \cos A, \qquad y=ta \sin A—\tfrac{1}{2}gt^2, \qquad (2)$$

we shall have the equation of the trajectory. The first gives $t=x\div a \cos A$, on substituting which in the second, there results

$$y=x \tan A—\tfrac{1}{2}g\frac{x^2}{a^2 \cos^2 A},$$

which is an equation to the Apollonian parabola, having its axis parallel to the ordinates y, and its parameter equal to $\frac{1}{2}g\div a^2 \cos^2 A$.

By the formula I. we have $a=\surd(2gh)$, therefore $a^2=2gh$; and on substituting this value of a^2, the equation becomes

$$y=x \tan A—\frac{x^2}{4h \cos^2 A}. \qquad (3)$$

Having found the equation of the curve, it is easy to assign its position in the plane of the co-ordinates. Let B be the point in which the parabola meets the horizontal line drawn through A, C the vertex of the parabola, and let CD be perpendicular to AB. The point C is thus found. Let θ be the angle which the tangent to the curve at any point P makes with the axis AB; we have then for any curve whatever, $\tan \theta \, dx=dy$. At the vertex, the tangent becomes parallel to AB, consequently θ vanishes, and we have $\frac{dy}{dx}=0$

Now on differentiating the equation (2), we find

$$\frac{dy}{dx}=\tan A—\frac{x}{2h \cos^2 A};$$

therefore at the vertex, $0=\tan A—\frac{x}{2h \cos^2 A}$, whence $x=2h \cos A \sin A$. Substituting this value of x in equation (3), we get, after reduction, $y=h \sin^2 A$. Hence denoting the co-ordinates of the vertex by x_1 and y_1 that is, making $AD=x_1$, $DC=y_1$, we have the two equations to determine x_1 and y_1, namely

$$x_1=2h \cos A \sin A, \qquad y_1=h \sin^2 A. \qquad (4)$$

To find the point B in which the projectile meets the horizontal line AB, it is only necessary to make $y=0$ in equation (3). This gives $0=x \tan A—\frac{x^2}{4h \cos^2 A}$; whence $4h \cos^2 A \tan A=x$, and therefore

$$x=AB=4h \cos A \sin A=2h \sin 2A. \qquad (5)$$

From this equation it appears that when the velocity of projection a, or the height h, corresponding to that velocity, is given, the line AB, which is called the *amplitude* or *horizontal range*, is a maximum when the angle of elevation A (that is, KAB) is equal to 45°, for then $\sin 2A=1$. In this case we have $AB=2h$, that is to say, when a ball is projected with an angle of elevation equal to 45 degrees, the amplitude or range on the horizontal plane is equal to twice the height from which a body must fall in order to acquire a velocity equal to the velocity of projection.

To find the velocity at any point P of the trajectory, in the direction of the tangent at that point, let z denote the arc AP, then, the velocity being equal to the increment of the space passed over, divided by the increment of the time, we have $v=\frac{dz}{dt}$, whence $v^2=\frac{dx}{dt^2}=\frac{dx^2+dy}{dt^2}$. Now, on differentiating the two equations (2), we get

$$\frac{dx}{dt}=a \cos A, \quad \frac{dy}{dt}=a \sin A—gt,$$

the squares of which being added together, give the following relation between the velocity and the time, viz.

$$v^2=a^2—2agt \sin A+g^2t^2.$$

At the point B we have $x=AB=4h \cos A \sin A$ by equation (5), and $y=0$. But from the equation $x=ta \cos A$, we have also $t=x\div a \cos A$; whence at the point B, $t=4h \sin A\div a$; therefore, since by formula I. $a^2=2gh$, $gt=$

$2a\sin A$. Substituting this value of gt in the above equation, we get

$$v^2=a^2-4a^2\sin^2A+4a^2\sin^2A=a^2;$$

so that the velocity in the parabola at the point B is equal to the initial velocity at A.

The angle under which the projectile meets the horizontal line AB, is also equal to the angle of elevation A. For since the tangent of the inclination of the curve to the axis of x is given in general by the equation

$$\frac{dy}{dx}=\tan A-\frac{x}{2h\cos^2A},$$

we have at the point B, where $x=4h\cos A\sin A$,

$$\frac{dy}{dx}=\tan A-\frac{2\sin A}{\cos A}=\tan A-2\tan A=-\tan A.$$

From the equation (3) we readily deduce the solution of the following problem, which contains the most important practical application of the theory. Given the velocity of projection $=a$, it is required to determine A, the angle of elevation, in order that the projectile may hit a given mark, or that the trajectory may pass through a given point E.

Let β,γ be the co-ordinates of E, namely $AF=\beta$, $FE=\gamma$. From equation (3) we have

$$\gamma=\beta\tan A-\beta^2\div4h\cos^2A,$$

and the object is to find from this equation the angle of elevation, or the value of A. Transposing, and observing that $1\div\cos^2A=1+\tan^2A$, the equation becomes

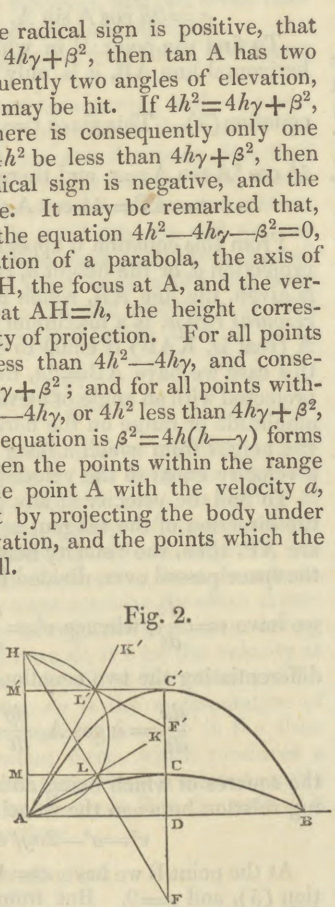
$$\tan^2A-\frac{4h}{\beta}\tan A=-\frac{4h\gamma}{\beta^2}-1,$$

which being solved in respect of tan A, gives

$$\tan A=\frac{2h}{\beta}\pm\frac{1}{\beta}\surd(4h^2-4h\gamma-\beta^2).$$

When the quantity under the radical sign is positive, that is, when $4h^2$ is greater than $4h\gamma+\beta^2$, then tan A has two values, and there are consequently two angles of elevation, by either of which the mark may be hit. If $4h^2=4h\gamma+\beta^2$, then $\tan A=2h\div\beta$, and there is consequently only one angle of elevation; and if $4h^2$ be less than $4h\gamma+\beta^2$, then the quantity under the radical sign is negative, and the problem becomes impossible. It may be remarked that, supposing γ and β variable, the equation $4h^2-4h\gamma-\beta^2=0$, or $\beta^2=4h(h-\gamma)$ is the equation of a parabola, the axis of which is the vertical line AH, the focus at A, and the vertex at a point H, such that $AH=h$, the height corresponding to the given velocity of projection. For all points within this parabola β^2 is less than $4h^2-4h\gamma$, and consequently $4h^2$ greater than $4h\gamma+\beta^2$; and for all points without it β^2 is greater than $4h^2-4h\gamma$, or $4h^2$ less than $4h\gamma+\beta^2$, so that the parabola, whose equation is $\beta^2=4h(h-\gamma)$ forms the line of separation between the points within the range of a body projected from the point A with the velocity a, and which may be each hit by projecting the body under two different angles of elevation, and the points which the projectile cannot reach at all.

Fig. 2.



The different expressions which have been found in the preceding solution, may be represented by a very simple geometrical construction. On the vertical line passing through A, (fig. 2.) take $AH=h=$ height due to the velocity of projection a, and let AK be the initial direction. On AH describe a semicircle, meeting AK in L, make LM perpendicular to AH, and join HL. Since ALH is a right angle, and therefore $AHL=LAB=A$, we have $AL=h\sin A$, $AM=AL\sin A=h\sin^2A$; and $LM=AL\cos A=h\cos A\sin A$. Comparing these expressions with the equations (4), we have $x_1=2LM$, and $y_1=AM$, x_1 and y_1 being the co-ordinates of the vertex. Hence the vertex of the parabola lies in the straight line ML, and is obtained by making LC=ML. It follows also from the equation (5), that AB, the horizontal range, is equal to 4ML.

Through L conceive a straight line to be drawn perpendicular to AB, or parallel to AH. This line will either be a tangent to the semicircle, or will meet it in another point L′. In the former case the angle of elevation is 45°, and there is only one parabola corresponding to the given velocity a, through which a projectile can pass to B. But when the horizontal range AB is less than twice the height AH due to the velocity, the vertical drawn through L again meets the circle in L′, and AL′ is the tangent to another parabola which passes through B, and of which the vertex is situated at the intersection of DC with M′L′ parallel to AB.

From the equation (3) the parameter of the parabola is $4h\cos^2A$. But $DC=h\sin^2A$; whence $DC+\frac{1}{4}$ parameter $=h$, and consequently $MH=\frac{1}{4}$ parameter. But (see Conic Sections, Part I. prop. xiv.) the distance of the directrix of a parabola from its vertex is equal to one-fourth of the parameter; and hence a straight line drawn through H parallel to AB is the common directrix of all the parabolas which can be described by a body projected from A with the velocity due to the height AH.

The focus of the parabola A C B is at the point F where H L meets the axis C D, and the focus of A C′ B at the point F′ where H L′ meets the axis; and if a circle be described about A as a centre, with a radius = A H, the foci of all the parabolas which can be described with the given velocity of projection, will be in the circumference of that circle.

These few simple propositions contain the whole theory of the motion of projectiles in vacuo, or independent on the resistance of the air; and being easily investigated, and connected with very interesting practice, they have been much commented on, and have furnished matter for many splendid volumes. But the air's resistance occasions such a prodigious diminution of motion in the great velocities of military projectiles, that this parabolic theory, as it is called, is hardly of any use. Mr. Robins found that a musket-ball, discharged with the usual allotment of powder, had the velocity of 1700 feet in a second. This requires a fall of 45,156 feet, and the range therefore should be 90,312, or $17\frac{1}{8}$ miles; whereas it does not much exceed half a mile. A twenty-four pound ball, discharged with sixteen pounds of powder, should range about sixteen miles; whereas it is generally short of three miles. It is only in the cases of slow motions, not exceeding 300 or 400 feet in a second, that the theory can be of any use, for then the path of the projectile differs little from a parabola.

In such experiments as can be performed with great accuracy in a chamber, the coincidence is as great as can be wished. A jet of water or mercury, gives us the finest example, because we have the whole parabola exhibited in the simultaneous places of the succeeding particles. Yet even in these experiments a deviation can be observed. When the jet is made on a horizontal plane, and the curve carefully traced on a perpendicular plane held close by it, it is found that the distance between the highest point of the curve and the mark is less than the distance between it and the spout, and that the descending branch of the curve is shorter than the ascending branch. And this difference is more remarkable as the jet is made with greater velocity, and reaches to a greater distance; and it is evidently produced by the resistance of the air, which diminishes the velocity, without affecting the gravity of a projectile. It is still more sensible in the motion of bombs. These can be traced through the air by the light of their fuzes; and we see that their highest point is always much nearer to the mark than to the mortar on a horizontal plane.

We now proceed to the problem of determining the path of a projectile in a resisting medium, and as the solution is attended with considerable difficulty, and cannot be obtained without the aid of the integral calculus, we shall endeavour to render it more perspicuous, by considering separately, 1st, the motion of a body allowed to fall from rest; 2d, of a body projected vertically upwards; and, lastly, the general case of a body projected with a given velocity in any direction oblique to the horizon. In order to simplify the subject, we shall suppose the density of the medium to be uniform, which may be considered to be the case of the atmosphere at all altitudes which can be reached by a projectile from the ground; and that the projected body is a sphere, either homogeneous, or composed of spherical strata, for each of which the density is uniform.

Suppose then the body to be let fall, or submitted to the action of gravity, and let R denote the force with which it is resisted at any given instant. By the principles of dynamics the corresponding accelerating force is equal to the moving force R divided by the mass of the body, (or the moving force referred to the unit of mass,) therefore the accelerating force due to the resistance is $R\div m$. As this force acts in the direction opposite to gravity, it must be taken with the negative sign, or deducted from g, and the whole accelerating force, causing the descent of the body being represented by φ, we have

$$\varphi = g - R \div m. \qquad (6)$$

It is necessary to remark, for the sake of preserving accurate principles, that a body descends in air, not by the whole of its weight, but by the excess of its weight above that of the air which it displaces. It descends by its *specific* gravity only as a stone descends in water. Suppose a body 32 times heavier than an equal bulk of air, it will be buoyed up by a force equal to 1-32d part of its weight; and, instead of acquiring the velocity of 32 feet in a second, it will only acquire a velocity of 31, even though it sustained no resistance from the inertia of the air. Let w be the weight of the body, and w' the weight of an equal bulk of air, then the *relative* acceleration of gravity will be correctly expressed by $g\left(1 - \frac{w'}{w}\right)$. But in all practical cases, and particularly in the case of military projectiles, which have a great density, the fraction which enters into this expression is so small that it is not worth attending to.

In order to reduce the force $R\div m$ to its simplest expression, let r denote the radius of the sphere, and δ its mean density. Its volume is then $\frac{4}{3}\pi r^3$, (π being as usual the ratio of the circumference of a circle to its diameter,) and we have for the mass $m = \frac{4}{3}\pi\delta r^3$. With respect to the force R, the usual hypothesis is to suppose it to be proportional to the square of the velocity of the moving body, to the surface of the projectile, and also to the density of the air. If then we take ρ to represent the density of the air, and assume $n =$ a numerical factor to be found by experiment, we shall have $R = n\rho . v^2 r^2$, and consequently

$$\frac{R}{m} = \frac{n\rho . v^2}{\delta r}. \qquad (7)$$

Since $R\div m$ is an accelerating force of the same nature as gravity, and may consequently be represented by a quantity of the same kind as g, we shall have a homogeneous expression by making $\frac{n\rho}{\delta r} = \frac{g}{b^2}$, b being a constant. The expression thus becomes $\frac{R}{m} = g\frac{v^2}{b^2}$; and it is necessary to observe that the constant b denotes the terminal velocity, or uniform final velocity which the body attains when the resistance becomes equal to gravity, or when $R\div m = g$, and it is consequently no longer urged by an accelerating or retarding force. For the resistance being assumed proportional to the square of the velocity, and $R\div m$ being the retarding force due to the velocity v, if $b =$ the terminal velocity, the retarding force due to which is g, we shall have the proportion $b^2 : v^2 :: g : \frac{R}{m}$; whence $\frac{R}{m} = g\frac{v^2}{b^2}$.

Thus the retarding force due to any velocity v is expressed in terms of the terminal velocity, but the great difficulty is to procure an absolute measure of this quantity. Sir Isaac Newton has attempted to determine the resistance by theory, and employs a great part of the second book of the *Principia* in demonstrating, that the resistance to a sphere moving with any velocity, is to the force which would generate or destroy its whole motion in the time that it would uniformly move over $\frac{8}{3}$ of its diameter with this velocity, as the density of the air is to the density of the sphere. This is equivalent to demonstrating that the resistance of the air to a sphere moving through it with any velocity, is equal to half the weight of a column of air having a great circle of the sphere for its base, and for its altitude the height from which a body must fall in *vacuo* to acquire this velocity. This appears from Newton's demonstration; for, let the specific gravity of the air be to that of the ball as 1 to β; then, because the times in which the same velocity will be extinguished by the uniform action of different forces are inversely as the forces, the resistance to this velocity would extinguish it in the time of describing $\frac{8}{3}\beta d$, d being the diameter of the ball. Now 1 is to β as the weight of the displaced air to the weight of the ball, or as $\frac{2}{3}$ of the ball to the length of a column of air of equal weight. Call this length k; k is therefore equal to $\frac{2}{3}\beta d$. Suppose the ball to fall from the height k in the time t, and acquire the velocity u. If it moved uniformly with this velocity u during the time t, it would describe a space $=2k$, or $\frac{4}{3}\beta d$. Now its weight would extinguish this velocity, or destroy this motion, in the same time, that is, in twice the time of falling. The resistance therefore is equal to half the weight of the ball, or to half the weight of the column of air whose height is the height producing the velocity. But the resistances to different velocities are as the squares of the velocities, and therefore, as their producing heights; and, in general, the resistance of the air to a sphere moving with any velocity, is equal to the half weight of a column of air of equal section, and whose altitude is the height producing the velocity. The result of this investigation has been acquiesced in by all Sir Isaac Newton's commentators. Many faults have indeed been found with his reasoning, and even with his principles; and it must be acknowledged that his reasoning is liable to serious objections, which his most ingenious commentators have not completely removed. We must add, however, that all the causes of deviation from the duplicate ratio of the velocities, and the causes of increased resistance, which the latter authors have valued themselves for discovering and introducing into their investigations, were pointed out by Sir Isaac Newton, but purposely omitted by him, in order to facilitate the discussion *in re difficillima*. (See *Schol.* prop. 37. book ii.)

It is known that the weight of a cubic foot of water is $62\frac{1}{2}$ pounds, and that the medium density of the air is $\frac{1}{840}$ of water; therefore, let h be the height producing the velocity (in feet), and d the diameter of the ball (in inches), and π the periphery of a circle whose diameter is 1; the resistance of the air will be $= \frac{62\frac{1}{2}}{840} \times \frac{\pi}{4} \times \frac{d^2}{144} \times \frac{h}{2} =$

$\frac{hd^2}{4928\frac{1}{2}}$ pounds, very nearly, or, since by formula III. $h=v\div 2g$, resistance$=\frac{v^2d^2}{4928\frac{1}{2}\times 64}=\frac{v^2d^2}{315417}$ pounds.

We may take an example. A ball of cast iron weighing 12 pounds, is $4\frac{1}{2}$ inches in diameter. Suppose this ball to move at the rate of $25\frac{1}{5}$ feet in a second (the reason of this choice will appear afterwards). The height which will produce this velocity in a falling body is $9\frac{7}{8}$ feet. The area of its great circle is 0·11044 feet, or $\frac{11044}{100000}$ of one foot. Suppose water to be 840 times heavier than air, the weight of the air incumbent on this great circle, and $9\frac{7}{8}$ feet high, is 0·081151 pounds; half of this is 0·0405755, or nearly $\frac{1}{25}$ of a pound. This should be the resistance of the air to this motion of the ball.

Newton himself attempted to compare his propositions with experiment. Some were made by dropping balls from the dome of St. Paul's cathedral; and all these shewed as great a coincidence with his theory as they did with each other; but the irregularities were too great to allow him to say with precision what was the resistance. It appeared to follow the proportion of the squares of the velocities with sufficient exactness; and though he could not say that the resistance was equal to the weight of the column of air having the height necessary for communicating the velocity, it was always equal to a determinate part of it; and might be stated $=n\,h$, n being a number to be fixed by numerous experiments.

Newton made another set of experiments with pendulums; and has pointed out some very curious and unexpected circumstances of their motions in a resisting medium. Their results were much more uniform, and confirmed his general theory; which, as we have said above, has been acquiesced in by the first mathematicians.

But the deductions from this theory were so inconsistent with the observed motions of military projectiles, when the velocities are prodigious, that no application could be made which could be of any service for determining the path and motion of cannon shot and bombs; and although John Bernoulli gave, in 1718, a most elegant determination of the trajectory and motion of a body projected in a fluid which resists in the duplicate ratio of the velocities, it has remained a dead letter. Mr. Benjamin Robins was the first who suspected the true cause of the imperfection of the usually received theories; and in 1737 he published a small tract, in which he showed clearly, that even the Newtonian theory of resistance must cause a cannon ball, discharged with a full allotment of powder, to deviate farther from the parabola, in which it would move *in vacuo*, than the parabola deviates from a straight line. But he farther asserted, on the authority of good reasoning, that in such great velocities the resistance must be much greater than this theory assigns; because, besides the resistance arising from the *inertia* of the air which is put in motion by the ball, there must be a resistance arising from a condensation of the air on the anterior surface of the ball, and a rarefaction behind it; and there must be a third resistance, arising from the statical pressure of the air on its anterior part, when the motion is so swift that there is a vacuum behind. Even these causes of disagreement with the theory had been foreseen and mentioned by Newton (see the Scholium to prop. 37, book ii. *Princip.*); but the subject seems to have been little attended to.

Two or three years after this first publication, Mr. Robins invented that ingenious method of measuring the great velocities of military projectiles, which has handed down his name to posterity, and discovered the prodigious resistance of the air by observing the diminution of velocity which it occasioned. This made him anxious to examine what was the real resistance to any velocity whatever, in order to ascertain what was the law of its variation; and he was equally fortunate in this attempt. His method of measuring the resistance has been fully described in the article GUNNERY.

It appears (Robins's *Math. Works*, vol. i. p. 205,) that a sphere of $4\frac{1}{2}$ inches in diameter, moving at the rate of $25\frac{1}{5}$ feet in a second, sustained a resistance of 0·04914 pounds, or $\frac{4914}{100000}$ of a pound. This is a greater resistance than that of the Newtonian theory, which gave 0·0405755, in the proportion of 1000 to 1211, or very nearly in the proportion of five to six in small numbers. And we may adopt as a rule in all moderate velocities, that the resistance to a sphere is equal to $\frac{61}{100}$ of the weight of a column of air having the great circle of the sphere for its base, and for its altitude the height through which a heavy body must fall *in vacuo* to acquire the actual velocity.

This experiment is peculiarly valuable, because the ball is precisely the size of a 12-pound shot of cast iron; and its accuracy may be depended on. There is but one source of error. The whirling motion must have occasioned some whirl in the air, which would continue till the ball again passed through the same point of its revolution. The resistance observed is therefore probably somewhat less than the true resistance to the velocity of $25\frac{1}{5}$ feet, because it was exerted in a relative velocity which was less than this, and is, in fact, the resistance due to this relative and smaller velocity. The Chevalier de Borda made experiments similar to those of Mr. Robins, and his results exceed those of Robins in the proportion of 5 to 6. It is much to be regretted, that in a subject so interesting both to the philosopher and the engineer, experiments have not been multiplied. Nothing would tend so much to perfect the science of gunnery, and indeed until this be done, no practical advantage can be derived from the theory.

Adopting this experimental measure of Robins, we have the product $n\rho$ of equation (7) $=$·04914 pounds in respect of a sphere of $4\frac{1}{2}$ inches diameter, or 2·25 inches radius, moving at the rate of 25·2 feet in a second. In order to determine from this experiment the resistance on a sphere of a different size, and moving with a different velocity, it will be convenient to reduce it to the case corresponding to the units of magnitude and velocity; therefore, since the resistance is assumed proportional to the square of the velocity and the surface of the projectile, or $R=n\rho v^2r^2$, if we denote by R_1 the corresponding resistance, in respect of a sphere whose radius is 1 inch, moving with the velocity of 1 foot per second, we shall have

$$R_1=n\rho=\frac{\cdot 04914}{(2\cdot 25)^2\times(25\cdot 2)^2}=\cdot 000015285 \text{ pounds.}$$

The logarithm of this number is 5·18427. The resistance here determined is independent of the density of the ball; but the retardation occasioned by it being in proportion to the quantity of motion, will therefore be proportional to the density of the ball, or its specific gravity. Military projectiles are of cast iron or lead, the specific gravities of which may be taken at 7·207, and 11·37 respectively, that of water being 1.

The following examples will illustrate the application of the above formula.

1. Let it be proposed to find the resistance to a 24-pound iron ball (whose diameter is 5·603 inches), moving with the velocity of 1670 feet in a second, which is nearly the velocity communicated by 16 lbs. of gunpowder.

Here $v=1670$, $r=2\cdot 8015$, and the formula $R=n\rho v^2r^2$ gives

$$R=\cdot 000015285\times(1670)^2\times(2\cdot 8015)^2=334\cdot 57 \text{ lbs.}$$

But it is found, by unequivocal experiments, that the retardation of such a motion, is equivalent to 504 lbs. This is owing to the causes often mentioned, the additional resistance to great velocities, arising from the condensation of the air, and from its pressure into the vacuum left by the ball.

2. Let the terminal velocity of the same ball be required. Here the equation (7) gives $\frac{R}{m}=g\frac{v^2}{b^2}$; therefore in respect of the ball whose velocity is 1 and radius 1, we have $R_1=mg\div b^2$, b being the terminal velocity. Now it is to be observed that the product of the mass of a body into the force of gravity expresses its weight, which we may denote by w; we have then $R_1=w\div b^2$, and consequently $b^2=w\div R_1$. Now in respect of another body of the same specific gravity, whose radius is r, we have $R : R_1 :: r^2 : 1$, whence $R=R_1 r^2$, and the equation becomes $b^2=w\div R_1 r^2$. Substituting in this equation the numbers given in the question, we get

$$b^2=\frac{24}{\cdot000015285\times(2\cdot8015)^2}=200060,$$

whence $b=447\cdot3$ feet.

As the terminal velocity b, and its producing height k, enter into all computations of military projectiles, we have inserted the following Table for the usual sizes of cannon-shot, computed both by the Newtonian theory of resistance, and by the resistances observed in Robins's experiments. A similar table, computed from Dr. Hutton's experiments, and not materially different, is given in *Hutton's Tracts*, vol. iii. p. 247.

Lb. Ball.	Newton.		Robins.		Diam. Inch.
	b Term Vel.	2k.	b Term Vel.	2k.	
1	289·9	2626·4	263·4	2168·6	1·94
2	324·9	3298·5	295·2	2723·5	2·45
3	348·2	3788·2	316·4	3127·9	2·80
4	365·3	4170·3	331·9	3442·6	3·08
6	390·8	4472·7	355·1	3940·7	3·52
9	418·1	5463·5	379·9	4511·2	4·04
12	438·6	6010·6	398·5	4962·9	4·45
18	469·3	6883·3	426·5	5683·5	5·09
24	492·4	7576·3	447·4	6265·7	5·61
32	512·6	8024·8	465·8	6780·4	6·21
42	540·5	9129·9	491·5	7538·3	6·75

Having thus explained the nature of the quantities employed in the investigation, we now proceed with the solution of the problem of determining the circumstances of the motion of a body falling vertically in the atmosphere. In consequence of the equation $\frac{R}{m}=g\frac{v^2}{b^2}$, the relation between the accelerating force and the resistance given by equation (6), becomes $\phi=g-g\frac{v^2}{b^2}=g\frac{b^2-v^2}{b^2}$. Hence from the second of equations (1), $\frac{dv}{dt}=g\frac{b^2-v^2}{b^2}$, whence $gdt=\frac{b^2dv}{b^2-v^2}$, or, which is the same, $gdt=\frac{b}{2}\left(\frac{dv}{b+v}+\frac{dv}{b-v}\right)$. On integrating this equation, and observing that as t and v commence together no correction is required, we get $gt=\frac{1}{2}b\{\log(b+v)-\log(b-v)\}$, whence

$$t=\frac{b}{2g}\log\frac{b+v}{b-v}. \qquad (8)$$

From this equation the time t during which a body must fall in a resisting medium in order to acquire the velocity v, is readily computed, supposing the terminal velocity b to be known. It will be observed that the logarithm is hyperbolic, and therefore, if the common tables are used, the tabular logarithm of the number in question must be divided by the modulus of the system $M=\cdot43429$ (see LOGARITHMS, vol. xiii. p. 429). The terminal velocity b, as appears by equation (7), varies with the radius of the ball, and the ratio of its density to that of the air, and must be determined by experiment.

As an example of the formula, assume the terminal velocity $=689\frac{1}{3}$ feet in a second, and let it be proposed to determine the time in which the body will acquire a velocity of 323·62 feet per second.

Here $b=689\cdot33$, $v=323\cdot62$, $b+v=1012\cdot95$, $b-v=365\cdot71$, whence the common logarithm of $\frac{b+v}{b-v}$ is 0·44245 and hyp. log $\frac{b+v}{b-v}=\frac{44245}{43429}$. Now $b\div2g=689\cdot33\div64=10\cdot77$, therefore $t=10\cdot77\times\frac{44245}{43429}=10\cdot97$ seconds, which is the time required.

Assume $\tau=gt\div b$, and let e denote the base of the Napierean or hyperbolic logarithms, that is, let $e=2\cdot71828$; the equation (8) gives, on passing to numbers $e^{2\tau}=\frac{b+v}{b-v}$, or $e^{-2\tau}=\frac{b-v}{b+v}$, whence $v=\frac{b(1-e^{-2\tau})}{1+e^{-2\tau}}$. Let the terms of this expression for v be multiplied by e_τ and the equation becomes

$$v=\frac{b(e^{\tau}-e^{-\tau})}{e^{\tau}+e^{-\tau}} \qquad (9)$$

which gives the velocity in terms of τ, that is, in terms of the time t, and the terminal velocity b.

To find the space described, the equations (1) give $vdt=dx$. Now we have assumed $gt\div b=\tau$, therefore $gdt=bd\tau$, whence and from equation (9)

$$gdx=\frac{b^2(e^{\tau}-e^{-\tau})dt}{e^{\tau}+e^{-\tau}}.$$

The integral of this is $gx=b^2\log(e^{\tau}+e^{-\tau})+C$, (C being a constant). When $x=0$, then $v=0$, and the equation becomes $0=b^2\log 2+C$; therefore the complete integral is

$$x=\frac{b^2}{g}\log\tfrac{1}{2}(e^{\tau}+e^{-\tau}) \qquad (10)$$

which gives the space in terms of the time and final velocity.

The space may also be expressed in terms of the velocity. From equations (1) we have $vdt=dx$ and $\phi dt=dv$. Eliminating dt between these two equations we get $\phi dx=vdv$. But $\phi\left(=\frac{dv}{dt}\right)=g\frac{b^2-v^2}{b^2}$, therefore $gdx=\frac{b^2vdv}{b^2-v^2}$. The integral of this gives $gx=-\frac{1}{2}b^2\log(b^2-v^2)+C$. To determine the constant, we have $v=0$, when $x=0$, and therefore $0=-b^2\log(b^2+C)$; whence the complete integral is $gx=\frac{1}{2}b^2\{\log b^2-\log(b^2-v^2)\}$, or

$$x=\frac{b^2}{2g}\log\frac{b^2}{b^2-v^2}. \qquad (11)$$

As an example of this formula, suppose, as above, $b=689\frac{1}{3}$ feet, and let it be required to find the space through which the body has descended when the acquired velocity $v=323.62$ feet. Here the common logarithm of b^2 is 5.67686, and that of b^2-v^2 is 5.56872; therefore the common logarithm of $b^2\div(b^2-v^2)$ is 0.10814, and its hyperbolic logarithm $=\frac{10814}{43429}$. We have also $b^2\div2g=7429.6$

feet, therefore $x=7429.6\times\frac{10814}{43429}=1850$ feet per second.

The formula may also be computed by means of the trigonometrical tables; for since $\frac{1}{2}\log\frac{b^2}{b^2-v^2}=\log\sqrt{\frac{b^2}{b^2-v^2}}$ = logarithmic secant of an arc whose radius is b and sine v, or of an arc whose radius is 1 and sine $=v\div b$, if we seek in the table the arc whose logarithmic sine = log $(v\div b)$, its logarithmic secant, or the logarithm of its cosine subtracted from unity, and divided by the modulus M $=.43429$, will be the value of $\frac{1}{2}\log\frac{b^2}{b^2-v^2}$. Thus in the last example we have the common logarithm of $1v\div b=9.67160$, which corresponds to an arc of 28°. Now log cos $28°=9.94593$, whence log secant $28°=0.05407$. But $b^2\div g=14859.2$ (the double of $b^2\div 2g$ or 7429.6 found above), therefore $x=148592\times\frac{5407}{43429}=1850$ feet, as before.

In this manner the equation (11) will also give the velocity when the space x is known. For let ψ denote the arc whose logarithmic sine in the common tables is log $(v\div l)$, and the equation becomes $x=\frac{b^2}{g\text{M}}$ log secant ψ, whence log sec. $\psi=\frac{g\text{M}x}{b^2}$. Having therefore found ψ corresponding to this secant, we shall have $v\div b=\sin\psi$, and consequently $v=b\sin\psi$. Suppose, as before, $b=689\frac{1}{3}$ feet, and let it be required to find the velocity when the body has fallen 1850 feet. Here $\frac{g\text{M}x}{b^2}=\frac{32\times.43429\times1850}{(689\frac{1}{3})^2}=.05407$, which is the logarithmic secant of ψ; but $1-.05407=.94593=\log\cos\psi$, whence ψ is found in the tables $=28°$, and $\log\sin\psi=9.67160$. Adding $\log b=2.83843$, we have $\log b\sin\psi=2.51003$, whence $v=b\sin\psi=323.62$ feet.

We come now to consider the case of a body, supposed, as before, to be a sphere of given magnitude and density, projected vertically upwards. In this case the resistance of the air and the force of gravity act both in the same direction, and the accelerating force becomes $\phi=-g-\frac{gv^2}{b^2}$; whence, since $\phi=dv\div dt$, we obtain the equation

$$\frac{bdv}{b^2+v^2}=-\frac{gdt}{b}.$$

To integrate the first member of this equation, let ψ denote an arc of a circle, then $d\tan\psi=d\psi\div\cos^2\psi$. Now let $\tan\psi=v\div b$, then $d\tan\psi=dv\div b$, and $1\div\cos^2\psi=1+\tan^2\psi=\frac{b^2+v^2}{b^2}$, and we get $d\psi=\frac{bdv}{b^2+v^2}$, whence

$$\int\frac{bdv}{b^2+v^2}=\psi=\text{arc}\left(\tan=\frac{v}{b}\right)$$

and the integral of the above equation becomes

$$\text{arc}\left(\tan=\frac{v}{b}\right)=-\frac{gt}{b}+\text{C}.$$

To determine the constant, let a as before denote the initial velocity. When $v=a$, then $t=0$, and we have

$$\text{arc}\left(\tan=\frac{a}{b}\right)=+\text{C},$$

therefore the complete integral is $\text{arc}\left(\tan=\frac{v}{b}\right)=\text{arc}\left(\tan=\frac{a}{b}\right)-\frac{gt}{b}$, whence

$$t=\frac{b}{g}\left\{\text{arc}\left(\tan=\frac{a}{b}\right)-\text{arc}\left(\tan=\frac{v}{b}\right)\right\},\qquad(12)$$

which gives the relation between the velocity and time. The quantities within the brackets express a portion of the arc of a circle whose radius is unit, and are therefore abstract numbers, multiplying $b\div g$, which is the number of units of time in which a heavy body falling in vacuo, acquires the velocity b, by formula 11.

Assume, as above, $\frac{gt}{b}=\tau$, and make $\frac{a}{b}=\tan\alpha$, $\frac{v}{b}=\tan\beta$; the equation (12) then becomes $\beta=\alpha-\tau$, whence by trigonometry

$$\tan\beta=\frac{\tan\alpha-\tan\tau}{1+\tan\alpha\tan\tau}.$$

On substituting for α and β their values as above, this gives

$$\frac{v}{b}=\frac{\frac{a}{b}-\frac{\sin\tau}{\cos\tau}}{1+\frac{a}{b}\,\frac{\sin\tau}{\cos\tau}},$$

$$\text{whence } v=\frac{b(a\cos\tau-b\sin\tau)}{a\sin\tau+b\cos\tau}.$$

Now, since $gt=b\tau$, we have $gdt=bd\tau$, and consequently

$$gvdt=\frac{b^2(a\cos\tau-b\sin\tau)d\tau}{a\sin\tau+b\cos\tau};$$

therefore, integrating, and observing that $\int vdt=x$, we have

$$gx=b^2\log(a\sin\tau+b\cos\tau)+\text{C}.$$

When $x=0$, then $t=0$, $\tau=0$, $\sin\tau=0$, $\cos\tau=1$; therefore $0=b^2\log b+\text{C}$, and the complete integral becomes

$$gx=b^2\{\log(a\sin\tau+b\cos\tau)-\log b\},$$

or

$$gx=b^2\left(\log\frac{a}{b}\sin\tau+\cos\tau\right);$$

whence on restoring the value of τ,

$$x=\frac{b^2}{g}\log\left(\frac{a}{b}\sin\frac{gt}{b}+\cos\frac{gt}{b}\right),\qquad(13)$$

which gives the space described in a function of the time.

To express the space in terms of the velocity, we have $\phi dx=vdv$. But in this case $\varphi=-g\frac{(b^2+v^2)}{b^2}$, therefore,

$$dx=-\frac{b^2}{g}\cdot\frac{vdv}{b^2+v^2}.$$

The integral of this gives $2gx=-b^2\log(b^2+v^2)+\text{C}$; and when $x=0$, then $v=a$; therefore $0=-b^2(b^2+a)+\text{C}$, and the complete integral becomes

$$x=\frac{b^2}{2g}\log\frac{b^2+a^2}{b^2+v^2}.\qquad(14)$$

Let h denote the greatest altitude. When the projectile reaches this altitude, $v=0$, and the last equation gives

$$h=\frac{b^2}{2g}\log\frac{b^2+a^2}{b^2}.\qquad(15)$$

This formula may be computed from the trigonometrical tables, by observing that $\frac{1}{2}\log\frac{b^2+a^2}{b^2}=\log\sqrt{\frac{b^2+a^2}{b^2}}$ = logarithmic secant of an arc ψ of which the tangent is $a\div b$. Suppose the velocity of projection to be 411 feet per second, and $b=689\frac{1}{3}$, the calculation of the height h will be as follows:

$$\begin{array}{rl} \log a = \log 411 & = 2{\cdot}61384 \\ \log b = \log 689\frac{1}{3} & = \underline{2{\cdot}83843} \\ \log \tan \psi & = 9{\cdot}77541 \end{array}$$

From the table of logarithmic tangents we find $\psi = 30^\circ 48' 20''$, the logarithmic cosine of which is $9{\cdot}93395$, whence $\log \sec \psi = 0{\cdot}06605$. We have therefore $h = \frac{b^2 \times {\cdot}06605}{g\text{M}} = \frac{(689\frac{1}{3})^2 \times {\cdot}06605}{32 \times {\cdot}43429} = 2259$ feet.

Having reached the greatest altitude h, the body will immediately begin to fall. From equation (11) we have $x = \frac{b^2}{2g} \log \frac{b^2}{b^2 - v^2}$ for the space through which the body must fall to acquire the velocity v. Now, if we make $x=h$, we shall have, on comparing this with the equation (15) $\log \frac{b^2+a^2}{b^2} = \log \frac{b^2}{b^2-v^2}$, whence $\sqrt{\frac{b^2+a^2}{b^2}} = \sqrt{\frac{b^2}{b^2-v^2}}$. But the first number of this equation is the secant of an arc, whose tangent is $a \div b$, and the second the secant of an arc whose sine is $v \div b$; and since the secants are equal, the arcs must be equal; therefore the velocity of projection is to the final returning velocity as the tangent to the sine, or as the radius to the cosine of an arc. Suppose the body projected with a velocity equal to the terminal velocity, that is, suppose $a=b$; the above equation will then become $2(b^2-v^2) = b^2$, or $b^2 = 2v^2$, whence $v = b \div \sqrt{2}$. If $b = 689\frac{1}{3}$, then $v=487$, or the body will reach with a velocity of 487 feet per second.

The time required for reaching the greatest altitude is found by making $v=0$ in equation (12). In this case the equation becomes $t = \frac{b}{g}$ arc $\left(\tan = \frac{a}{b}\right)$. We learn from this expression of the time, that however great the velocity of projection, and the height to which the body will rise, may be, the time of its ascent is limited. It never can exceed the time of falling *in vacuo* from the height due to the terminal velocity b, namely $t = b \div g$, in a greater proportion than that of a quadrantal arc to the radius, nearly the proportion of 8 to 5. A 24-pound iron ball cannot continue rising above 14 seconds, even if the resistance to quick motions did not increase faster than the square of the velocity. It probably will attain its greatest height in less than 12 seconds, let its velocity be ever so great.

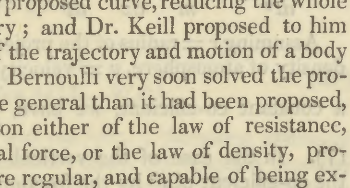
Having thus determined the relations subsisting between the velocity, the space described, and the time, in the cases of vertical ascent and descent in a resisting medium, we come now to consider the general problem, and to determine the motion of a body projected in any direction whatever. Our readers will readily conceive that this must be a difficult subject, when they see the simplest cases of rectilineal motion abundantly abstruse. In the infancy of the fluxionary calculus, the difficulty was indeed such that Newton himself did not succeed in obtaining a complete solution of the problem. In the tenth and subsequent propositions of the second book of the *Principia*, he shows what state of density in the air will comport with the motion of a body in any curve whatever; and then, by applying this result to several curves which have some similarity to the path of a projectile, he found one which is not very different from what may be supposed to obtain in the atmosphere. But even the approximation was involved in calculations of such intricacy, that it seemed impossible to make any use of it. In the second edition of the *Principia*, published in 1713, he corrects some mistakes into which he had fallen in the first, and carries the approximation much farther, but still does not attempt a direct investigation of the trajectory. In proposition 14, &c. he shows how a body, actuated by a centripetal force, in a medium of a density varying according to certain laws, will describe an eccentric spiral, of which he assigns the properties, and the law of description. Had he supposed the density constant, and the difference between the greatest and least distances from the centre of centripetal force exceedingly small in comparison with the distances themselves, his spiral would have coincided with the path of a projectile in the air of uniform density, and the steps of his investigation would have led him immediately to the complete solution of the problem. For this is the real state of the case. A heavy body is not acted on by equal and parallel gravity, but by a gravity inversely proportional to the square of the distance from the centre of the earth, and in lines tending to that centre nearly; and it has been only with the view of simplifying the investigation, that mathematicians have adopted the other hypothesis.

Soon after the publication of this second edition of the *Principia*, the dispute about the invention of the fluxionary calculus became very violent, and the great promoters of that calculus upon the continent were in the habit of proposing difficult problems as trials of skill to each other. Challenges of this kind frequently passed between the British and foreigners. Dr. Keill of Oxford had keenly espoused the claim of Sir Isaac Newton to this invention, and had engaged in a very acrimonious altercation with the celebrated John Bernoulli of Basle. Bernoulli had published in the *Acta Eruditorum* of Leipsic an investigation of the law of the forces, by which a body moving in a resisting medium might describe any proposed curve, reducing the whole to the simplest geometry; and Dr. Keill proposed to him the particular problem of the trajectory and motion of a body moving through the air. Bernoulli very soon solved the problem in a way much more general than it had been proposed, viz. without any limitation either of the law of resistance, the law of the centripetal force, or the law of density, provided only that they were regular, and capable of being expressed algebraically. Dr. Brook Taylor, the celebrated author of *The Method of Increments*, solved it at the same time, in the limited form in which it was proposed. Other authors since that time have given other solutions. But they are all (as indeed they must be) the same in substance with Bernoulli's. Indeed they are all (Bernoulli's not excepted) the same with Newton's first approximations, modified by the steps introduced into the investigation of the spiral motions mentioned above.

We now proceed to the problem itself, restricted to the case of uniform density and a resistance proportional to the square of the velocity.

Problem. To determine the trajectory, and all the circumstances of the motion of a body projected through the air, from a given point, and in a given direction, and resisted in the duplicate ratio of the velocity.

Fig. 3.



Suppose the body to be projected from A, in the direction AK, with a velocity $=a$, and let AB and AH, horizontal and vertical lines drawn through A, be assumed as the axes of the rectangular co-ordinates x and y. Let P be the place of the projectile at the end of the time t, make the arc $\text{AP}=z$, and let $\text{P}p=dz$, be an infinitely small portion of the arc, which may be regarded as coinciding with PM, the tangent to the curve at P; draw PQ and pq parallel to AH, and Pn parallel to AB, and let the angle $p\text{P}n$ ($=$PMA, which the tangent makes with the horizontal axis), be denoted by θ; we have then $Pn=dx$, $np=dy$, and $dy=dx \tan\theta$.

The intensity of the force of resistance being denoted as before by R, and the mass of the projectile by m, the accelerating force due to the resistance is $R\div m$. This force is exerted in the direction of the tangent at P, and as it tends to diminish the velocity in the direction Pp, it must be taken with the negative sign. Now, the accelerating force in the direction Pp, is to the accelerating force in the direction Pn as $1 : \cos\theta$, and to the force in the direction np as $1 : \sin\theta$; therefore in the direction of the axis x the accelerating force is $(R\div m)\cos\theta$, and in the direction of the axis y, $(R\div m)\sin\theta$. But $\cos\theta=\frac{dx}{dz}$, and $\sin\theta=\frac{dy}{dz}$, therefore the accelerating forces due to the resistance, in the direction of the co-ordinates, are $-\frac{R}{m}\cdot\frac{dx}{dz}$ and $-\frac{R}{m}\cdot\frac{dy}{dz}$ respectively. In the horizontal direction, the sole force acting on the projectile is that which is due to the resistance; in the vertical direction the body is also acted on by the accelerating force of gravity, g, which, when the body is ascending, acts in the same direction with the resisting force of the atmosphere, and must therefore be taken with the same sign. Now, the accelerating forces in the directions x and y, are respectively $\frac{d^2x}{dt^2}$ and $\frac{d^2y}{dt^2}$ by equations (1); we have therefore for the equations of motion,

$$\frac{d^2x}{dt^2}=-\frac{R}{m}\cdot\frac{dx}{dz},\quad \frac{d^2y}{dt^2}=-g-\frac{R}{m}\cdot\frac{dy}{dz}. \qquad (16)$$

Assuming $r=$ radius of the projectile, $\delta=$ its density, $\rho=$ density of atmosphere, $v=$ velocity at the point P, and $n=$ a constant co-efficient, we have, $\frac{R}{m}=\frac{n\rho}{\delta r}v^2$ by equation (7). In the case of the vertical motion, we represented the co-efficient of v^2 by the fraction $g\div b^2$, (b being the terminal velocity); it will now be more convenient to denote it by a single letter; we shall therefore assume $c=n\rho\div\delta r$; and consequently, as n and the ratio $\rho\div\delta$ are both abstract numbers, the reciprocal of the constant c, or $1\div c$, will represent a straight line; in fact, the reciprocal of c is twice the altitude producing the terminal velocity b *in vacuo*, for calling h' this altitude, we have by formula (III.) $b^2=2gh'$, therefore $g\div b^2=1\div 2h'=c$. We have then $R\div m=cv^2$; whence, since $v=\frac{dz}{dt}$, $\frac{R}{m}=\frac{dz^2}{dt^2}$. Substituting this in the above equations of motion (16) we get

$$\left.\begin{aligned}\frac{d^2x}{dt^2}+c\frac{dz}{dt}\cdot\frac{dx}{dt}&=0\\ \frac{d^2y}{dt^2}+c\frac{dz}{dt}\cdot\frac{dy}{dt}+g&=0,\end{aligned}\right\} \qquad (17)$$

from which the equation of the trajectory must be deduced by integration.

To integrate the first of these equations, suppose $\frac{dx}{dt}=ke^{-cz}$, where k is an arbitrary constant, and e the base of the hyperbolic logarithms. The differential of this equation is, $\frac{d^2x}{dt}=-kce^{-cz}dz$, or, dividing by dt, and substituting for ke^{-cz} its value, $\frac{d^2x}{dt^2}=-c\frac{dz}{dt}\cdot\frac{dx}{dt}$, which is the first of the above equations. Hence the integral of that equation is $\frac{dx}{dt}=ke^{-cz}$.

To determine the constant k, suppose $z=0$. When $z=0$, the velocity in the direction of the tangent AK is the initial velocity a, and in the direction AB it is $a\cos A$, assuming A as before to represent the angle KAB. But $\frac{dx}{dt}=v$, the velocity at P, therefore when $z=0$, the equation $\frac{dx}{dt}=ke^{-cz}$ gives $a\cos A=k$. The complete integral of the first of the equations (17) is therefore

$$\frac{dx}{dt}=a\cos A\, e^{-cz}. \qquad (18)$$

The integral of the second equation (17) is found as follows. Since $dy=\tan\theta\, dx$, we have, on supposing x and y to be functions of t, $\frac{dy}{dt}=\tan\theta\frac{dx}{dt}$. Differentiating this equation, and observing that $d\tan\theta=\frac{d\theta}{\cos^2\theta}=\sec^2\theta\, d\theta$, we get $\frac{d^2y}{dt^2}=\frac{d\theta}{\cos^2\theta\, dt}\cdot\frac{dx}{dt}+\tan\theta\frac{d^2x}{dt^2}$. Substituting these values of $\frac{d^2y}{dt^2}$ and $\frac{dy}{dt}$ in the equation in question, it becomes

$$\frac{d\theta}{\cos^2\theta\, dt}\cdot\frac{dx}{dt}+\tan\theta\left\{\frac{d^2x}{dt^2}+c\frac{dz}{dt}\cdot\frac{dx}{dt}\right\}+g=0;$$

whence, by reason of the first of the equations (17)

$$\frac{d\theta}{\cos^2\theta\, dt}\cdot\frac{dx}{dt}+g=0; \qquad (19)$$

and on dividing by $\frac{dx^2}{dt^2}=a^2\cos^2A\, e^{-2cz}$ (18), we get

$$\frac{d\theta}{\cos^2\theta\, dt}\div\frac{dx}{dt}=\frac{-g}{a^2\cos^2A}e^{-2cz}.$$

Now if θ be regarded as a function of x, then $\frac{d\theta}{dt}\div\frac{dx}{dt}=\frac{d\theta}{dx}$; and from the formula (III.) we have also $a^2=2hg$ (h being the height due to the velocity a); therefore by substitution

$$\frac{d\theta}{\cos^2\theta\, dx}=\frac{1}{2h\cos^2A}e^{2cz}$$

But we have $dx=dz\cos\theta$, therefore this equation becomes

$$\frac{d\theta}{\cos^3\theta}=-\frac{dz}{2h\cos^2A}e^{2cz}, \qquad (20)$$

which is the differential equation of the trajectory.

The integral of this equation is found as follows. By Fluxions (*Art.* 153), $\int\frac{d\theta}{\cos^3\theta}=\frac{\sin\theta}{2\cos^2\theta}+\frac{1}{2}\int\frac{d\theta}{\cos\theta}$; and (*Art.* 155), $\int\frac{d\theta}{\cos^2\theta}=\log\tan(45°+\frac{1}{2}\theta)$ We have also $\int e^{2cz}dz=\frac{1}{2c}e^{2cz}$; therefore assuming K to denote an arbitrary constant, the general integral becomes

$$\frac{\sin\theta}{\cos^2\theta}+\log\tan(45°+\tfrac{1}{2}\theta)=K-\frac{1}{2ch\cos^2A}e^{2cz}.$$

To determine the constant, suppose $z=0$. When $z=0$ then $\theta=A$, and the last equation gives

$$K=\frac{1}{2ch\cos^2A}+\frac{\sin A}{\cos^2A}+\log\tan(45°+\tfrac{1}{2}A). \qquad (21)$$

For the sake of abridging, let us assume

$$F(\theta)=\frac{\sin\theta}{\cos^2\theta}+\log\tan(45°+\tfrac{1}{2}\theta), \qquad (22)$$

$$F(A)=\frac{\sin A}{\cos^2 A}+\log\tan(45^\circ+\tfrac{1}{2}A),$$

then the complete integral of equation (20) becomes $F(\theta)-F(A)=\frac{1}{2ch\cos^2 A}(1-e^{2cz})$; whence, by transposition,

$$e^{2cz}-1=2ch\cos^2 A\{F(A)-F(\theta)\}, \qquad (23)$$

an equation which gives the length z of the arc AP in terms of the angle which the tangent at P makes with the horizontal line AB.

We have now to find expressions for the co-ordinates x and y. In consequence of the equation (21), the last may be otherwise written

$$\frac{1}{2h\cos^2 A}e^{2cz}=c\{K-F(\theta)\}. \qquad (24)$$

Substituting this in (20) we get $\frac{d\theta}{\cos^3\theta}=-dzc\{K-F(\theta)\}$, whence $dz=\frac{d\theta}{c\cos^3\theta\{F(\theta)-K\}}$. Now, we have also $dx=dz\cos\theta$, $dy=dz\sin\theta$, therefore by substitution,

$$dx=\frac{d\theta}{c\cos^2\theta\{F(\theta)-K\}}$$

$$dy=\frac{\tan\theta\,d\theta}{c\cos^2\theta\{F(\theta)-K\}} \qquad (25)$$

These expressions are not susceptible of integration in finite terms; but as x and y have the forms $x=\int\psi(\theta)d\theta$ and $y=\int\psi'(\theta)d\theta$ (ψ and ψ' denoting known functions of θ) and as θ varies within given limits, from $\theta=A$ to $\theta=0$ in the ascending branch of the curve, and from $\theta=0$ to $\theta=90^\circ$ in the descending branch, the problem is thus brought within the method of quadratures; that is to say, it depends on finding the areas of two curves, of which the ordinates are respectively $\psi(\theta)$ and $\psi'(\theta)$, corresponding to the absciss θ. Hence x and y may be found for given values of θ, and consequently any number of points may be found in the trajectory.

Instead of employing the equations (25), the curve may be constructed by means of equation (24), which is the method followed by Euler. That equation gives $e^{2cz}=2ch\cos^2 A\{K-F(\theta)\}$, whence we have

$$\log z=\frac{1}{2c}\log\left[2ch\cos^2 A\{K-F(\theta)\}\right].$$

Now, if θ be the angle which the tangent makes with the horizon at the point P of the curve, and z the length of the arc AP, and if at the point p at a small but finite distance from P, the angle becomes $\theta-\omega$, and the arc $z+\Delta z$, then if the formula be computed for a given value of θ, (for example 30°), and also for $\theta-\omega$ (suppose 25°), the difference between the two resulting numbers will give the length of the arc $Pp=\Delta z$. Thus we can find the values of a great number of small portions, and the inclinations of the two tangents at their extremities. We can also assign to each of these portions its proportion of the absciss and ordinate, without having recourse to the values of x and y; for the portion of the absciss corresponding to Pp or Δz being Δx, and $\theta-\frac{1}{2}\omega$ being the inclination of its middle point to the horizon, we have $\Delta x=\Delta z\cos(\theta-\frac{1}{2}\omega)$; and in like manner $\Delta y=\Delta z\sin(\theta-\frac{1}{2}\omega)$. By adding all these portions together, the co-ordinates will be obtained, and consequently the points of the curve from $\theta=A$ to $\theta=0$, or through the ascending branch from A to the vertex. Near the point of projection, the variation of the length of the arc is much greater than that of the angle θ, and therefore at the commencement it may be necessary to compute θ for each degree, that is, to assume $\omega=1^\circ$; but a sufficiently near approximation will be obtained by taking intervals of 5°, or making $\omega=5^\circ$ throughout the rest of the curve. It will be observed that the logarithms of the formulæ are hyperbolic; and therefore the logarithms of the common tables must be divided by the modulus M.

We have still to find expressions for the time and velocity. From equation (19) $\frac{d\theta}{\cos^2\theta}dx=-gdt^2$. Multiplying by c, and substituting for dx, its value given by the first of the equations (25), this becomes $\frac{d\theta^2}{\cos^4\theta\{F(\theta)-K\}}=-cgdt^2$, whence, transposing and extracting the root,

$$\sqrt{cg}\,.\,dt=\frac{d\theta}{\cos^2\theta\{F(\theta)-K\}^{\frac{1}{2}}}. \qquad (26)$$

In this equation the radical must be regarded as a positive quantity, because when the time t increases, the angle θ diminishes.

For the velocity we have from (19) $\frac{dx}{dt}=-g\cos^2\theta\frac{dt}{d\theta}$. But $dx=dz\cos\theta$, therefore $v=\frac{dz}{dt}=-g\cos\theta\frac{dt}{d\theta}$, and $v^2=g^2\cos^2\theta\frac{dt^2}{d\theta^2}$. Substituting in this equation the value of $\frac{dt^2}{d\theta^2}$ given by (26), we have

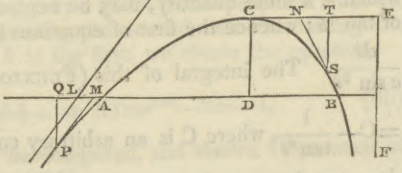
$$v^2=\frac{g}{c\cos^2\theta\{K-F(\theta)\}}. \qquad (27)$$

As the vertex, $\theta=0$, and $\cos^2\theta=1$; therefore, assuming u to denote the velocity at the vertex, the equation becomes $u^2=g\div cK$; or, since $c=g\div b^2$, $u^2=b^2\div K$; whence it appears that K is the ratio of the square of the terminal velocity to the square of the velocity in the vertex.

If there were no resistance, the smallest velocity would be at the vertex, and beyond the vertex it would immediately increase by the action of gravity conspiring (in a small degree, however) with the motion of the body. But in a resisting medium the velocity at the vertex is diminished by a quantity to which the acceleration of gravity in that point bears no assignable proportion. It is therefore diminished upon the whole, and the point of smallest velocity is a little way beyond the vertex. It is not material for our present purpose to determine the exact position of that point.

By means of the expressions which have now been found, we are enabled to compute for every value of θ, from the point of projection where $\theta=A$, to the vertex where $\theta=0$, the corresponding point of the trajectory, the time which the projectile takes to arrive at that point, and the velocity with which it is then moving. We now proceed to consider the motion in the descending branch.

Fig. 4.



Let the origin of the co-ordinates (fig. 4.) be transferred to the vertex C; let CE be horizontal, CD vertical, S a point in the descending branch, SN a tangent at S, meeting CE in N, and ST parallel to CD. Also let x' and y' be the co-ordinates of S referred to the vertex, that is, make $x'=\text{CT}$, $y'=\text{ST}$, and suppose the co-ordinates of the vertex to be p and q, namely $\text{AD}=p$, $\text{CD}=q$. Then the co-ordinates of S referred to A being always represented by x and y, we have

$$x=p+x',\ y=q-y',\ dx=dx',\ dy=-dy'.$$

Now it will be observed, that in the descending branch the angle θ is negative, or that $\text{ENS}=-\theta$; whence the first of the two equations in (25) becomes in the present case

$$dx'=\frac{-d\theta}{c\cos^2\theta\left\{\text{F}(-\theta)-\text{K}\right\}}.$$

But from (23), $\text{F}(-\theta)=\dfrac{-\sin\theta}{\cos^2\theta}+\log\tan(45°-\tfrac{1}{2}\theta)$; and

$\tan(45°-\tfrac{1}{2}\theta)=\cot(45+\tfrac{1}{2}\theta)=\dfrac{1}{\tan(45°+\frac{1}{2}\theta)}$; whence

$\log\tan(45°-\tfrac{1}{2}\theta)=-\log\tan(45°+\tfrac{1}{2}\theta)$, and consequently $\text{F}(-\theta)=-\text{F}(\theta)$. Equations (25) therefore become

$$dx'=\frac{d\theta}{c\cos^2\theta\left\{\text{K}+\text{F}(\theta)\right\}}$$
$$dy'=\frac{-\tan\theta\,d\theta}{c\cos^2\theta\left\{\text{K}+\text{F}(\theta)\right\}}. \tag{28}$$

In like manner the equation (24) becomes in this case

$$e^{2cz'}=2ch\cos^2\text{A}\left\{\text{K}+\text{F}(\theta)\right\},$$

z' being the arc counted from the vertex; and the expressions for the time and velocity become respectively

$$\sqrt{cg}.\,dt=\frac{d\theta}{\cos^2\theta\left\{\text{K}+\text{F}(\theta)\right\}^{\frac{1}{2}}};\ v^2=\frac{g}{c\cos^2\theta\left\{\text{K}+\text{F}(\theta)\right\}}. \tag{29}$$

All these expressions are computed for successive values of θ from $\theta=0$; and a sufficient approximation will be obtained by assuming θ to vary by intervals of 5°. The ascending and descending branches of the trajectory are thus computed independently, as if they belonged to different curves.

In the descending branch the angle $\theta=\text{ENS}$ continually increases with the distance of the point S from C, until it becomes a right angle, which is its limiting value. But x' can only increase to a certain magnitude, which it would attain when S is at an infinite distance, and consequently this branch of the curve has an asymptote, which is perpendicular to the horizon. To prove this, let the factor $\text{K}+\text{F}(\theta)$ be developed, and let us consider what it becomes when θ approaches its limit. We have $\text{F}(\theta)=\dfrac{\sin\theta}{\cos^2\theta}+\log.\tan(45°+\tfrac{1}{2}\theta)$. Now when θ approaches very nearly to a right angle, $\sin\theta=1$, and $\dfrac{1}{\cos^2\theta}\ (=1+\tan^2\theta)$ $=\tan^2\theta$; therefore $\dfrac{\sin\theta}{\cos^2\theta}=\tan^2\theta$. With respect to the second term, when θ is nearly $=90°$, then $\tan(45°+\tfrac{1}{2}\theta)$ becomes very large, and nearly equal to $\tan\theta$; but the logarithm of a very large number may be neglected as insensible in comparison of the square of the number, we have therefore simply $\text{F}(\theta)=\tan^2\theta$. In like manner, K, which is a finite quantity, may be neglected in comparison of $\tan^2\theta$; whence the first of equations (28) becomes $dx'=\dfrac{d\theta}{c\sin^2\theta}$. The integral of this (Fluxions, art. 153) is $x'=\text{C}-\dfrac{1}{\tan^2\theta}$, where C is an arbitrary constant. Hence x does not increase indefinitely, but as θ increases, it approaches nearer and nearer to a constant C, with which it coincides when θ is infinite. The constant C cannot be determined from this equation; but if we assume $k=\dfrac{1}{c}\displaystyle\int_0^\infty\frac{d\theta}{\cos^2\theta\left\{\text{K}+\text{F}(\theta)\right\}}$, the value of k may be approximately computed by the method of quadratures. Suppose k to be determined, make $\text{CE}=k$, and draw through E the vertical EF, then EF is the asymptote of the descending branch of the curve.

The terminal velocity b may be determined from equation (27). On changing θ into $-\theta$ in that equation, and supposing θ to become a right angle, we have $b^2=\dfrac{g}{c\sin^2\theta}=\dfrac{g}{c}$; whence $b=\sqrt{\dfrac{g}{c}}$, which agrees with the assumed value of c, namely $c=g\div b^2$.

Although the motion commences at the point A, the curve may be supposed to be continued infinitely below the line AB. This branch of the curve has also an asymptote, the position of which it is important to determine. If in the equation (23)

$$e^{2cz}-1=2ch\cos^2\text{A}\left\{\text{F(A)}-\text{F}(\theta)\right\},$$

we suppose z to be negative and infinite, and assume B to denote the value of θ when z is infinite, we shall have

$$\text{F(B)}=\frac{1}{2ch\cos^2\text{A}}+\text{F(A)}, \tag{30}$$

whence from equation (22), $\text{F(B)}=\text{K}$. Substituting this value of K in the two equations (25), and observing, that for any point in this branch of the curve below AB, x and y are both negative, we have

$$dx=\frac{d\theta}{c\cos^2\theta\left\{\text{F(B)}-\text{F}(\theta)\right\}},\ dy=\frac{\tan\theta\,d\theta}{c\cos^2\theta\left\{\text{F(B)}-\text{F}(\theta)\right\}}.$$

Now let P (fig. 4.) be a point in the curve, PM a tangent at P, meeting AB in M, let AQ and PQ be the co-ordinates of P, and make $\text{AM}=l$. We have then $l=\text{AQ}-\text{MQ}=x-\dfrac{y}{\tan\theta}$. Suppose now the point P at an infinite distance, then θ becomes B, the tangent MP becomes an asymptote, and $l=x-\dfrac{y}{\tan\text{B}}$. Hence $dl=dx-\dfrac{dy}{\tan\text{B}}$; and therefore, on substituting the above values of dx and dy, we get

$$dl=\frac{(\tan\text{B}-\tan\theta)d\theta}{c\tan\text{B}\cos^2\theta\left\{\text{F(B)}-\text{F}(\theta)\right\}}.$$

The integral of this expression from $\theta=\text{A}$ to $\theta=\text{B}$ will give the distance of the asymptote from the point. Let the definite integral be denoted by λ, that is, let

$$\lambda=\frac{1}{c\tan\text{B}}\int_{\text{A}}^{\text{B}}\frac{(\tan\text{B}-\tan\theta)d\theta}{\cos^2\theta\left\{\text{FB}-\text{F}(\theta)\right\}}, \tag{31}$$

then λ may be computed by the method of quadratures. If we then take on the prolongation of AB, AL equal to λ, and draw through L the line LG, making with AB an angle $=\text{B}$, then LG will be the asymptote of the branch AC. The whole curve will then lie between the two asymptotes, which are inclined to each other in an angle $=90°-\text{B}$.

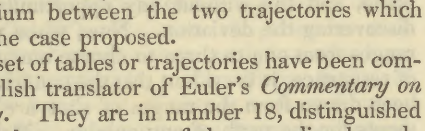
Such, then, is the process by which the form and magnitude of the trajectory, and the motion in it may be determined. But it does not yet appear how this is to be applied to any question in practical artillery. By means of the preceding formulæ, we are enabled to compute the motion from any point in the ascending branch to the vertex, where the motion becomes horizontal, and the motion from the vertex to a point in the descending branch, where the motion has acquired another determinate direction; the constants which enter into the formulæ being c and K, of which c $(=g \div b^2)$ depends on the terminal velocity, and therefore on the nature of the projectile and the ratio of its density to that of the air; and K on the initial velocity, the terminal velocity, and the angle of elevation. We have also shewn that K denotes the ratio of the square of the terminal velocity to the square of the velocity in the vertex; therefore the terminal velocity and velocity in the vertex may be regarded as the two constants of the formulæ. The mode in which the formulæ are applied to the solution of the usual question, namely, to find the motion of a ball projected in a certain direction, with a certain velocity, is as follows: Suppose a trajectory, computed for a particular terminal velocity b, and for a particular velocity at the vertex, and that the velocity at that point of the ascending branch where the inclination of the tangent is 30° is 900 feet per second. Then, we are certain, that if a ball, whose terminal velocity is b, be projected with the velocity of 900 feet per second, and an elevation of 30°, it will describe this very trajectory, and the velocity and time corresponding to every point will be such as is here determined.

Now this trajectory will, in respect to form, answer an infinity of cases: for its characteristic is the proportion of the velocity in the vertex to the terminal velocity. If, therefore, we compute the trajectories for a sufficient variety of these proportions, we shall find a trajectory that will nearly correspond to any case that can be proposed: and an approximation sufficiently exact will be had by taking a proportional medium between the two trajectories which come nearest to the case proposed.

Accordingly, a set of tables or trajectories have been computed by the English translator of Euler's *Commentary on Robins's Gunnery*. They are in number 18, distinguished by the position of the assymptote of the ascending branch. This is given for 5°, 10°, 15°, &c. to 85°, and the whole trajectory is computed as far as it can ever be supposed to extend in practice.

Since the path of a projectile is much less incurvated, and more rapid in the ascending than in the descending branch, and the difference is so much the more remarkable in great velocities, it must follow, that the range on a horizontal or inclined plane depends most on the ascending branch: therefore the greatest range will not be made with that elevation which bisects the angle of position, but with a lower elevation; and the deviation from the bisecting elevation will be greater as the initial velocities are greater. It is difficult to frame a rule for determining with much precision, the elevation which gives the greatest range.

Fig. 5.



When the angle of elevation is very small, and consequently the path of the projectile nearly horizontal, the formulæ admit of simplifications which it is important to consider. Suppose KAB (fig.5.) the angle of elevation to be small, then θ, the angle which the tangent at any other point of the trajectory makes with AB, will be very small, and $\sin\theta$ and $\tan\theta$ will be very small fractions. Suppose the angle so small that $\tan^2\theta$ may be neglected as insensible; then $\cos\theta$ may be regarded as unit, and the equation $dx=dz\cos\theta$ gives $dx=dz$. Hence $x=z$ and equation (20) becomes

$$\frac{d\theta}{\cos^2\theta}=-\frac{dx}{2h\cos^2 A}e^{2cx}, \qquad (32)$$

the integral of which, since $d.\,e^{2cx}=2c\,e^{2cx}dx$, is

$$\tan\theta=-\frac{1}{4ch\cos^2 A}e^{2cx}+\mathrm{C}.$$

To determine the constant we suppose $x=0$, in which case $\theta=A$, and we have

$$\tan A=-\frac{1}{4ch\cos^2 A}+\mathrm{C},$$

whence the complete integral is

$$\tan\theta=\tan A-\frac{1}{4ch\cos^2 A}\left(e^{2cx}-1\right).$$

Multiplying both sides of this equation by dx, observing that $dy=dx\tan\theta$, and integrating, we get

$$y=\tan A\,x-\frac{1}{4ch\cos^2 A}\left(\frac{1}{2c}e^{2cx}-x\right)+\mathrm{C}.$$

But when $x=0$, $y=0$, and this equation becomes

$$0=\frac{1}{8c^2h\cos^2 A}+\mathrm{C};$$

therefore the complete integral is

$$y=x\tan A-\frac{1}{8c^2h\cos^2 A}(e^{2cx}-2cx-1), \qquad (33)$$

which gives an approximate equation of the trajectory between the co-ordinates x and y.

To determine the time corresponding to the horizontal distance x, we have from equation (19) $\frac{d\theta}{\cos^2\theta}dx=-g\,dt^2$, whence by reason of (32) $dt^2=\frac{1}{2gh\cos^2 A}e^{2cx}dx^2$, and consequently

$$dt=\frac{1}{\surd(2gh)\cos A}e^{cx}dx.$$

Integrating this expression, and determining the constant so that $x=0$ when $t=0$, we get

$$t=\frac{1}{c\cos A\surd(2gh)}(e^{cx}-1.) \qquad (34)$$

The two equations (33) and (34) may be employed for the purpose of determining the co-efficient c of the resistance on the terminal velocity which depends on it, from experiments. Suppose the trajectory to be continued to D, a small distance below the horizontal line AB. For this point of the curve the approximation may still be regarded as sufficiently accurate. Let DE be vertical, make $AE=a$, $ED=\beta$, and the time in which the projectile passes from A to $D=\tau$. Substituting these values of x, y, and t in the equations (33) and (34), making $\cos A=1$, because A is by supposition a very small angle, and observing that since D is below AB, y must be taken as negative, the two equations give

$$8hc^2(\beta+a\tan A)=e^{2ca}-2ca-1,$$
$$\tau c\surd(2gh)=e^{ca}-1. \qquad (35)$$

Now, of the quantities involved in these equations, g and $\tan A$ are known, and a, β, τ, can be determined by direct experiments, leaving only c and h to be computed from the equations. On squaring the second, and substituting the resulting value of h in the first, we obtain the equation

$$\frac{(4e^{ca}-1)^2}{\tau^2 g}(\beta+a\tan A)=e^{2ca}-2ca-1, \qquad (36)$$

from which c may be computed, and thence h by means of one of the equations (35).

Of the quantities which enter into the equations (35) and which are to be found from experiment, that which can be determined with the least certainty is τ, the time of flight. This, however, may be eliminated by varying the experiment. Suppose the projectile to be discharged at a different height above the ground, for instance the top of a tower, (the angle of elevation A, and the initial velocity remaining the same,) and let α, β, become respectively α', β', we have then, from the first of equations (35),

$$8hc^2(\beta'+\alpha' \tan A)=\epsilon^{2c\alpha'}-2c\alpha'-1$$

$$8hc^2(\beta+\alpha \tan A)=\epsilon^{2c\alpha}-2c\alpha-1,$$

whence

$$(\beta'+\alpha' \tan A)(e^{2c\alpha}-2c\alpha-1)=(\beta+\alpha \tan A)(c^{2c\alpha'}-2c\alpha'-1)$$

an equation from which the value of c may be computed when α, β, and also α' β' are determined from experiments.

The solution which we have now given of this celebrated problem is exact in principle, and the application of it by no means difficult or even operose. But let us see what advantage we are likely to derive from it.

In the first place, it is very limited in its application. There are few circumstances of general coincidence, and almost every case requires an appropriate calculus. Perhaps the only general rules are the two following:

1. Balls of equal density, projected with the same elevation, and with velocities which are as the square roots of their diameters, will describe similar curves. This is evident, because, in this case, the resistance will be in the ratio of their quantities of motion. Therefore all the homologous lines of the motion will be in the proportion of the diameters.

2. If the initial velocities of balls projected with the same elevation are in the inverse subduplicate ratio of the whole resistances, the ranges, and all the homologous lines of their track, will be inversely as those resistances.

These theorems are of considerable use; for by means of a proper series of experiments on one ball projected with different elevations and velocities, tables may be constructed which give the motions of an infinity of others.

But when we take a retrospective view of what we have done, and consider the conditions which were assumed in the solution of the problem, we shall find that much yet remains before it can be rendered of great practical use. The resistance is all along supposed to be in the duplicate ratio of the velocity; but even theory points out many causes of deviation from this law, such as the pressure and condensation of the air, in the case of very swift motions; and Mr. Robins's experiments are sufficient to show us that the deviations must be exceedingly great in such cases. Euler and all subsequent writers have allowed that it may be three times greater, even in cases which frequently occur; and Euler gives a rule for ascertaining with tolerable accuracy what this increase and the whole resistance may amount to. Let H be the height of a column of air whose weight is equivalent to the resistance taken, in the duplicate ratio of the velocity. The whole resistance will be expressed by $H+\frac{H^2}{28845}$. This number 28845 is the height in feet of a column of air whose weight balances its elasticity. We shall not at present call in question his reason for assigning this precise addition. They are rather reasons of arithmetical conveniency than of physical import. It is enough to observe, that if this measure of the resistance is introduced into the process of investigation, it is totally changed; and it is not too much to say, that with this complication it requires the knowledge and address of a Euler to make even a partial and very limited approximation to a solution. Any law of the resistance, therefore, which is more complicated than what Bernoulli has assumed, namely, that of a simple power of the velocity, must be abandoned on account of the intricacy of the calculations; and mathematicians have attempted to avoid the error arising from the assumption of the duplicate ratio of the velocity, either by supposing the resistance throughout the whole trajectory to be greater than what it is in general, or they have divided the trajectory into different portions, and assigned different resistances to each, which vary, through the whole of that portion, in the duplicate ratio of the velocities. In this manner they make up a trajectory and motion which correspond, in some tolerable degree, not with an accurate theory, but with a series of experiments. For, in the first place, every theoretical computation that we make, proceeds on a supposed initial velocity; and this cannot be ascertained with any thing approaching to precision, by any theory of the action of gunpowder that we are yet possessed of. In the next place, our theories of the resisting power of the air are entirely established on the experiments on the flights of shot and shells, and are corrected and amended till they tally with the most approved experiments we can find. We do not learn the ranges of a gun by theory, but the theory by the range of the gun. Now the variety and irregularity of all the experiments which are appealed to are so great, and the acknowledged difference between the resistance to slow and swift motions is also so great, that there is hardly any supposition which can be made concerning the resistance, that will not agree in its results with many of those experiments. It appears from the experiments of Dr. Hutton of Woolwich, in 1784, 1785, and 1786, that the shots frequently deviated to the right or left of their intended track 200, 300, and sometimes 400 yards. This deviation was quite accidental and anomalous, and there can be no doubt but that the shot deviated from its intended and *supposed* elevation as much as it deviated from the intended vertical plane, and this without any opportunity of measuring or discovering the deviation. Now, when we have the whole ranges from one to three to choose among for our measure of resistance, it is evident that the confirmations which have been drawn from the ranges of shot are but feeble arguments for the truth of any opinion. Mr. Robins finds his measures fully confirmed by experiments made at Metz and Minorca. Mr. Muller finds the same. Yet Mr. Robins's measures, both of the initial velocity and of the resistance, are at least treble of Mr. Muller's; but by compensation they give the same results. The Chevalier Borda has adduced the very same experiments in support of his theory, in which he abides by the Newtonian measure of the resistance, which is about $\frac{1}{3}$ of Mr. Robins's, and about $\frac{2}{3}$ of Muller's. From all this we may conclude, that we have as yet a very uncertain and imperfect knowledge of the law and the measure of the air's resistance.

There is another essential defect in the conditions assumed in the solution. The density of the air is supposed uniform; whereas we are certain that it is less by one-fifth or one-sixth towards the vertex of the curve, in many cases which frequently occur, than it is at the beginning and end of the flight. This is another latitude given to authors in their assumptions of the air's resistance. Borda has, with considerable ingenuity, accommodated his investigation to this circumstance, by dividing the trajectory into portions, and, without much trouble, has made one equation answer them all. We are disposed to think that his solution of the problem (in the *Memoirs* of the Academy of Paris for 1769) corresponds better with the physical circumstances of the case than any other. But this process is there delivered in too concise a manner to be intelligible to a person not perfectly familiar with all the resources of modern analysis.

After all, the practical artillerist must rely chiefly on the records of experiments contained in the books of practice at the academies, or those made in a more public manner.

Even a perfect theory of the air's resistance can do him little service, unless the force of gunpowder were uniform. This is far from being the case even in the same powder. A few hours of a damp day will make a greater difference than occurs in any theory; and, in service, it is only by trial that everything is performed. If the first shell fall very much short of the mark, a little more powder is added; and in cannonading, the correction is made by varying the elevation.

The experiments of Mr. Robins and Dr. Hutton show, in the most incontrovertible manner, that the resistance to a motion exceeding 1100 feet in a second, is almost *three times* greater than in the duplicate ratio of the resistance to moderate velocities. Euler's translator, in his comparison of the author's trajectories with experiment, supposes it to be *no* greater. Yet the coincidence is very great. The same may be said of Borda's. Nay, the same may be said of Mr. Robins's own practical rules: for he assumes the quantity which represents the height due to the terminal velocity, almost double of what these authors do, and yet his rules are confirmed by practice.

But it must not be inferred from all this, that the physical theory is of no use to the practical artillerist. It plainly shows him the impropriety of giving the projectile an enormous velocity. This velocity is of no effect after 200 or 300 yards at farthest, because it is so rapidly reduced by the prodigious resistance of the air. Mr. Robins has deduced several practical maxims of the greatest importance from what we already know of this subject, and which could hardly have been even conjectured without this knowledge. See GUNNERY.

It must also be acknowledged, that this branch of physical science is highly interesting to the philosopher; nor should he despair of carrying it to a greater perfection. The defects arise almost entirely from our ignorance of the law of variation of the air's resistance. Experiments may be contrived much more conducive to our information here than those commonly resorted to. The oblique flights of projectiles are, as we have seen, of very complicated investigation, and ill fitted for instructing us; but numerous and well contrived experiments on the perpendicular ascents are of great simplicity, being affected by nothing but the air's resistance.

We shall conclude this article, by giving two tables, computed from the principles established above, and which serve to bring into one point of view the chief circumstances of the motion in a resisting medium. Although the result of much calculation, as any person who considers the subject will readily see, they must not be considered as offering any very accurate results; or that, in comparison with one or two experiments, the differences shall not be considerable. Let any person peruse the published registers of experiments which have been made with every attention, and he will see such enormous irregularities, that all expectations of perfect agreement with them must cease. In the experiments at Woolwich in 1785, which were continued for several days, not only do the experiments of one day differ among themselves, but the mean of all the experiments of one day differs from the mean of all the experiments of another no less than one-fourth of the whole. The experiments in which the greatest regularity may be expected, are those made with great elevations. When the elevation is small, the range is more affected by a change of velocity, and still more by any deviation from the supposed or intented direction of the shot.

The first table shows the distance in yards to which a ball projected with the velocity of 1600 feet in a second will go, before its velocity is reduced one-tenth, and the distance at which it drops 16 feet from the line of its direction. This table is calculated by the resistance observed in Mr. Robins's experiments. The first column is the weight of the ball in pounds. The second column remains the same whatever be the initial velocity; but the third column depends on the velocity. It is here given for the velocity which is very usual in military service, and its use is to assist us in directing the gun to the mark. If the mark at which a ball of 24 pounds is directed is 474 yards distant, the axis of the piece must be pointed 16 feet higher than the mark. These deflections from the line of direction are nearly as the squares of the distances.

I.	II.	III.
2	92	420
4	121	428
9	159	456
18	200	470
32	272	479

The next table contains the ranges in yards of a 24-pound shot, projected at an elevation of 45°, with the different velocities in feet per second, expressed in the first column. The second column contains the distances to which the ball would go *in vacuo* in a horizontal plane; and the third contains the distances to which it will go through the air. The fourth column is added, to shew the height to which it rises in the air; and the fifth shows the ranges corrected for the diminution of the air's density as the bullet ascends, and may therefore be called the *corrected range*.

I.	II.	III.	IV.	V.
200	416	349	106	360
400	1664	1121	338	1150
600	3740	1812	606	1859
800	6649	2373	866	2435
1000	10300	2845	1138	2919
1200	14961	3259	1378	3343
1400	20364	3640	1606	3734
1600	26597	3950	1814	4050
1800	33663	4235	1992	4345
2000	41559	4494	2168	4610
2200	50286	4720	2348	4842
2400	59846	4917	2460	5044
2600	70235	5106	2630	5238
2800	81456	5293	2760	5430
3000	93465	5455	2862	5596

The initial velocities can never be pushed as far as they have been calculated for in this table; but we mean it for a table of more extensive use than appears at first sight. Recollect, that while the proportion of the velocity at the vertex to the terminal velocity remains the same, the curves will be similar; therefore, if the initial velocities are as the square roots of the diameters of the balls, they will describe similar curves, and the ranges will be as the diameters of the balls.

Let it be required, for example, to find the range of a 12-pound shot, projected at an elevation of 45°, with the velocity 1500; suppose the diameter of the twelve-pounder to be d, and that of the twenty-four-pounder D; and let the velocities be v and V: Then say, $\sqrt{d} : \sqrt{D} = 1500$: a fourth proportional V. If the twenty-four-pounder be projected with the velocity V, it will describe a curve similar to that described by the twelve-pounder, having the initial velocity 1500. Therefore find (by interpolation) the range of the twenty-four-pounder, having the initial velocity V. Call this R. Then $D : d = R : r$, the range of the twelve-pounder which was wanted, and which, assuming the diameters of the balls to be 4·45 and 5·61 inches, respectively, will be found 3312.

This table shews the immense difference between the motions through the air and in a void. It shews also that the ranges through the air, instead of increasing in the duplicate ratio of the initial velocities, really increase slower than those velocities in all cases of military service; and in the most usual cases, viz. from 800 to 1600, they increase nearly as the square roots of the velocities.

A set of similar tables, made for different elevations, would almost complete what can be done by theory, and would be much more expeditious in their use than Mr. Euler's *Trajectories*, computed with great labour by his English translator.

The same table may also serve for computing the ranges of bomb-shells. We have only to find what must be the initial velocity of the twenty-four-pound shot which corresponds to the proposed velocity of the shell. This must be deduced from the diameter and weight of the shell, by making the velocity of the twenty-four pounder such, that the ratio of its weight to the resistance may be the same as in the shell.

Dr. Hutton, in his *Mathematical Tracts* (vol. iii. p. 276), has given a similar table, deduced partly from theory and partly from experiment, but the numbers in the three last columns differ greatly from the above, particularly for the higher velocities. Thus, for the velocity of 1600 feet, Dr. Hutton's corrected range is 2264 yards, and the height to which the ball rises 650 yards, instead of 4050 and 1814, as in our table.

For further information on this subject, see GUNNERY; Robins's *Mathematical Tracts*; Brown's *True Principles of Gunnery*; Hutton's *Mathematical Tracts*; and for an example of the computation of a trajectory by the method of quadratures, Legendre's *Exercises de Calcul.* tome i. p. 330.

PROJECTION. Projection of the Sphere in *Astronomy* and *Geography* signifies in general a perspective representation of the surface of the sphere on a plane; and it is of various kinds according to the different positions of the eye and the plane of projection.

As the principles of the different projections commonly employed in the construction of maps and charts, and the method of applying them, have already been explained in the article GEOGRAPHY, (chap. iv.,) we shall merely give a general view of the subject in this place, referring the reader to the article just cited, for the details and demonstrations.

The simplest of all the projections is the *Orthographic.* Considered as a perspective delineation of the surface of the sphere, this supposes the eye to be placed at an infinite distance, so that all the rays coming from the different parts of the surface are parallel; and the *plane of projection*, or plane upon which the representation is made, is assumed to be perpendicular to the direction of the visual rays, and to pass through the centre of the sphere. The orthographic projection of any point is therefore the intersection of a perpendicular from that point with the plane of projection. When the object is to represent only a small portion of the surface of the sphere, situated near the *pole of projection*, or point in which the straight line from the eye to the centre of the sphere intersects the surface, this projection answers every purpose; but it is not so well adapted to the delineation of a whole hemisphere, or even a considerable portion of it; for the distances from the pole being represented by the sines of the arcs by which they are measured on the sphere, and as the sines of large arcs increase in a much smaller ratio than the arcs themselves, the map is necessarily crowded and distorted towards the extremities, and gives a very imperfect representation of the objects delineated.

The principal properties of the orthographic projection are, 1st, That all the great circles of the sphere, the planes of which pass through the eye, are represented by straight lines: 2d, That all circles, (they can only be small circles) the planes of which are perpendicular to the line of sight, are represented by circles: 3d. That all other circles, whether large or small, being seen obliquely, are represented by ellipses. This method of projection was known to the ancient astronomers, and employed by them in the construction of the *Analemma*, a sort of instrument for the graphical solution of various problems of the sphere, on which Ptolemy wrote a treatise, which has been preserved through the medium of an Arabic version, and of which a Latin translation was published by Commandine at Rome in 1562. The orthographic projection is conveniently used for various astronomical purposes, such as the geometrical delineation of eclipses, transits, and occultations; and it has numerous applications in the arts, the plans and sections by which artificers execute their constructions, being merely orthographical projections of the things to be constructed.

In the *Stereographic* projection the eye is supposed to be situated at the surface of the sphere, and the plane of projection is the plane of the great circle, at the pole of which the eye is placed. The hemisphere which is projected, is that which is opposite to the eye, and consequently the sphere must be supposed transparent, in order that the different points of its surface may be visible. According to the testimony of two ancient authors, Synesius and Proclus, this projection was invented by Hipparchus. It was called the *Planisphere*, on which also there is a treatise by Ptolemy, preserved through the Arabic. The term *Stereographia* (derived from στερεος, solid, because it results from the intersection of two solids, the sphere and the cone) was, according to Delambre, first applied to it by the Jesuit Aguilon in a *Treatise on Optics*, published at Antwerp in 1613. The astrolabe, an instrument formerly much in use for the graphical solution of astronomical problems connected with the diurnal motion, was constituted on this projection.

The two principal properties of the stereographic projection are, 1st, That all circles on the sphere which do not pass through the eye, whether great or small, are projected into circles; and, 2d, That the circles of projection intersect each other under the same angles as their corresponding circles on the sphere. The first of these properties is of great importance, by reason of the facility which it affords for the construction of maps. It is demonstrated in the planisphere of Ptolemy for all the particular cases that occur in the projections there described; and although the general proposition is not formally mentioned, it can scarcely be supposed to have been unknown to him, as his demonstrations are easily rendered applicable to every case. It is, indeed, an almost obvious consequence of a property demonstrated by Apollonius relative to the subcontrary sections of the oblique cone. The demonstration of Ptolemy for the particular cases is, however, entirely independent of the theorem of Apollonius. Delambre (*Astronomie Ancienne*, tom. ii. p. 456) states, that the oldest work in which he has met with the enunciation of the general property is the *Planisphere* of Jordanus, published with some other astronomical tracts, at Toulouse in 1544. It may be remarked, that Jordanus, instead of projecting the hemisphere on the plane of the equator, chooses for the plane of projection, the plane touching the sphere at the north pole. The property of the equality of angles, which is also very curious and important, appears to be of modern discovery, but the author of it is not certainly known. Delambre (*Astronomie*, tom. iii. p. 674) says, he has searched for it in vain in the large treatise of Clavius, in that of Stoflerinus, and in Bion; and (*Histoire de l'Astronomie au Dix-Huitième Siècle*, p. 88,) that the oldest demonstration of it known to him is in *Leadbetter's Astronomy*, London, 1728. It had, however, been previously demonstrated by Dr. Halley in 1696, in No. 219 of the *Philosophical Transactions*, in which he attributes the first discovery of the proposition to Demoivre or Hook.

As the surface of a sphere is equal to four times the area of one of its great circles, it follows that in the stereographic projection on the plane of a great circle, the surface of the hemisphere is reduced to one-half of its original dimensions. This would be no defect, if the reduction were uniform; which, however, is far from being the case; for at the centre, the linear dimensions are reduced to one-half, and consequently the superficial to one-fourth; and the reduction becomes less and less towards the extremities of the map. Any portion of the upper hemisphere projected in this way would be enlarged. Hence there is little resemblance between a given portion of the spherical surface and its representation, which is the great defect of the projection. In maps of the stars, for which it is most frequently employed, there is also an inconveniency in the difficulty of finding the places of particular stars, for three or more objects, which in the apparent heavens are situated in the same straight line, are placed in the map on the circumference of a circle which is not represented. Nevertheless, the projection answers conveniently enough all the purposes, for which a map is required by the astronomer.

In the *Gnomonic* or *Central* projection, the eye is supposed to be placed at the centre of the sphere, and the plane of projection is a plane touching the sphere at any point assumed at pleasure. The point of contact is called the *principal point;* the projection of all other points are at the extremities of the tangents of the arcs intercepted between them and the principal point, and the tangents make with each other angles equal to those in which their arcs intersect at the pole. This projection is also described by Ptolemy in the *Analemma*, (Delambre, *Astr. Ancienne*, tom. ii. p. 486); but as the Greeks had no idea of the trigonometrical tangents, the polar distances are in that work expressed by the ratios of the sines to the cosines of the arcs. As the tangents of arcs exceeding 45° increase very rapidly, and become infinite for arcs of 90°, the projection cannot be employed for a whole hemisphere. The celestial maps published by the Society for the Diffusion of Useful Knowledge, are projected in this manner, and the surface embraced is one-sixth of the whole sphere, or the sphere is projected on the six sides of its circumscribing cube. For a map of the stars this projection possesses some advantage over the stereographic. All stars which appear in the same straight line in the heavens, are projected in the same straight line, so that their places can be readily found on the map; and from the position of the eye at the centre of the sphere, the appearance of the heavens is better preserved. The map is necessarily distorted in some degree near the extremities and corners, but not to so great an extent as to render it a bad representation. Besides, the distortion is equal for lines equally distant from the centre, and there is no angular distortion with respect to lines which pass through the centre of the map. This projection is particularly applicable to the construction of sun-dials and gnomons, whence its name.

The three kinds of projection now described, are chiefly employed in the construction of celestial maps; but for the purpose of representing portions of the earth's surface, the *Globular projection* is frequently had recourse to. This may be considered as a modification of the stereographic, or in a manner intermediate between the stereographic and orthographic. In the orthographic, the proportion of the parts of the projection to the parts on the sphere which they represent, decreases from the centre to the circumference of the projection; in the stereographic the projection increases; and as in the first case the eye is supposed at an infinite distance, and in the second, on the surface of the sphere, there must be some position at a finite distance from the surface, in which if the eye is placed, the proportion between the parts of the surface of the sphere and their representations, will be the same or nearly so, whether those parts be taken at the centre or circumference of the map. It is easy to shew that the height above the sphere at which this takes place is equal to the sine of 45 degrees, and therefore very nearly 71-hundredths of the radius. This projection was first proposed by La Hire, in the *Memoirs* of the Academy of Sciences of Paris for 1701. It is employed in many cases, on account of the small change of configuration; but by the removal of the eye from the surface the characteristic advantages of the stereographic projection are lost.

Projections of the circles of the sphere on a plane, are easily found by the methods of the descriptive Geometry, by spherical Trigonometry, or common Algebra. Whatever be the situation of the eye, every circle on the sphere, unless its plane pass through the eye, forms the base of a cone, of which the eye is the apex; and the intersection of this cone with the plane of projection, gives the curve into which the circle is projected. Hence the curve is necessarily a conic section and its equation cannot exceed the second degree. On forming the general equation of the curve, and assigning a determinate position to the eye and the plane of projection, all the properties of the different kinds of projection, which are merely particular cases of the same general problem, are readily deduced.

Although it is convenient to employ the principles of perspective in representing the lines and circles of the sphere on a plane surface, there is nothing in the nature of the thing itself, (unless the map is to be regarded as a picture) which renders such a mode of proceeding necessary. The meridians and parallels may be represented on the map by any lines whatever, and the map will still be accurate, if the different points are laid down so as to have respectively the same relative positions with respect to those lines as the points represented have to the corresponding circles of latitude and longitude; for in this case, any point on the map can be referred to its proper place on the sphere, which is the essential condition of a correct map. In order, however, to render the problem determinate, the lines chosen to represent the meridians and parallels of the sphere must be such as satisfy certain conditions capable of being expressed by an algebraic equation. But these conditions may have no reference to perspective. Mercator's Chart is an example. In this chart the condition which determines the relative situations of the meridians and parallels is, that the rhumbs shall be straight lines, and make with each other the same angles as on the sphere. This condition determines the well known property of the chart, namely, that the degrees of longitude are all equal, while the degrees of latitude vary in the inverse ratio of the sines of their polar distances.

The theory of the construction of maps on this general principle, was first considered by Lambert, who, in the third volume of his *Beiträge zum Gebrauche der Mathematik*, &c., published at Berlin in 1772, undertook the solution of the problem to determine the nature and situation of the lines on the map representing the meridians and parallels, where the condition to be fulfilled is, that the angles formed by lines on the map shall be equal to the corresponding angles on the sphere. This condition is important; for it follows from the equality of the angles that any indefinitely small portion of the surface of the sphere, and its projection on the map, are similar figures; and consequently that the representations of such parts differ from the original only in respect of magnitude. The same problem was considered by Euler in the *Petersburg Commentaries* for 1777, but neither of these illustrious geometers prosecuted the subject farther than to shew that the known properties of the stereographic projection, and Mercator's Chart, are comprehended in their general solution.

In the volume of the *Berlin Memoirs* for 1779, there are two memoirs by Lagrange on the same subject. In the first he gave a solution of the problem of Lambert, of which he shewed the stereographic projection to be only a particular case; and in the second, he undertook the more difficult task of determining the form which the arbitrary functions that enter into the general solution must have in order that the lines representing the meridians and parallels may be of a given nature.

The general problem of projection has been more recently considered by the celebrated Professor Gauss of Göttingen, in a memoir written in answer to a prize question proposed by the Academy of Sciences of Copenhagen. In this memoir the author, instead of confining himself to the particular case of the representation of a spherical surface on a plane, undertook the solution of the general problem; namely, to represent the parts of any given surface on any other given surface, subject to the condition that the differential elements of the first surface shall be similar to their representations on the second. Having determined the differential expressions of the co-ordinates of any point on the map, in terms of the co-ordinates of the corresponding point of the primitive surface, he applies the general solution to the particular cases of a plane surface projected on another plane, the surface of a cone on a plane, of a sphere and spheroid on a plane, and lastly, of an ellipsoid of revolution on the surface of a sphere. Gauss's memoir is published in No. 3 of Schumacher's *Abhandlungen*, and a translation of it in the *Philosophical Magazine* for August and September 1828. Considered in this general view, the theory of projection becomes an interesting and very difficult mathematical speculation; but it is one of which, it must be confessed, the results are of no great practical use.

PROJECTION, in *Perspective*, denotes the appearance or representation of an object on the perspective plane. The projection of a point is a point through which an optic ray passes from the objective point through the plane to the eye; or it is the point in which the plane cuts the optic ray; and hence may be easily conceived what is meant by the projection of a line, a plane, or a solid.

PROJECTION, in *Alchemy*, the casting of a certain imaginary powder, called *powder of projection*, into a crucible or other vessel full of some prepared metal or other matter, which is to be hereby presently transmuted into gold.

Powder of PROJECTION, or of the philosopher's stone, is a powder supposed to have the virtue of changing any quantity of an imperfect metal, as copper or lead, into a more perfect one, as silver or gold, by the admixture of a little quantity of the powder. The mark to which alchemists directed all their endeavours, was to discover this powder of projection.

PROJECTURE, in *Architecture*, the outjetting and prominence, or embossing, which the mouldings and other members have beyond the naked wall, column, or other part of the building.

PROLAPSUS, in *Surgery*, a prolapsion or falling out of any part of the body from its natural situation. Thus we say, *prolapsus intestini*, a prolapsion of the intestine, &c.

PROLATE, in *Geometry*, an epithet applied to a spheroid produced by the revolution of a semi-ellipsis about its larger diameter.

PROLATION, a musical term signifying a series of notes, ascending or descending, which are to be sung to one syllable. Anciently the word had a different musical meaning. Thus Morley, in his Introduction, page 14, tells us that prolation is the measuring of semibreves by minims, and is either greater or less. The greater prolation is when the semibreve contains three minims. The sign of this is ⊙ or 𝇉. The less prolation is when the semibreve contains only two minims. The sign of this is ○ or C. The old musicians called the ternary measure *perfect*, and the binary measure *imperfect*.

PROLEGOMENA, in *Philology*, certain preparatory observations prefixed to a book or treatise, and containing something necessary for the reader to be apprised of, to enable him the better to understand the book, or to enter deeper into the science.

PROLEPSIS, a figure in *Rhetoric*, by which we anticipate or prevent what might be objected by the adversary.

PROLEPTIC, an epithet applied to a periodical disease which anticipates, or whose paroxysm returns sooner and sooner every time; as is frequently the case in agues.

PROLOGUE, in dramatic poetry, a discourse addressed to the audience before the drama or play begins. The original intention was to advertise the audience of the subject of the piece, and to prepare them to enter more easily into the action, and sometimes also to make an apology for the poet.

PROME, a city of the Birman empire, in the province of Ava, situated on the eastern bank of the Irrawaddy River, in a fertile plain between the hills and the river. It was the original and natural boundary of the Birman empire to the south, before conquest had extended its dominion beyond it. It was formerly surrounded by two walls, constructed partly of brick and partly of timber. It is composed of the *myo* or fort, being a common square stockade, resembling that of Rangoon, but much larger; and of two suburbs, the one lying to the east and the other to the west of it, along the banks of the river. The first contains two streets running parallel to each other and to the river. The houses are few and scattered; and the principal space is occupied by gardens, or rather by patches of ground planted with fruit or ornamental trees, or coarse esculent vegetables, such as gourds, pumpkins, and cucumbers, the whole overgrown with rank weeds, and without order or neatness. Prome is, according to Mr Crawford, a thriving place; and he estimates its population at 10,000. It carries on a very considerable trade in grain, oil, wax, ivory, iron, lead, flagstones, and timber. The ruins of the former city, which extend far beyond the modern town, contain the remains of a number of temples dedicated to Buddha. Adjacent to the town is a royal menagerie of elephants, consisting of two rows of lofty and well-built stables, in which these animals are lodged during the rains. Long. 95. E. Lat. 18. 50. N.

PROMETHEUS, the son of Japetus and Asia or Clymenë, was the brother of Atlas, Epimetheus, and Menœtius. He was a prince of Meconë (the ancient name of Sicyon in the Peloponnesus), if we may trust the legend told by Hesiod. It is said that the inhabitants were debating with the gods which part of the animal ought to be offered to them in sacrifice, and that Prometheus recommended that the flesh and best parts should be covered with the caul, whilst the bones were enveloped in fat. Jupiter was then requested to make choice of the part he preferred; and, being deceived by the trick of Prometheus, he selected the bones, which were ever afterwards offered upon his altar. Indignant at this proceeding, he deprived men of the use of fire; but Prometheus is said to have again outwitted him, and drawn down fire from heaven, which he presented to man. This is explained by supposing that Prometheus was the first who discovered that fire could be extracted from two pieces of wood rubbed together. By another tradition, we find him making a man of clay, into which he conveys the fire he had stolen from heaven, and for this daring invasion of his privileges, Jupiter orders Vulcan to chain Prometheus on Mount Caucasus, where he was visited daily by an eagle, which fed on his liver. Here he is said to have remained thirty thousand years, until Hercules accidentally visited him whilst in search of the Gardens of the Hesperides. He pointed out the way to him, and from gratitude Hercules slew the eagle and released Prometheus. Another tradition represents him as having been released by Jupiter, in return for warning him against marrying Thetis, as it was fated that her son should be more illustrious than his father. He was the father of Deucalion by Clymenë or Pandora.

Prometheus, in *Ancient Astronomy*, was the name of a constellation of the northern hemisphere, now called *Hercules Eugonasin.*

PROMISE, in ordinary cases, is a declaration of some intention to be put in execution; but in morals it is a solemn asseveration by which one pledges his veracity that he will perform, or cause to be performed, the thing which he undertakes. As such a declaration excites expectations in the minds of those to whom it is made, and to frustrate such expectations might arouse indignation, and be followed by consequences injurious to the person, the character, or the interest of him who made it, it becomes a matter of prudence in the promiser to keep his word. And, farther, since a certain degree of confidence is found necessary to the very existence of civil society, and others may have acted upon the faith of such promise, it is now not a matter of prudence only to keep one's word, but is a duty which every man owes to all who have spent their time, their money, or their labour, in consequence of those expectations which he has warranted them to entertain. It being, then, consonant to sound reason, necessary to the existence of civil society, and in general the interest of both the promiser and promisee, that the words of the promise should be fulfilled, it has become a maxim in morals, that a man is obliged to perform his promise. See Moral Philosophy.

PROMONTORY, in *Geography*, a high point of land or rock projecting into the sea, and the extremity of which is called a *cape* or *headland.* See Geography.

PROMPTER, in the drama, an officer posted behind the scenes, whose business it is to watch attentively the actors speaking on the stage, in order to suggest and put them forward when at a stand, and correct them when at fault in their parts.

PROMULGATED, or Promulged, something published or proclaimed, and generally applied to a law, to denote the publishing or proclaiming it to the people.

PRONAOS, in ancient architecture, a porch to a church, palace, or other spacious building.

PRONOUN, Pronomen, in *Grammar*, a declinable part of speech, which, being put instead of a noun, points out some person or thing.

PRONUNCIATION, in *Grammar*, the manner of articulating or sounding the words of a language.

Pronunciation forms the most difficult part of written grammar, in as much as a book expressing itself to the eyes, in a manner that wholly concerns the ears, seems next akin to that of teaching the blind to distinguish colours. Hence it is that there is no part so defective in grammar as that of pronunciation; for as the writer has frequently no term whereby to give the reader an idea of the sound he would express, so, for want of such a term, he often substitutes a vicious and precarious one. To give a just idea of the pronunciation of a language, it seems necessary to fix, as nearly as possible, all the several sounds employed in the pronunciation of that language. Cicero tells us, that the pronunciation underwent several changes amongst the Romans; and indeed it is more precarious in the living languages, being in these subservient to fashion and usage.

Pronunciation is also used to indicate the fifth and last part of rhetoric, which consists in varying and regulating the voice agreeably to the matter and words, so as most effectually to persuade and touch the hearers.

PROOF, in *Law* and *Logic*, is that degree of evidence which carries conviction to the mind. It differs from demonstration, which is applicable only to those truths of which the contrary is inconceivable. It differs likewise from probability, which produces for the most part nothing more than opinion, whilst proof produces belief.

PROPERTIUS, Sextus Aurelius, a celebrated elegiac poet, who flourished between 31–15 b. c. The exact date of his birth is uncertain; but Mr Clinton brings forward satisfactory reasons for believing that it was about the year 51 b. c., being thus fourteen years younger than Horace, and eight younger than Livy. The place of his birth has also been disputed; but he himself states that he was a native of Umbria, though whether of Merania, Ameria, Hispellum, or Assisium, is uncertain. He studied at Rome with the intention of devoting himself to the bar; but his love of poetry seduced him from the dry study of law, and he entirely withdrew from taking any share in the active business of life. He died at an early age, leaving behind him a collection of elegies divided into four books, of which the last is supposed to have been published by one of his friends after his death. Nobbe, a German critic, who has examined the subject with considerable care, thinks that the first book was published not before 29 b. c., and not after 27 b. c.; the second book not before 24 b. c.; the third not before 21 b. c.; the fourth not before 16 b. c.

Many of his elegies are addressed to his mistress Cynthia, to whom he remains constant, though he suffers much from her cruelty. The language is powerful, and the structure of the verse correct, though not without some peculiarities; as, for example, the close of the pentameter line with a word of several syllables. In comparing the elegies of Propertius with those of Tibullus, we perceive that there is less of tenderness and softness, less of that simplicity for which Tibullus is so eminently distinguished; but, on the other hand, there is more spirit, a greater reach of thought, and more power of expression. He possesses much of the spirit of the lyric poet, and had talents which fitted him for things of greater moment than those upon which he bestowed them. Propertius was a close imitator of the Greek writers; Callimachus and Philetas were the poets whom he more particularly followed, so that he was sometimes called the Roman Callimachus. Like Callimachus, he is fond of displaying his learning, and has frequent allusion to mythological subjects; but this at times is the cause of some obscurity, and detracts from that simplicity which is the soul of true elegaic poetry. The best separate edition is that of Lachmann, with notes, Leipzig, 1816, but they are generally published along with Catullus and Tibullus.

PROPERTY, in a general sense, is a particular virtue or quality which nature has bestowed upon some things exclusive of all others. Thus, colour is a property of light; extension, figure, divisibility, and impenetrability, are properties of body.

Definition.

Property, in *Law*, is described to be the highest right which a person has or can have to any thing.

The original foundation of the right of property.

There is nothing which so generally strikes the imagination and engages the affections of mankind, as the right of property; or that sole and despotic dominion which one man claims and exercises over certain external things of the world, in total exclusion of the right of any other individual in the universe. And yet there are very few that will give themselves the trouble to consider the origin and foundation of this right. Pleased as we are with the possession, we seem afraid to look back to the means by which it was acquired, as if suspicious of some defect in our title; or at best we rest satisfied with the decision of the laws in our favour, without examining the reason or authority upon which those laws have been built. We think it enough that our title is derived from the grant of the former proprietor, by descent from our ancestors, or by the last will and testament of the dying owner, not caring to reflect, that, strictly and accurately speaking, there is no foundation in nature or in natural law why a set of words upon parchment should convey the dominion of land; why the son should have a right to exclude his fellow-creatures from a determinate spot of ground, because his father had done so before him; or why the occupier of a particular field or of a jewel, when lying upon his death-bed, and no longer able to maintain possession, should be entitled to tell the rest of the world which of them should enjoy it after him. These inquiries, it must be owned, would be useless, and even troublesome, in common life. It is well if the mass of mankind obey the laws when made, without scrutinizing too nicely into the reasons of making them. But when law is to be considered not only as a matter of practice, but also as a rational science, it cannot be improper or useless to examine more deeply the rudiments and grounds of these positive constitutions of society.

This right arises from a divine grant.

In the beginning of the world, we are informed by Holy Writ, that the all-bountiful Creator gave to man dominion over all the earth; "over the fish of the sea, and over the fowl of the air, and over every living thing that moveth upon the earth." This is the only true and solid foundation of man's dominion over external things, whatever airy metaphysical notions may have been started by fanciful writers upon this subject. The earth, therefore, and all things therein, are the general property of all mankind, exclusive of other beings, from the immediate gift of the Creator. And, whilst the earth continued thinly inhabited, it is reasonable to suppose that all was in common amongst them, and that every one took from the public stock to his own use such things as his immediate necessities required.

The state of property in the early ages of the world.

These general notions of property were then sufficient to answer all the purposes of human life, and might perhaps still have answered them, had it been possible for mankind to have remained in a state of primeval simplicity; as may be collected from the manners of many American nations, when first discovered by the Europeans, and from the ancient method of living amongst the first Europeans themselves, if we may credit either the memorials of them preserved in the golden age of the poets, or the uniform accounts given by historians of those times wherein *erant omnia communia et indivisa omnibus, veluti unum cunctis patrimonium esset.* Not that this communion of goods seems ever to have been applicable, even in the earliest ages, to aught but the *substance* of the thing; nor could it be extended to the *use* of it. For, by the law of nature and reason, he who first began to use it acquired therein a kind of transient property, that lasted as long as he was using it, and no longer; or, to speak with greater precision, the *right* of possession continued for the same time only that the *act* of possession lasted. Thus the ground was in common, and no part of it was the permanent property of any man in particular; yet whoever was in the occupation of any determinate spot of it, for rest, for shade, or the like, acquired for the time a sort of ownership, from which it would have been unjust, and contrary to the law of nature, to drive him by force; but the instant that he quitted the use or occupation of it, another might seize it without injustice. Thus also a vine or other tree might be said to be in common, as all were equally entitled to its produce; and yet any private individual might gain the sole property of the fruit which he had gathered for his own repast: a doctrine well illustrated by Cicero, who compares the world to a great theatre, which is common to the public, and yet the place which any man has taken is for the time his own.

Rise of permanen property in various things.

But when mankind increased in number, craft, and ambition, it became necessary to entertain conceptions of more permanent dominion, and to appropriate to individuals, not the immediate *use* only, but the very *substance* of the thing to be used; otherwise innumerable tumults must have arisen, and the good order of the world been continually broken and disturbed, whilst a variety of persons were striving who should get the first occupation of the same thing, or disputing which of them had actually gained it. As human life also grew more and more refined, abundance of conveniencies were devised to render it more easy, commodious, and agreeable; such as habitations for shelter and safety, and raiment for warmth and decency. But no man would be at the trouble to provide either, as long as he had only an usufructuary property in them, which was to cease the instant that he quitted possession; if, as soon as he walked out of his tent, or pulled off his garment, the next stranger who came by would have a right to inhabit the one and to wear the other. In the case of habitations in particular, it was natural to observe, that even the brute creation, to whom everything else was in common, maintained a permanent property in their dwellings, especially for the protection of their young; that the birds of the air had nests, and the beasts of the field had caverns, the invasion of which they esteemed a very flagrant injustice, and would sacrifice their lives to preserve them. Hence a property was soon established in every man's house and home-stall; which seem to have been originally mere temporary huts or moveable cabins, suited to the design of Providence for more speedily peopling the earth, and suited to the wandering life of their owners, before any extensive property in the soil or ground was established. And there can be no doubt, but that moveables of every kind became sooner appropriated than the permanent substantial soil; partly because they were more susceptible of a long occupancy, which might be continued for months together without any sensible interruption, and at length by usage ripen into an established right; but principally because few of them could be fit for use, till improved and meliorated by the bodily labour of the occupant, which, bestowed upon any subject that before lay in common to all men, is universally allowed to give the fairest and most reasonable title to an exclusive property therein.

Nature of patriarcha property.

The article of food was a more immediate call, and therefore a more early consideration. Such as were not contented with the spontaneous product of the earth sought for a more solid refreshment in the flesh of beasts, which they obtained by hunting. But the frequent disappointments incident to that method of provision induced them to gather together such animals as were of a more tame and sequacious nature, and to establish a permanent property in their flocks and herds, in order to sustain themselves in a less precarious manner, partly by the milk of their dams, and partly by the flesh of the young. The support of these their cattle made the article of water also a very important point. And therefore the book of Genesis, the most venerable monument of antiquity, considered merely with a view to history, will furnish us with frequent instances of violent contentions concerning wells; the exclusive property of which appears to have been established in the first digger or occupant, even in places where the ground and the herbage remained yet in common. Thus we find Abraham, who was but a sojourner, asserting his right to a well in the country of Abimelech, and even exacting an oath for his security, "because he had digged that well." And Isaac, about ninety years afterwards, reclaimed this his father's property, and, after much contention with the Philistines, was suffered to enjoy it in peace.

All this while the soil and pasture of the earth remained still in common as before, and open to every occupant; except perhaps in the neighbourhood of towns, where the necessity of a sole and exclusive property in lands, for the sake of agriculture, was earlier felt, and therefore more readily complied with. Otherwise, when the multitude of men and cattle had consumed every convenience upon one spot of ground, it was deemed a natural right to seize upon and occupy such other lands as would more easily supply their necessities. This practice is still retained amongst the wild and uncultivated nations that have never been formed into civil states, like the Tartars and others in the East; where the climate itself, and the boundless extent of their territory, conspire to retain them still in the same savage state of vagrant liberty, which was universal in the earliest ages, and which Tacitus informs us continued amongst the Germans till the decline of the Roman empire. We have also a striking example of the same kind in the history of Abraham and his nephew Lot. When their joint substance became so great, that pasture and other conveniencies grew scarce, the natural consequence was, that a strife arose between their servants; so that it was no longer practicable to dwell together. This contention Abraham endeavoured to compose: "Let there be no strife, I pray thee, between thee and me. Is not the whole land before thee? Separate thyself, I pray thee, from me: if thou wilt take the left hand, then I will go to the right; or if thou depart to the right hand, then I will go to the left." This plainly implies an acknowledged right, in either, to occupy whatever ground he pleased, that was not pre-occupied by other tribes. "And Lot lifted up his eyes, and beheld all the plain of Jordan, that it was well watered everywhere, even as the garden of the Lord. Then Lot chose him all the plain of Jordan, and journeyed east; and Abraham dwelt in the land of Canaan."

Upon the same principle was founded the right of migration, or sending colonies to find out new habitations, when the mother-country was overcharged with inhabitants; which was practised as well by the Phœnicians and Greeks, as by the Germans, Scythians, and other northern people. And, as long as it was confined to the stocking and cultivation of desert uninhabited countries, it kept strictly within the limits of the law of nature.

Necessity of property, and of laws respecting it.

But as the world by degrees grew more populous, it daily became more difficult to find out new spots to inhabit, without encroaching upon former occupants; and by constantly occupying the same individual spot, the fruits of the earth were consumed, and its spontaneous produce destroyed, without any provision for a future supply or succession. It therefore became necessary to pursue some regular method of providing a constant subsistence; and this necessity produced, or at least promoted and encouraged, the art of agriculture. And the art of agriculture, by a regular connection and consequence, introduced and established the idea of a more permanent property in the soil than had hitherto been received and adopted. It was evident that the earth would not produce her fruits in sufficient quantities without the assistance of tillage; but who would be at the pains of tilling it, if another might watch an opportunity to seize upon and enjoy the product of his industry, art, and labour? Had not therefore a separate property in lands, as well as moveables, been vested in some individuals, the world must have continued a forest, and men have been mere animals of prey; which, according to some philosophers, is the genuine state of nature. Whereas now, so graciously has Providence interwoven our duty and our happiness together, the result of this very necessity has been the ennobling of the human species, by giving it opportunities of improving its rational faculties, as well as of exerting its natural. Necessity begat property; and in order to insure that property, recourse was had to civil society, which brought along with it a long train of inseparable concomitants; states, governments, laws, punishments, and the public exercise of religious duties. Thus connected together, it was found that a part only of society was sufficient to provide, by their manual labour, for the necessary subsistence of all; and leisure was given to others to cultivate the human mind, to invent useful arts, and to lay the foundation of science.

Property acquired first by occupancy.

The only question remaining is, How this property became actually vested, or what it is that gave a man an exclusive right to retain in a permanent manner that specific land which before belonged generally to every body, and particularly to nobody? And, as we before observed that *occupancy* gave the right to the temporary *use* of the soil, so it is agreed upon all hands, that occupancy gave also the original right to the permanent property in the *substance* of the earth itself, which excludes every one else but the owner from the use of it. There is indeed some difference amongst the writers on natural law, concerning the reason why occupancy should convey this right, and invest one with this absolute property: Grotius and Puffendorf insisting that this right of occupancy is founded upon a tacit and implied assent of all mankind, that the first occupant should become the owner; and Barbeyrac, Titius, Locke, and others, holding that there is no such implied assent, neither is it necessary that there should be, as the very act of occupancy alone, being a degree of bodily labour, is, from a principle of natural justice, without any consent or compact, sufficient of itself to found a title. The dispute, however, savours too much of nice and scholastic refinement. But both sides agree in this, that occupancy is the thing by which the title was in fact originally acquired; every man seizing to his own continued use such spots of ground as he found most agreeable to his own convenience, provided he found them unoccupied by any one else.

By what means it is preserved or lost.

Property, both in lands and moveables, being thus originally acquired by the first taker, which taking amounts to a declaration that he intends to appropriate the thing to his own use, it remains in him, by the principle of universal law, till such time as he does some other act which shews an intention to abandon it; for then it becomes, naturally speaking, *publici juris* once more, and is liable to be again appropriated by the next occupant. So if one is possessed of a jewel, and casts it into the sea or a public highway, this is such an express dereliction, that a property will be vested in the first fortunate finder who shall seize it to his own use. But if he hides it privately in the earth, or other secret place, and it is discovered, the finder acquires no property therein; for the owner had not by this act declared any intention to abandon it, but rather the contrary; and if he loses or drops it by accident, it cannot be collected from thence that he designed to quit the possession; wherefore in such cases the property still remains in the loser, who may claim it again of the finder. And this, we may remember, is the doctrine of the English law with relation to *treasure-trove*.

But this method of one man's abandoning his property, and another seizing the vacant possession, however well founded in theory, could not long subsist in fact. It was calculated merely for the rudiments of civil society, and necessarily ceased amongst the complicated interests and artificial refinements of polite and established governments. In these it was found, that what became inconvenient or useless to one man, was highly convenient and useful to another, who was ready to give in exchange for it some equivalent that was equally desirable to the former proprietor. This mutual convenience introduced commercial traffic, and the reciprocal transfer of property by sale, grant, or conveyance; which may be considered either as a continuance of the original possession which the first occupant had, or as an abandoning of the thing by the present owner, and an immediate successive occupancy of the same by the new proprietor. The voluntary dereliction of the owner, and delivering the possession to another individual, amount to a transfer of the property; the proprietor declaring his intention no longer to occupy the thing himself, but that his own right of occupancy shall be vested in the new acquirer. Or, taken in the other light, if I agree to part with an acre of my land to Titius, the deed of conveyance is an evidence of my intending to abandon the property; and Titius, being the only or first man acquainted with such my intention, immediately steps in and seizes the vacant possession. Thus the consent expressed by the conveyance gives Titius a good right against me, and possession or occupancy confirms that right against all the world besides.

How it goes on the death of the occupant.

The most universal and effectual way of abandoning property is by the death of the occupant, when, both the actual possession and intention of keeping possession ceasing, the property, which is founded upon such possession and intention, ought also to cease of course. For, naturally speaking, the instant a man ceases to be, he ceases to have any dominion; otherwise, if he had a right to dispose of his acquisitions one moment beyond his life, he would also have a right to direct their disposal for a million of ages after him, which would be highly absurd and inconvenient. All property must therefore cease upon death, considering men as absolute individuals, and unconnected with civil society; for then, by the principles before established, the next immediate occupant would acquire a right in all that the deceased possessed. But as, under civilized governments, which are calculated for the peace of mankind, such a constitution would be productive of endless disturbances, the universal law of almost every nation, which is a kind of secondary law of nature, has either given the dying person a power of continuing his property, by disposing of his possessions by will; or, in case he neglects to dispose of it, or is not permitted to make any disposition at all, the municipal law of the country then steps in, and declares who shall be the successor, representative, or heir of the deceased; that is, who alone shall have a right to enter upon this vacant possession, in order to avoid that confusion which its becoming common again would occasion. And farther, in case no testament be permitted by the law, or none be made, and no heir can be found so qualified as the law requires, still, to prevent the robust title of *occupancy* from again taking place, the doctrine of escheats is adopted in almost every country, whereby the sovereign of the state, and those who claim under his authority, are the ultimate heirs, and succeed to those inheritances to which no other title can be formed.

Of the right of inheritance.

The right of inheritance, or descent to the children and relations of the deceased, seems to have been allowed much earlier than the right of devising by testament. We are apt to conceive at the first view that it has nature on its side; yet we often mistake for nature what we find established by long and inveterate custom. It is certainly a wise and effectual, but clearly a political, establishment; since the permanent right of property, vested in the ancestor himself, was not a natural, but merely a civil, right. It is true, that the transmission of one's possessions to posterity has an evident tendency to make a man a good citizen and a useful member of society: it sets the passions on the side of duty, and prompts a man to deserve well of the public, when he is sure that the reward of his services will not die with himself, but be transmitted to those with whom he is connected by the dearest and most tender affections. Yet, reasonable as this foundation of the right of inheritance may seem, it is probable that its immediate origin arose not from speculations altogether so delicate and refined, but, if not from fortuitous circumstances, at least from a plainer and more simple principle. A man's children or nearest relations are usually about him on his death-bed, and are the earliest witnesses of his decease. They became therefore generally the next immediate occupants, till at length in process of time this frequent usage ripened into general law. And therefore also in the earliest ages, on the failure of children, a man's servants born under his roof were allowed to be his heirs, being immediately on the spot when he died. For we find the patriarch Abraham expressly declaring, that "since God had given him no seed, his steward Eliezer, one born in his house, was his heir."

Last wills or testaments.

Whilst property continued only for life, testaments were useless and unknown; and when it became inheritable, the inheritance was long indefeasible, and the children or heirs at law were incapable of exclusion by will; until at length it was found, that so strict a rule of inheritance made heirs disobedient and headstrong, defrauded creditors of their just debts, and prevented many provident fathers from dividing or charging their estates as the exigencies of their families required. This introduced pretty generally the right of disposing of one's property, or a part of it, by *testament;* that is, by written or oral instructions properly witnessed and authenticated, according to the pleasure of the deceased, which we therefore emphatically style his *will.* This was established in some countries much later than in others. In England, till modern times, a man could only dispose of one third of his moveables from his wife and children; and in general, no will was permitted of lands till the reign of Henry VIII. and then only of a certain portion; for it was not till after the Restoration that the power of devising real property became so universal as at present.

These are creatures of the civil laws.

Wills, therefore, and testaments, rights of inheritance, and successions, are all of them creatures of the civil or municipal laws, and accordingly are in all respects regulated by them; every distinct country having different ceremonies and requisites to make a testament completely valid. Neither does any thing vary more than the right of inheritance under different national establishments. In England particularly, this diversity is carried to such a length, as if it had been meant to point out the power of the laws in regulating the succession to property, and how futile every claim must be that has not its foundation in the positive rules of the state. In personal estates, the father may succeed to his children; in landed property, he never can be their immediate heir by any the remotest possibility. In general, only the eldest son, in some places only the youngest, in others all the sons together, have a right to succeed to the inheritance. In real estates, males are preferred to females, and the eldest male will usually exclude the rest; in the division of personal estates, the females of equal degree are admitted together with the males, and no right of primogeniture is allowed.

Scruples respecting heritable property removed.

This one consideration may help to remove the scruples of many well-meaning persons, who set up a mistaken conscience in opposition to the rules of law. If a man disinherits his son, by a will duly executed, and leaves his estate to a stranger, there are many who consider this proceeding as contrary to natural justice; whilst others so scrupulously adhere to the supposed intention of the deed, that if a will of lands be attested by only two witnesses instead of three, which the law requires, they are apt to imagine that the heir is bound in conscience to relinquish his title to the devisee. But both of them certainly proceed upon very erroneous principles: as if, on the one hand, this son had by nature a right to succeed to his father's lands; or as if, on the other, the owner was by nature entitled to direct the succession of his property after his own decease; whereas the law of nature suggests, that on the death of the possessor, the estate should again become common, and be open to the next occupant, unless otherwise ordered, for the sake of civil peace, by the positive law of society. The positive law of society, which is with us the municipal laws of England and Scotland, directs it to vest in such person as the last proprietor shall by will, attended with certain requisites, appoint; and, in defect of such appointment, to go to some particular person, who, from the result of certain local constitutions, appears to be the heir at law. Hence it follows that, where the appointment is regularly made, there cannot be a shadow of right in any one but the person appointed; and, where the necessary requisites are omitted, the right of the heir is equally strong, and built upon as solid a foundation as the right of the devisee would have been supposing such requisites were observed.

Of things hat are still in ommon.

But, after all, there are some few things which, notwithstanding the general introduction and continuance of property, must still unavoidably remain in common, being those in which nothing but an usufructuary property is capable of being had; and therefore they still belong to the first occupant, during the time he holds possession of them, and no longer. Such, amongst others, are the elements of light, air, and water, which a man may occupy by means of his windows, his gardens, his mills, and other conveniencies; such also are the generality of those animals which are said to be *feræ naturæ*, or of a wild and untameable disposition, and which any man may seize upon and keep for his own use or pleasure. All these things, as long as they remain in possession, every man has a right to enjoy without disturbance; but if once they escape from his custody, or he voluntarily abandons the use of them, they return to the common stock, and any other man has an equal right to seize and enjoy them afterwards.

Of similar hings which have een ap- ropriated.

Again, there are other things in which a permanent property may subsist, not only as to the temporary use, but also the solid substance; and which yet would frequently be found without a proprietor, had not the wisdom of the law provided a remedy to obviate this inconvenience. Such are forests and other waste grounds, which were omitted to be appropriated in the general distribution of lands: such also are wrecks, estrays, and that species of wild animals which the arbitrary constitutions of positive law have distinguished from the rest by the well-known appellation of *game*. With regard to these and some others, as disturbances and quarrels would frequently arise amongst individuals contending about the acquisition of this species of property by first occupancy, the law has therefore wisely cut up the root of dissension, by vesting the things themselves in the sovereign of the state, or else in his representatives appointed and authorized by him, being usually the lords of manors. And thus our legislature has universally promoted the grand ends of civil society, the peace and security of individuals, by steadily pursuing that wise and orderly maxim, of assigning to everything capable of ownership a legal and determinate owner.

Literary PROPERTY. See COPY-RIGHT.

PROPHECY is a word derived from προφητεια, and in its original import signifies the prediction of future events. As God alone can perceive with certainty the future actions of free agents, and the remote consequences of those laws of nature which he himself established, prophecy, when clearly fulfilled, affords the most convincing evidence of an intimate and supernatural communion between God and the person who uttered the prediction. Hence this, together with the power of working miracles, is indeed the only evidence which can be given of such a communion. See THEOLOGY.

PROPHET, in general, a person who foretells future events; but it is particularly applied to such inspired persons amongst the Jews as were commissioned by God to declare his will and purposes to that people. Amongst the canonical books of the Old Testament we have the writings of sixteen prophets, four of whom are denominated the *greater prophets*, viz. Isaiah, Jeremiah, Ezekiel, and Daniel, being so called from the length and extent of their writings, which exceed those of the others, viz. Hosea, Joel, Amos, Obadiah, Jonah, Micah, Nahum, Habakkuk, Haggai, Zechariah, and Malachi, who are called the *lesser prophets*, from the shortness of their writings. The Jews do not place Daniel amongst the prophets, because, they say, he lived the life of a courtier rather than that of a prophet.

PROPITIATION, in *Theology*, is a sacrifice offered up to God to assuage his wrath and render him propitious. Amongst the Jews there are both ordinary and public sacrifices, as holocausts, and the like, offered by way of thanksgiving; and extraordinary ones, offered by particular persons guilty of any crime, by way of propitiation. The church of Rome believes the mass to be a sacrifice of propitiation for the living and the dead. The reformed churches allow of no propitiation but that one offered up by Jesus Christ on the cross. See THEOLOGY.

PROPONTIS, or SEA OF MARMORA, a part of the Mediterranean, dividing Europe from Asia. It has the Hellespont, or Canal of the Dardanelles, to the south-west, whereby it communicates with the Archipelago, and the ancient Bosphorus of Thrace, or Strait of Constantinople, to the north-east, communicating with the Black or Euxine Sea. It has two castles; that on the Asiatic side is on a cape, where formerly stood a temple of Jupiter. The Castle of Europe is on the opposite cape, and had anciently a temple of Serapis.

PROPORTION, the identity or similitude of two ratios. Hence quantities that have the same ratio between them are said to be proportional. Thus, if A be to B as C to D, or 8 be to 4 as 30 to 15; A, B, C, D, and 8, 4, 30, and 15, are said to be in proportion, or are simply called proportionals. Proportion is frequently confounded with ratio; yet have the two in reality very different ideas, which ought by all means to be distinguished. Ratio is properly the relation or habitude of two things, which determines the quantity of one from the quantity of another, without the intervention of any third. Thus we say the ratio of 5 and 10 is 2, the ratio of 12 and 24 is 2. Proportion is the sameness or likeness of two such relations; thus the relations between 5 and 10 and 12 and 24 being the same, or equal, the four terms are said to be in proportion. Hence ratio exists between two numbers, but proportion requires at least three. Proportion, in fine, is the habitude or relation of two ratios when compared together; as ratio is of two quantities.

PROPORTION, *Harmonical* or *Musical*. This subject, as usually treated, has little or no practical nor even theoretical utility. Enough regarding the ratios of musical sounds and intervals will be found under the articles MUSIC and TEMPERAMENT.

Arithmetical and Geometrical PROPORTION. See PROGRESSION.

Inordinate PROPORTION is where the order of the terms compared is disturbed or irregular. As, for example, in two ranks of numbers, three in each rank, namely,

in one rank..2, 3, 9,
and in the other.....................................8, 24, 36,

which are proportional, the former to the latter, but in a different order, viz.........................2 : 3 : : 24 : 36,
and...3 : 9 : : 8 : 24.
Then, casting out the mean terms in each rank, it is concluded that......................................2 : 9 : : 8 : 36,
that is, the first is to the third in the first rank as the first is to the third in the second rank.

PROPORTIONAL, relating to proportion. Thus we say, proportional compasses, parts, scales, spirals, and the like.

PROPORTIONALS, in *Geometry*, are quantities, either linear or numeral, which bear the same ratio or relation to each other.

PROPOSITION, in *Logic*, part of an argument, in which some quality, either negative or positive, is attributed to a subject.

PROPOSITION, in *Mathematics*, is either some truth advanced and shown to be such by demonstration, or some operation proposed and its solution explained. If the proposition be deduced from several theorctical definitions compared together, it is called a *theorem;* if from a praxis, or series of operations, it is called a *problem.*

PROPREFECT, amongst the Romans, the prefect's lieutenant, or an officer whom the prefect of the prætorium commissioned to do part of his duty in his stead.

PROPRETOR, or Proprætor, a Roman magistrate, who, having discharged the office of prætor at home, was sent into a province to command there with his former prætorial authority. It was also an appellation given to those who, without having been prætors at Rome, were sent extraordinarily into the provinces to administer justice with the authority of prætors.

PRO RATA, in commerce, a term sometimes used by merchants for *in proportion;* as, each person must reap the profit or sustain the loss *pro rata* to his interest, that is, in proportion to his stock.

PROROGATION, the act of prolonging, or adjourning, or putting off to another time. The difference between a prorogation and an adjournment of parliament is, that by prorogation the session is ended, and such bills as passed in either house, or both houses, and had not the royal assent, must at the next assembly begin again.

PROSE, the natural language of mankind, loose and unconfined by poetical measures or restraints; and in this sense it stands opposed to verse. The word *prose* comes from the Latin *prosa,* which some have derived from the Hebrew *poras,* which signifies *expendit;* whilst others deduce it from the Latin *prorsa,* of *prorsus,* going forwards, by way of opposition to *versa,* or turning backwards, as is necessary in writing.

PROSERPINE, in fabulous history, the daughter of Jupiter and Ceres, who was carried off by Pluto as she was gathering flowers with her companions. Ceres, disconsolate for the loss of her daughter, after having long sought her, heard where she was, and entreated Jupiter to permit her to return from hell. This request Jupiter granted, on condition that she had not tasted anything in Pluto's dominions. Ceres therefore went to fetch her; but when her daughter was preparing to return, Ascalaphus gave information that he had seen Prosperine eat some grains of a pomegranate she had gathered in Pluto's garden; on which she was sentenced to continue in Tartarus in quality of Pluto's spouse, and the queen of those gloomy regions: but, to mitigate the grief of Ceres for her disappointment, Jupiter granted that her daughter should only spend six months in hell together with her husband, and the other six on earth with her mother. Some mythologists imagine that the latter part of the fable alludes to the corn, which must remain all the winter hidden in the earth, in order to sprout forth in the spring, and produce the harvest.

PROSEUCHE, in *Antiquity,* properly signifies *prayer;* but it is taken for the places of prayer of the Jews, and was pretty nearly the same as their synagogues. But the synagogues were originally in the cities, and were covered places; whereas, for the most part, the proseuches were out of the cities, and on the banks of rivers, having no covering except perhaps the shade of some trees or covered galleries. The word is Greek, προσευχη, *prayer.*

PROSLAMBANOMENOS (Greek, προσλαμβανομενος, the term προσλαμβανομενη being found as an exception in Bryennius only) signifies a lower string (χορδη) or sound (φϑογγος) added to what was previously the lowest sound of the ancient Greek system of conjunct and disjunct tetrachords. For cxample, to the sounds BCDE, EFG*a,* forming two conjunct tetrachords in the lowest part of the scale, was added A, an octave below the last of the sounds above named. This formed a series of sounds similar to that of our minor scale when its 6th and 7th are made minor; thus, ABCDEFG*a,* ascending diatonically from A in the lowest space of the stave with bass-clef, to A upon the highest line of the stave with same clef. In this place we may mention, that the ancient Perfect System, or Immutable System of the Greeks, as it is described by Greek writers on music, appears to have consisted of fifteen sounds comprehended within two octaves, reckoning from the Proslambanomenos above described, up to a sound two octaves higher. The order of these sounds, and their ancient Greek names and modern literal names, ascending, are as follows: Proslambanomenos A, Hypate-hypaton B, Parypate-hypaton C, Lichanos-hypaton D, Hypate-meson E, Parypate-meson F, Lichanos-meson G, Mese *a,* Paramese *b,* Trite-diezeugmenon *c,* Paranete-diezeugmenon *d,* Nete-diezeugmenon *e,* Trite-hyperbolæon *f,* Paranete-hyperbolæon *g,* Nete-hyperbolæon *ā.* Some of these strings or sounds were called Apycni, Baropycni, Mesopycni, Oxypycni. Some, too, were *fixed,* and others *moveable.* For various observations upon Greek scales, and upon certain oriental scales and ecclesiastical scales, see the article Music, and Appendix to Graham's *Essay on the Theory and Practice of Musical Composition,* 1838.

The texts of the ancient Greek writers upon music are so corrupted, and so obscure in many respects, and contain so little of a really *practical* or useful nature, that we have purposely refrained from inserting in this work many old Greek theoretical terms, of which the exact signification is now lost. Attempts to explain these could end in nothing better than vague and useless conjectures. Those who feel any particular interest in the very obscure subject of ancient Greek music, may consult the Greek writers edited by Meibomius and Wallis, and various other ancient writers who treat of music expressly or incidentally; also Hawkins, Burney, Forkel, and others.

PROSODY, that part of grammar which treats of the quantities and accents of syllables, and the manner of making verses.

PROSOPOPŒIA, a figure in oratory, by which we raise qualities of things inanimate into persons.

PROSTYLE, in *Architecture,* means a range of columns in the front of a temple.

PROSZNITZ, a city of the Austrian province of Moravia, in the circle of Olmutz. It is the capital of the principality of Lichtenstein, being situated on the river Rumza, in a fertile district, and contains 540 houses, with 8500 inhabitants, who are occupied in extensive distilleries, and in making woollen goods of a fine quality, besides some linens.

PROTAGORAS, a celebrated sophist of Abdera, was the son of Artemon or Mæandrios, and flourished 444 B. C. His poverty had compelled him to adopt the humble trade of a wood-carrier, when some circumstance attracted the notice of his countryman Democritus, and he was admitted as one of his pupils. After he had profited sufficiently by the instruction of Democritus, he proceeded to Athens, where he opened a school, which was attended by all the most illustrious men of the age. Amongst others, Pericles is said to have been his pupil. Protagoras is said to have been the first who set a price on his instruction, and by this means he was enabled to amass a large fortune. Plato, who was his avowed opponent, is willing to allow that Protagoras possessed a lively and fertile imagination, a wonderful memory, and great eloquence; but he was vain, impudent, and presumptuous; he spoke of his rivals with contempt, and of himself with a degree of confidence which excited the admiration of the vulgar. In the *Theætetus* of Plato we have a summary of the doctrines of this philosopher. Protagoras having in one of his works declared that he could not argue on the nature of the gods, because he was not certain of their existence, he was accused of impiety, and condemned to suffer death, or, according to others, banishment. On his passage to Sicily he suffered shipwreck, and was drowned. His works were collected by order of the magistrates, and condemned to the flames. See Hardion, *Dissertation sur l'Origine et les Progrès de la Rhétorique*, in the fifteenth volume of the *Mémoires de l'Académie des Inscriptions*, p. 148.

PROTASIS, in the ancient drama, the first part of a comic or tragic piece, in which the several persons are announced, their characters intimated, and the subject of the piece proposed and entered upon.

PROTESTANT, a name first given in Germany to those who adhered to the doctrine of Luther, because, in 1529, they protested against a decree of the Emperor Charles V. and the Diet of Spires, declaring that they appealed to a general council. The same name has now become a common denomination for all those of the reformed churches.

PROTHONOTARY, a term which properly signifies *first notary*, and which was anciently the title of the principal notaries of the emperors of Constantinople.

Prothonotary is with us an officer in the court of king's bench and in that of common pleas, the former of which has one, and the latter three. The prothonotary of the king's bench records all civil actions sued in that court, as the clerk of the crown-office does all criminal causes. The prothonotaries of the common pleas enter and enrol all declarations, pleadings, assizes, judgments, and actions; make out all judicial writs, except writs of *habeas corpus* and *distringas jurator*, enter recognizances acknowledged, and all common recoveries; and make exemplifications of records, &c.

In the court of Rome there is a college of twelve prelates, called *apostolical prothonotaries*, empowered to receive the last wills of cardinals, to direct all informations and proceedings necessary for the canonization of saints, and to attend on the pope whenever he performs any extraordinary ceremony out of Rome.

PROTO, a Greek term, frequently used in composition, and signifying priority.

PROTOGENES, a celebrated painter, was a native of Xanthus, in Caria, and flourished 330 B. C., in the time of Alexander the Great, being the contemporary of Apelles. Protogenes lived principally in Rhodes, where he was held in little honour by his neighbours, until Apelles paid him a visit, and declared that Protogenes was only inferior to himself in one particular, that he bestowed too much pains in finishing his paintings. From that moment the reputation of Protogenes was established. His finest painting was that representing the grandson of Sol, which he took seven years to finish, having put on it four courses of colour, that it might be less liable to be obliterated by age. Having been placed in a temple at Rhodes, when the city was besieged by Demetrius, and the painting in danger of being destroyed, Demetrius is said to have retired rather than it should run any risk. It was afterwards carried to Rome and placed in the Temple of Peace, where it was destroyed by fire. There was a dog in this picture, which the painter wished to represent with foam at its mouth; but, after many vain attempts, he threw his brush in a fury at the spot, and by a strange accident produced the very effect he wanted. He also painted a satyr playing on the shepherd's pipe, which is said to have been very fine; likewise a portrait of Pythias the mother of the philosopher Aristotle, a Pan, and portraits of Alexander. He was the author of two books on painting.

PROTOTYPE is the original or model after which a thing has been formed; but it is chiefly used for the patterns of things to be engraved, cast, or sculptured.

PROTRACTOR, an instrument for laying down and measuring, with accuracy and despatch, angles upon paper, and by which the use of the line of chords is superseded. This instrument is variously formed, and constructed of different materials; and it is necessary in laying down those surveys or other plans where angles are concerned.

PROVEDITOR, an officer in several parts of Italy, particularly at Venice, who has the direction of matters relating to policy.

PROVENCE, a province or government of France, bounded by Dauphiné on the north, by Piedmont on the east, by the Mediterranean on the south, and by the river Rhone, which separates it from Languedoc, on the west. It is about 100 miles in length, and nearly as many in breadth.

PROVENDER originally signified a kind of vessel containing the measure of corn daily given to a horse, or other beast of labour, for his subsistence; but it is now generally used to signify the food for cattle, whatever it may consist of.

PROVERB, according to Camden, is a concise, witty, and wise speech, grounded upon experience, and for the most part containing some useful instruction.

Book of PROVERBS, a canonical book of the Old Testament, containing a part of the proverbs of Solomon the son of David king of Israel. The first twenty-four chapters are acknowledged to be the genuine work of that prince; the next five chapters are a collection of several of his proverbs made by order of King Hezekiah; and the two last seem to have been added by different but unknown authors.

PROVIDENCE, the superintendent care which God exercises over creation, material and spiritual.

Belief of a providence universal.

That there exists a divine providence which attends to the affairs of this world, and directs their course, has been a received opinion amongst the human race in every country and in every period of history. Every altar that is erected, every prayer and every sacrifice that is offered up, affords a proof of this belief. So fully have men been convinced of the sincerity of each other's faith upon this subject, that in one form, that of an appeal to the Divine Ruler of the world, by the solemnity of an oath, they have introduced it into the most ordinary as well as the most important business of life.

But this doctrine has been disputed.

But notwithstanding this universal reception, in some form or other, of the doctrine of a divine providence, it has in every age met with some opponents. The most ancient of these were Democritus and Leucippus. They denied the existence of a Deity, asserted that all things were mechanically necessary, and maintained that thought and sense were only modifications of matter. This is atheism in the strictest sense, and the only form of it that has ever been consistently supported. Epicurus followed upon the same principles; but he rendered the system altogether absurd, by confessing the freedom of the human will. To avoid the imputation of atheism, he asserted the existence of God; but declared that the Deity resided above the heavens, and interfered not in human affairs. One of his maxims was, that "the blessed and immortal Being neither has any employment himself, nor troubles himself with others." Maximus Tyrius justly observes, that this is rather a description of Sardanapalus than of a Deity, whose very existence implies his government. And some of the moralists of antiquity remarked, that they knew many men amongst themselves, possessed of active and generous minds, whose characters they valued more highly than that of Epicurus's god. Some of the ancients also appear to have entertained a strange notion. They acknowledged the existence of a Supreme and of many inferior deities; but they at the same time supposed that there is a certain fate which rules over all, and is superior to the gods themselves.

The providence exerted by the Author of nature over his works is usually divided into two branches; a *general*, referring to the management of the universe at large; and a *particular* providence, chiefly regarding particular men.

General providence.

Upon the first of these, in Wollaston's *Religion of Nature delineated*, the question is stated somewhat in the following manner. The world may be said to be governed, or at least cannot be said to fluctuate fortuitously, if there be laws or rules by which natural causes act; if the several phenomena in it succeed regularly, and in general the constitution of things is preserved; if there are rules observed in the production of herbs, trees, and the like; if the several kinds of animals are furnished with faculties proper to determine their actions in the different stations which they hold in the general economy of the world; and, lastly, if rational beings are taken care of in such a manner as will at last agree best with reason. By the providence of God we ought to understand his governing the world by such laws as these now mentioned; so that if there are such, there must be a divine providence.

Inanimate objects.

With regard to *inanimate objects*, the case agrees precisely with the above supposition. The whole of that universe which we see around us is one magnificent and well-regulated machine. The world that we inhabit is a large globe, which, conducted by an invisible power, flies, with a rapidity of which we have no conception, through an extent of space which sets at defiance every power of fancy to embody it into any distinct image. A large flaming orb stands immoveable in the heavens, around which this, and other worlds of different magnitudes, perform their perpetual revolutions. Hence arise the expected returns of day and night, and the regular diversity of seasons. Upon these great operations a thousand other circumstances depend. Hence, for example, the vapours ascend from the ocean, meet above in clouds, and, after being condensed, descend in showers to cover the earth with fertility and beauty. These appearances are regular and permanent. During every age since men have been placed upon the earth, this astonishing machine has continued steadily to perform its complicated operations. Nothing is left to chance. The smallest bodies are not less regular than the largest, and observe continually the same laws of attraction, repulsion, &c. The apparent variations of nature proceed only from different circumstances and combinations of things, acting all the while under their established laws. We ourselves can calculate the effects of the laws of gravitation and of motion. We can render them subservient to our own purposes, with entire certainty of success, if we only adhere to the rules established by nature, that is to say, by providence.

Vegetables.

Vegetables also live and flourish according to prescribed methods. Each sort is produced from its proper seed, has the same texture of fibres, is at all times nourished by the same kind of juices, digested and prepared by the same vessels. Trees and shrubs receive annually their peculiar liveries, and bear their proper fruits. So regular are they in this last respect, that every species may be said to have its profession or trade appointed to it, by which it furnishes a certain portion of manufacture, or of food, to supply the wants of animals. Being created for the purpose of consumption, all vegetables produce great quantities of seed to supply the necessary waste. Here, then, there is evidently a *regulation* by which the several orders are preserved, and the ends of them answered according to their first establishment.

Animals.

With regard to *animals*, they too, in structure of their form, are subject to laws similar to those which govern the vegetable world. In the sentient part of their constitution they are no less subject to rule. The lion is always fierce, the fox crafty, and the hare timid. Every species retains from age to age its appointed place and character in the great family of nature. The various tribes are created and placed in such a manner as to find proper means of support and defence. Beasts, birds, fishes, and insects, are all possessed of organs and faculties adapted to their respective circumstances and opportunities of finding their proper food and prey.

Man.

Man is subject to the ordinary laws which other material and animal substances obey; but he is left more at large in the determination of his actions. Yet even here things do not fluctuate at random. Individuals do indeed rise and perish according to fixed rules; and nations themselves have only a temporary endurance. But the species advances with a steady progress to intellectual improvement. This progress is often interrupted; but it appears to be not less sure at the long-run than even the mechanical laws which govern the material part of our constitution. Amidst the convulsion of states and the ruin of empires, the useful arts, when once invented, are never lost. These, in better times, render subsistence easy, and give leisure for reflection and study to a greater number of individuals. Tyre and Sidon have passed away, Athens itself has become the prey of barbarians, and the prosperity of ancient Egypt is departed perhaps for ever; but the ship, and the plough, and the loom, remain, and have been perpetually improving. Thus every new convulsion of society does less mischief than the last; and it is hoped that, by the assistance of printing, the most polished arts and the most refined speculations have at length become immortal. The world is not then left in a state of confusion; it is reduced into order, and methodized for ages to come, the several species of beings having their offices and provinces assigned them. Plants, animals, men, and nations, are in a state of continual change; but successors are appointed to relieve them, and to carry on the *scheme of providence.*

Particula providenc

But the great difficulty is how to account for that providence which is called *particular;* for rational beings and free agents are capable of doing and deserving well or ill; and the safety or danger, the happiness or unhappiness of a man here, must depend upon many things which seem scarcely capable of being determined by providence. Besides himself and his own conduct, he depends upon the conduct of other men, whose actions, as we naturally suppose, cannot, consistently with their free will, be controlled for the advantage of another individual. The actions of numbers of men, proceeding upon their private freedom, with different degrees of ability, as they cross and impede, or directly oppose each other, must produce very different effects upon men of different characters, and thus in a strange manner embarrass and entangle the general plan. And as to the course of nature, it may justly be asked, is the force of gravitation to be suspended till a good man pass by an infirm building? Add to this, that some circumstances appear absolutely irreconcileable. The wind which carries one into port drives another back to sea; and the rains which are just sufficient upon the hills may drown the inhabitants of the valleys. In short, may we expect miracles? or can there be a particular providence that foresees and prepares for the several cases of individuals, without force frequently committed upon the laws of nature and the freedom of intelligent agents?

No good argumen against i existence

But in whatever way it is brought about, there is little doubt that something of this kind must take place. For as the Deity does direct, as already mentioned, the great and general progress of things in this world, he must also manage those of less importance. Nations are composed of individuals. The progress of individuals is the progress of the nation, and the greatest events usually depend upon the history and the most trifling actions of private persons. The difficulty is to conceive how the superintendence and management of all this can be brought about. But as the ways and the thoughts of the Omnipotent Spirit, whose influence pervades, and rules, and animates nature, resemble not the limited operations of men, we can only form conjectures concerning the means by which his government is conducted.

Objectio Imperfe tions of ture.

We shall next proceed to state some of the chief objections which, in ancient or modern times, have been brought against the opinion that the world is governed by a divine providence. And the first of these is, that the system of nature contains many imperfections which it ought not to do if it be the work of a perfectly wise and good Being. To avoid the force of this objection, some modern writers have deserted the ground of supreme and absolute goodness, which the ancient theists always occupied, and have asserted that the divine perfection consists in unlimited power and uncontrolled supremacy of will; that, consequently, the Deity does not always that which is best, but merely what he himself pleases; and that for no other reason but because he wills so to do. But this is no better than atheism itself. For it is of no importance to us whether the universe is governed by blind fate or chance, that is to say, by nothing at all; or whether it is governed by an arbitrary sovereign will that is directed by chance, or at least by no principle of beneficence.

nswer.

The true answer to this objection is, that no created system can have every perfection, because it must necessarily be destitute of self-existence and independence; and therefore, if being destitute of some perfections be better than nothing, it was worthy of infinite power and perfect goodness to create such beings. In our present state, we mortals stand upon too low ground to take a commanding view of the whole frame of things. We can only reason concerning what is unknown from the little that is within our reach. But in this little we can see that wisdom and goodness reign, that nature always aims to produce perfection, that many salutary effects result even from the thunder and the storm; and we doubt not that a view of the whole structure of the universe would afford an additional triumph to the goodness and skill of its great Architect.

We see a regular ascent in the scale of beings from mere lifeless matter up to man; and the probability is, that the scale continues to ascend as far above man in perfection as created beings can possibly be raised. The sole purpose of God in creating the world must have been to produce happiness. But this would be most effectually done by creating, in the first place, as many of the most perfect class of beings as the system could contain; and afterwards other classes less and less perfect, till the whole universe should be completely full. We do not positively assert that such a scheme of creation was actually in the divine Architect's intention; but that it is possible, is sufficiently obvious. No man will pretend to say, that this earth could afford a comfortable subsistence to a greater number of the human race, were all the inferior animals annihilated, than it could at present, swarming as every element is with life. Suppose, then, that as many men had been placed at first upon the earth as it could possibly support, and that matters had been so constituted that the number should never have been either increased or diminished; we beg leave to ask, whether, since there would have been evidently room for inferior animals, it would have been most worthy of infinite goodness to leave the whole globe to men, or to introduce into it different orders of less perfect beings, which, whilst they could not incommode the principal inhabitant, would each find pleasure in its own existence? To this question different answers cannot surely be given. Let the reader then extend his view, and consider the universe, which, however vast, cannot be positively infinite, as one system so much united as the several parts of this globe are; let him suppose that there were at first created as many of the highest order of beings as it could have contained had creation stopt there; let him also remember that happiness in many different degrees is valuable; and he will not surely think it any imputation on the goodness of God that there are in the universe many beings far from perfection. The most imperfect of these are by themselves better than nothing; and they all contribute to make up a system which, considered as a whole, we have every reason to believe to be as perfect as anything not self-existent can possibly be.

Objection from the introduction of evil.

If the world be conducted by a benevolent providence, how came evil to be introduced into it? This question has perplexed mankind in all ages. The ancient Persians resolved it by asserting the existence of two gods, Oromasdes the author of good, and Arimanius the author of evil. From them the Christian heretics called Manicheans borrowed their doctrine of two opposite co-eternal principles. Both the Platonists and Stoics ascribed the origin of evil to the perverseness or imperfection of matter, which they thought the Deity could not alter; and Pythagoras imagined a state of pre-existence, in which the souls of men had committed offences, for which they are here suffering the punishment. But these hypotheses are, some of them impious, and all unsatisfactory.

Answer.

Taking the expression in its most extensive sense, the evils to which the human race are exposed may be reduced to pain, uneasiness, disappointment of appetites, and death; of which not one could have been wholly prevented without occasioning greater evils, inconsistent with the perfect goodness of the Creator. As long as we have solid bodies capable of motion, supported by food, subject to the influence of the atmosphere, and divisible, they must necessarily be liable to dissolution or death. But if a man could suffer death, or have his limbs broken, without feeling pain, the human race would have been long ago extinct. A fever is a state of the body in which the fluids are in great disorder. If we felt no uneasiness from that disorder, we should have no inducement to pay the proper attention to our state, and should certainly die unawares, without suspecting ourselves to be in danger; whereas, under the present administration of divine providence, the pain and sickness of the disease compel us to have recourse to the remedies proper for restoring us to soundness and health. Of the uneasinesses to which we are liable, and which are not the effect of immediate pain, the greatest has been sometimes said to arise from the apprehension of death, which constantly stares us in the face, and frequently embitters all our pleasures even in the hour of perfect health. But this dread of death is implanted in our breasts for the very best of purposes. Had we no horror at the apprehension of death, we should be apt, whenever any misfortune befell us, to quit this world rashly, and rush unprepared into the presence of our Judge; but the horror which attends our reflections upon our own dissolution, arising not from any apprehensions of the pain of dying, but from our anxiety concerning our future state of existence, tends strongly to make us act, whilst we are still here, in such a manner as to insure our happiness hereafter. Add to this, that the fear of death is the greatest support of human laws. We every day see persons breaking through all the regulations of society and good life, notwithstanding they know death to be the certain consequence, and feel all the horrors of it which are natural to man. Were death therefore divested of these horrors, how insignificant would capital punishments be as guardians of the law, and how insecure would individuals be in civil society?

With regard to the unavoidable misfortunes and anxieties of our present state, these, so far from being truly hurtful in themselves, are proofs of divine beneficence. When we see men displeased with their situation, when we hear them complain of the difficulties, the miseries, and the cares of life, of the hardships which they have undergone, and the labours which still lie before them, instead of accounting them unfortunate, we ought to regard them as active beings, placed in the only situation which is fit for the improvement of their nature. That discontent, and these restless wishes to improve their condition, are so many sure indications that their faculties will not languish. They who are in the least degree accustomed to observe the human character, know well the influence which pleasure and repose have in enfeebling every manly principle, and how capable they are of attaching us even to a sordid and dishonourable existence.

Providence.

Happy indeed it is for the human race, that the number of those men is small whom providence has placed in situations in which personal activity is unnecessary. By far the greater number are compelled to exert themselves, and to mix and to contend with their equals, in the race of fortune and of honour. It is thus that our powers are called forth, and that our nature reaches its highest perfection. It is even perhaps a general truth, that they who have struggled with the greatest variety of hardships, as they always acquire the highest energy of character, so, if they have retained their integrity, and have not sunk entirely in the contest, seldom fail to spend their remaining days respectable and happy, superior to passion, and secured from folly by the possession of a wisdom dearly earned.

Objection from the permission of moral guilt.

The most serious difficulty lies in accounting for the permission of moral evil or guilt, in a system governed by infinite benevolence and wisdom. Those who in a consistent manner hold the doctrine of the absolute necessity of human actions in its full extent, and acknowledge all its consequences, find it easy to elude this difficulty. They very fairly deny the existence of any such thing as moral evil in the abstract; and assert, that what we call a *crime*, is nothing more than an action which we always regard with a painful sensation; that these apparent evils endure only for a time; and that all will at last terminate in the perfection and happiness of every intelligent being.

Answer.

Upon the system of liberty, the shortest answer seems to be this: That some things are absolutely impossible, not from any weakness in the Deity, but because they infer absurdity or contradiction. Thus it is impossible for twice two to be any thing else than four; and thus it is impossible for Omnipotence itself to confer self-approbation upon an intelligent being who has never deserved it; that is to say, it is impossible for a man of sense to be pleased with himself for having done a certain action, whilst he himself is conscious that he never did that action. But self-approbation constitutes the highest, the most unmingled, and the only permanent felicity, of which our nature is capable. It is not in the power of Omnipotence itself, then, to bestow the highest and most permanent felicity of our nature; it must be earned and deserved before it can be obtained. In the same manner good desert, virtue, or merit, cannot be conferred; they must be acquired. To enable us to acquire these, we must be exposed to difficulties, and must suffer in a certain degree. If these difficulties had no influence upon our conduct and feelings, if they exposed us to no real danger, no fabric of merit and of self-approbation could be reared upon them. All that the Supreme Being could do for us would have been to confer such an original constitution and character as should enable us to do well if we were to exert our utmost powers. The universe is not ruled by favour, but by justice. Complete felicity must be purchased. Guilt is an abuse of our freedom, a doing ill where we could have done well, and is entirely the work of man. Heaven could not avoid permitting its existence, and exposing us to danger; for temptation is necessary to virtue, and virtue is the perfection of our nature, our glory, and our happiness.

Objection from the apparent confusion of human affairs.

The last objection to the belief of a divine providence arises from the apparent confusion of human affairs, that all things happen alike to all, that bad men are prosperous, and that a total want of justice appears to attend the divine administrations. Even the best men have at times been shaken by this consideration. But there are many reasons for rendering this world a mixed scene; it would become unfit for a state of trial and of education to virtue if it were otherwise.

Answer.

It has been already shown, that physical evil is the parent of moral good; and therefore it would be absurd to expect that the virtuous should be entirely exempted from that evil. For the occasional prosperity of the wicked many reasons have been assigned, even by those who, in their disquisitions, were not guided by that revelation which has brought to light life and immortality. "God," says Plutarch, "spares the wicked, that he may set to mankind an example of forbearance, and teach them not to revenge their injuries too hastily on each other. He spares some wicked men from early punishment, in order to make them instruments of his justice in punishing others. And he spares all for a time, that they may have leisure for repentance; for men look at nothing further, in the punishments which they inflict, than to satisfy their revenge and malice, and therefore they pursue those who have offended them with the utmost rage and eagerness; whereas God, aiming at the cure of those who are not utterly incurable, gives them *time to be converted*."

Providence, the capital of Rhode Island, one of the United States of North America. It is situated at the head of the tide-waters of Naraganset Bay, immediately above the mouth of the Seekhouk, about thirty miles from the Atlantic Ocean. The town is built on both sides of an arm of the bay, which is usually called Providence River; and its position is pleasant, although on the sharp acclivities of hills. The two sections of Providence are connected by two bridges, one of which is ninety feet in length. This is a wealthy and flourishing town, and of late years has rapidly increased in importance. The buildings are chiefly of wood, uniformly painted white; but a number of them are composed of more substantial materials, as granite and brick. Those of a public nature are the State-house, the Arcade, the halls of Brown University, the Dexter Asylum, nearly twenty places of public worship, a number of public schools, and several large manufacturing establishments. The Arcade is the most splendid building of the kind in the Union. It presents two fronts of hammered granite, each seventy-two feet in width, and forming a colonnade of six columns of pure Grecian Doric. The body of the building is two hundred and twenty-two feet in length. Several of the churches are handsome structures. Brown University has two halls, both built of brick, and each containing about fifty rooms for students and the necessary business of the establishment. It was founded in the year 1764, and in 1838 contained ten instructors, 1253 alumni, 450 ministers, 187 students, 6000 volumes in the college library, and 5600 volumes in the students' libraries. There are also a number of public schools, a mechanics' and a manufacturers' association, an athenæum, a large asylum for the poor, a Friends' boarding school, which is a large and excellent establishment, and libraries attached to all or most of these, besides the Providence Library. About twelve newspapers are published in this city.

Providence was early a place of much commercial enterprise; but it is now most distinguished for its manufactures. There are four or five cotton factories; several extensive bleacheries, in which large quantities of cotton cloth from many of the factories in Rhode Island and other states are bleached and otherwise prepared; a number of dye-houses, founderies, and machine-shops, the two latter being employed principally in building cotton machinery. There are, besides, establishments for the manufacture of steam-engines, files, leather, shoes, soap, combs, hats, jewellery, and for working in tin and other metals; and there is also a large glass-house for the manufacture and cutting of flint-glass. In the year 1831, there were imported 55,707 bales of cotton, 71,369 barrels of flour, 216,662 bushels of corn, and 7772 bushels of rye. The imports in 1831 amounted to 457,717 dollars; and the exports, domestic and foreign, to 329,634 dollars. The amount of shipping registered for the same year was 12,362 tons; that enrolled, 4788 tons. It possesses a fine harbour, there being water for vessels of nine hundred tons burden close to the wharfs. Business is greatly promoted by a number of banks, which possess an aggregate capital of about five millions of dollars. This town was founded in the year 1636 by one Williams, who was banished from Massachusetts on account of his religious tenets. It has repeatedly been nearly destroyed by fire and storm. In 1831 Providence was incorporated as a city, and divided into six wards, the municipal government being vested in a mayor, a board of aldermen, and a common council. The population, which in 1832 was about 20,000, cannot in 1839 be estimated under 30,000. Providence is situated forty miles south-south-west of Boston, thirty north of Newport, and one hundred and ninety north-east of New York, in lat. 41. 51. north, and long. 71. 26. west from Greenwich.

Providence, a small island in the Pacific Ocean, seen by the Felice in the year 1783, in long. 127. 12. E. lat. 4. 2. N. Another in the Indian Ocean, in long. 52. 36. E. lat. 9. 10. S. And a third in long. 78. E. lat. 54. 5. N.

Providence, New, one of the Bahama Islands, in the West Indies, situated between longitude 77. 10. and 77. 38. west, and latitude 25. 3. north. It is twenty-one miles in length from east to west, seven miles in breadth from north to south, and for the most part flat, and covered with brushwood and extensive lagoons. A low range of rocky hills traverses part of the island at a short distance from the sea, in a direction from east to west; and another ridge, called the Blue Hills, situated about two miles and a half inland, runs nearly parallel to the former. The soil is in many parts very productive, and there is abundance of water, which possesses the valuable property of keeping good at sea for any length of time. Vegetables and fruits thrive abundantly; beef, mutton, and poultry are good and plentiful, and the shores abound with fish, including turtle. Amongst the exports are cotton, bark, broziletto, and fustic. The climate is mild, equable, and salubrious. New Providence, from its harbour and relative situation with respect to the Florida channel, is considered as the most important of the Bahamas; and on it is situated Nassau, the seat of government for the islands, as well as the head-quarters of the naval and military establishments. It is the centre of commerce, and possesses a fine harbour nearly land-locked. The streets are regularly laid out, the buildings are good, and there is an air of liveliness and cleanliness about the place. The island is divided into parishes, each of which has its church, clergy, and school liberally provided for. New Providence was colonized by the English in the year 1629, the natives having by that time become totally extinct. In 1641 the Spaniards drove out the settlers; but they returned in 1666, to be again expelled, however, in 1703. In 1783 New Providence, along with the other Bahama Islands, was restored to Great Britain by treaty. The population is about 6000.

Providence, Old, an island of the Caribbean Sea, situated about 125 miles from the nearest point of the Mosquito coast, its centre being in latitude 13. 21. north, and longitude 81. 21. 50. west from Greenwich. Its shape is an irregular oval, four miles and a quarter in length by two and a half in breadth. It is surrounded by an extensive coral reef; and at its northern extremity is another smaller island called Santa Catalina, separated from Old Providence only by a very narrow channel. Both islands are very hilly, and present an agreeable variety of scenery. The soil is exceedingly productive, and vegetation flourishes luxuriantly. The cattle and horses are excellent; but cotton is the staple export, which, with turtle-shell and hides, are the principal articles of trade. These are annually taken away by traders in exchange for English goods brought from Jamaica. Isabella, the only village on the island, is situated at the northern extremity, close to the channel, between the two islands. It was once a populous and flourishing place, but has now fallen into decay. The island is under the government of New Grenada, and, with that of St Andrews, forms the ninth canton of the republic. Old Providence is noted in the history of piracy as having been the resort formerly of bucaneers, and latterly that of privateers. It is but thinly inhabited, and capable of supporting a much larger population.

PROVIDENTIAL Channel lies between some shoals in the South Pacific Ocean, through which the Endeavour passed, near the north-east coast of New Holland. Long. 137. 50. E. Lat. 5. 38. S.

PROVINCE, in *Geography*, a division of a kingdom or state, comprising several cities, towns, and districts, all under the same government, and usually distinguished by the extent either of the civil or the ecclesiastical jurisdiction.

The church distinguishes its provinces by archbishoprics; in which sense England is divided into two provinces, namely, Canterbury and York.

PROVINCIAL, something relating to a province. It also denotes, in Catholic countries, a person who has the direction of the conventual establishments of a province.

PROVINS, an arrondissement of the department of the Seine and Marne, in France. It extends over 486 square miles, is divided into five cantons and 106 communes, and contains 48,500 inhabitants. The capital is a city of the same name, situated on the river Bouzie. It is well built, and ornamented by good promenades; and it contains 880 houses, with 5760 inhabitants, who, besides carrying on the manufacture of mixed cloths, and a considerable trade in corn, cultivate a great quantity of roses for the perfumers of Paris. There is also a mineral spring of some celebrity. Long. 3. 12. E. Lat. 48. 33. 39. S.

PROVOST of a city or town, is a name applied to the chief municipal magistrate in corporate towns or cities. He presides in civic courts, and, with the bailies, who are his deputies, determines in all differences that arise amongst citizens.

Provost, or *Prévôt-Royal*, a sort of inferior judge formerly established throughout France, to take cognizance of all civil, personal, real, and mixed causes, amongst the people only.

Grand Provost of France, an officer who had jurisdiction in the king's house, and over the officers therein.

Provost-Marshal of an Army, is an officer appointed to seize and secure deserters, and all other criminals.

Provost of the Mint, a particular judge instituted for the apprehending and prosecuting of false coiners.

PROW, the head or fore-part of a ship, particularly in a galley, being that which is opposite to the poop or stern.

PROXIMITY denotes the relation of nearness, whether in respect of place, of blood, or of alliance.

PRUDENCE, in *Ethics*, may be defined an ability of judging what is best, in the choice both of ends and of means. According to the definition of the Roman moralist (*De Officiis*, lib. i. cap. 43), prudence is the knowledge of what is to be desired or avoided. Accordingly, he takes *prudentia* to be a contraction of *providentia*, or foresight. Plato calls this the leading virtue; and Juvenal observes, that where prudence is present no divinity is absent.

The extremes of prudence are craft or cunning on the one hand, and folly on the other.

PRUDENTIUS, or Aurelius Prudentius Clemens, a famous Christian poet, who flourished under the reign of Theodosius the Great. Born in Spain in the year 348, he first followed the profession of advocate, was afterwards a judge, then a soldier, and at length had an honourable employment at court. A great number of his poems remain; but the style is barbarous, forming a singular contrast to the purity of the Augustan age. The best editions of his works are that of Amsterdam, 1667, with Heinsius's notes; and that of Paris, 1687, *in usum Delphini*.

PRUNING, in *Gardening* and *Agriculture*, is lopping off the superfluous branches of trees, to make them bear better fruit, grow higher, or appear more regular.

PRUSSIA.

History.

Prussia, formerly a duchy, but now a powerful and extensive kingdom of the second rank, was formed on the ancient electoral possessions as a nucleus, by means of successive territorial acquisitions, particularly in Poland, in Westphalia, and on the Rhine. The name is supposed by some to have been derived from that of the *Borussi*, a Sarmatian or Slavonic tribe, who, having migrated from the foot of the Riphæan Mountains, were tempted to settle in the district which is called Prussia proper. But others are of opinion that the country derived its name from its vicinity to the vast territory of Russia, and was for this reason called *Porussia; po* in the Slavonic language signifying *near* or *adjacent*, and consequently Porussia, shortened into Prussia, meaning near or adjacent to Russia. Nor is this derivation of the name entirely fanciful or hypothetical. Several others have been formed on the same principle. For instance, the river Elbe in Slavonic was termed Labe, and, by a similar combination, the tribes who inhabited its banks were called Po Labæ or *Polabæ*. The reader, however, must judge for himself which of these conjectures is the more probable. To the latter Frederick the Great has given the sanction of his authority in the treatise entitled Memoirs of the House of Brandenburg.

The ancient inhabitants.

The original inhabitants of Prussia were the Slavi or Sarmatæ, in the east and north-east; the Vandals on the shores of the Baltic, to the north of Pomerania; and the Suevi in the remainder of the kingdom. These people, particularly the first, are represented as having been extremely savage and barbarous; living upon raw flesh, and drinking, even to intoxication, the blood of horses at their feasts. They seem to have been unacquainted with the method of constructing huts, and to have lived in caves or under the shelter of rocks and trees, where they protected themselves and their children from the inclemencies of the weather. Such rude tribes cannot be expected to furnish materials for history; and hence little is known respecting them until the thirteenth century, when the Teutonic knights first obtained a footing in the country.

The Teutonic knights.

This celebrated fraternity is more or less known to every reader. After the death of Barbarossa, the Germans behaved with so much bravery in the Holy Land, that the king of Jerusalem, the patriarch, and other princes, rewarded their valour by conferring upon their order certain privileges. The body in question was thus instituted under the most favourable auspices. The members were originally called Knights of St George; but they were afterwards denominated *Equites Mariani*, or Knights of St Mary. In the year 1190, they elected Henry Walpol, a German, who had distinguished himself for conduct and bravery, as their first grand-master; and in the subsequent year Pope Celestine III. confirmed to them the privileges which they already enjoyed, and conferred on them the title of Knights of the Teutonic Order, an appellation by which they afterwards became so famous. On the expulsion of the Christians from the Holy Land by Saladdin, a settlement was given to these knights in Prussia by Conrad duke of Mazovia, the competitor of Boleslas V. for the crown of Poland. Their original residence in the former country was Culm, to which territory they were confined by the conditions of the grant, excepting what they might conquer from their pagan neighbours, all which the emperor granted to them in perpetuity. Encouraged by this grant, the knights conquered the greater part of the country now called *Prussia;* and, not content with this, they became so troublesome to Poland, that the monarchs of that kingdom were sometimes obliged to carry on dangerous and bloody wars with the order. (See the article **Poland**.)

The Teutonic order continued in Prussia until the year 1531. Their last grand-master was Albert marquis of Brandenburg, and nephew of Sigismund I. king of Poland. He was preferred to this dignity in hopes that his affinity to Sigismund might procure a restitution of some of the places which had been taken from the order during the previous unsuccessful wars with Poland; but in this the fraternity were disappointed. Albert, however, was so far from endeavouring to obtain any favour from his uncle by pacific means, that he refused to do homage to him, and immediately began to make preparations for throwing off his dependence, and recovering by force of arms the whole of Prussia and Pomerania. But he was so far from succeeding in his design, that, foiled in every attempt, he was forced to resign the dignity of grand-master; and in recompense for divesting himself of this office, his uncle bestowed on him part of Prussia in quality of secular duke. It was now the interest of the house of Brandenburg to assist in the expulsion of the fraternity; and accordingly, the knights, being at last driven out of Prussia and Pomerania, transferred their chapter to Mariendal in Franconia; but in that and in other provinces of the empire where they settled, little more than the name of the order now remains.

History of Brandenburg.

The electorate of Brandenburg, like other parts of Germany, was anciently possessed by barbarians, of whom no accurate account can be given. They were subdued by Charlemagne, as has been related in the history of France (see the article **France**, part first); but being on every occasion ready to revolt, Henry the Fowler, in 927, established margraves, or governors of the frontiers, in order to keep the barbarians in awe. The first margrave of Brandenburg was Sigefroy, brother-in-law of the emperor, under whose administration the bishoprics of Brandenburg and Havelberg were established by Otho I. From the time of this Sigefroy, till the succession of the house of Hohenzollern, from whom the present family derive their descent, there are reckoned eight different families who have been margraves of Brandenburg; namely, the family of the Saxons, of Walbeek, Staden, Plenck, Anhalt, Bavaria, Luxemburg, and Misnia. The margraves of the first four races carried on continual wars with the Vandals and other barbarous tribes; nor could their ravages be stopped till the reign of Albert surnamed the Bear, the first prince of the house of Anhalt, who was appointed margrave by the Emperor Conrad III., and afterwards raised to the dignity of elector by Frederick Barbarossa, about the year 1100. Some years afterwards, the king of the Vandals having died without issue, left the Middle March by his last will to the elector, who was besides possessed of the Old March, Upper Saxony, the country of Anhalt, and part of Lusatia. In the year 1332 this line became extinct, and the electorate devolved to the empire. It was then given by the Emperor Louis of Bavaria to his son Louis, who was the first of the sixth race. Louis the Roman succeeded his brother; and as he also died without children, he was succeeded by Otho, his third brother, who sold the electorate to the Emperor Charles IV. of the house of Luxemburg, for two hundred thousand florins of gold. Charles IV. gave the March to his son Winceslas, who was succeeded by Sigismund; and this elector, being embarrassed in his circumstances, sold the New March to the knights of the Teutonic order. Josse succeeded Sigismund; but aspiring to the empire, he sold the electorate to William duke of Misnia, who, after possessing it for one year, sold it again to the Emperor Sigismund. In 1417, Frederick VI. burgrave of Nuremberg, received at the Diet of Constance the investiture of the country of Brandenburg from the hands of the Emperor Sigismund, who, two years previously, had conferred upon Frederick the dignity of elector, and arch-chamberlain of the Holy Roman empire.

This prince, the first of the family of Hohenzollern, one of the oldest in Europe, found himself possessed of the Old and the Middle March; but the dukes of Pomerania had usurped the March of the Ukraine. The elector therefore declared war against them, and soon recovered the province. But as the New March still remained in the hands of the Teutonic knights, to whom it had been sold, as already mentioned, the elector, to compensate for this, took possession of Saxony, which at that time happened to be vacant by the death of Albert, the last elector of the Anhalt line. The emperor, however, disapproving of this step, gave the investiture of Saxony to the Duke of Misnia, upon which Frederick voluntarily desisted from his acquisitions. This elector made a division of his possessions by will. To his eldest son, who had too closely applied himself to the search of the philosopher's stone, he left only Voightland. The electorate was given to his second son Frederick; Albert, surnamed Achilles, received the duchies of Franconia; and Frederick, surnamed the Fat, had the Old March, which, by his death, returned to the electorate of Brandenburg.

Frederick I. was succeeded by his son, called also Frederick, and surnamed Irontooth on account of his strength. He might with as much reason have been surnamed the Magnanimous, since he refused two crowns, that of Bohemia, which was offered him by the pope, and the kingdom of Poland, to which he was invited by the people; but Frederick declared he would not accept of the latter unless Casimir, brother of Ladislas, the late king, should refuse it. These instances of magnanimity had such an effect on the neighbouring people, that the states of Lower Lusatia made him a voluntary surrender of their country. But as Lusatia was a fief of Bohemia, the king of that country immediately made war on the elector, in order to recover it. In this, however, he was so far from being successful, that, by a treaty of peace concluded in 1462, he was obliged to surrender to the elector the perpetual sovereignty of Corbus, Peits, Sommerfeld, and some other places. Frederick having redeemed the New March from the Teutonic order for the sum of a hundred thousand florins, and having still further enlarged his dominions, resigned the sovereignty to his brother Albert, in the year 1469.

Exploits of Albert.

Albert was fifty-seven years old when his brother resigned to him the electorate. Most of his exploits had been performed whilst he was burgrave of Nuremberg. Having declared war against Louis duke of Bavaria, he defeated that prince and took him prisoner. He also gained eight battles against the Nurembergers, who had rebelled and contested his rights to the burgraviate. In one of these he fought singly against sixteen men, until his people came up to his assistance. He made himself master of the town of Greiffenburg in the same manner as Alexander the Great took the capital of the Oxydracæ, by leaping from the top of the walls into the town, where he defended himself singly against the inhabitants until his men forced the gates and rescued him. The confidence which the Emperor Frederick III. placed in him, gained him the direction of almost the whole empire. He commanded the imperial armies against Louis the Rich, duke of Bavaria; and also against Charles the Bold, duke of Burgundy, who had laid siege to Nuis, but concluded a peace at the interposition of Albert. He gained the prize at seventeen tournaments, and was never dismounted. All these exploits, however, had been performed before Albert obtained the electorate.

From that time we meet with no very important transactions until the year 1594, when John Sigismund of Brandenburg, having married Anne, the only daughter of Albert duke of Prussia, that duchy was united to the electorate, of which it has ever since formed part; and he also obtained pretensions to the countries of Juliers, Berg, Cleves, Marck, Ravensburg, and Ravenstein, of which Anne was the heiress.

Reign of the elector George William.

Sigismund died in the year 1619, and was succeeded by his son George William, during whose government the electorate suffered great calamities. At this time commenced the war between the Protestants and Catholics, which, from the period of its endurance, has been denominated the Thirty Years' War. The former, although leagued together, were on the point of being utterly destroyed by the imperialists under the command of Tilly and Wallenstein, when Gustavus Adolphus of Sweden turned the scale in their favour, and threatened the Catholic party with total destruction. But by the death of the king on the field of battle at Lutzen, the fortune of war was once more changed. At last, however, peace was concluded with the emperor; and, in 1640, the elector died, leaving his dominions to his son Frederick William.

That of Frederick William.

This young prince, though only twenty years of age at the time of his accession, applied himself with the utmost diligence to repair the losses occasioned by the wars which had preceded. He received the investiture of Prussia personally from the king of Poland, on condition of paying a hundred thousand florins annually, and not making peace with the enemies of that country. His envoy likewise received the investiture of the electorate from the Emperor Ferdinand III. The elector then thought of recovering his provinces from those who had usurped them. He concluded a truce of twenty years with the Swedes, who evacuated the greater part of his states. He likewise paid a hundred and forty thousand crowns to the Swedish garrisons, which still possessed some of his towns; he concluded a treaty with the Hessians, who delivered up a part of the duchy of Cleves; and he obtained of the Hollanders the evacuation of several other cities.

Treaty of Westphalia.

In the mean time, the powers of Europe began to be sickened of a war which had continued for such a length of time with unrelenting fury. The cities of Osnaburg and Munster being chosen as the most proper places for negotiation, the conferences were opened in the year 1645; but, by reason of the multiplicity of business, they were not concluded till two years afterwards. France, which had espoused the interests of Sweden, demanded that Pomerania should be ceded to the latter, as an indemnification for the expenses which the war had cost Gustavus Adolphus and his successors. Although the empire and the elector refused to give up Pomerania, it was at last agreed to cede to the Swedes Hither Pomerania, the isles of Rugen and Wollin, and also some cities; in return for which, the bishoprics of Halberstadt, Minden, and Kamin were secularized in favour of the elector, and he was put in possession of them, together with the lordships of Hochenstein and Richenstein, and the reversion of the archbishopric of Magdeburg. Thus was concluded, in 1648, the treaty of Westphalia, which serves as a basis to all the possessions and rights of the German princes. The elector then concluded a treaty with the Swedes for the regulation of limits, and for the acquittal of certain debts; and next year the electorate, Pomerania, and the duchies of Cleves, were evacuated by the Swedes.

Proceedings against the Swedes. Peace.

Notwithstanding these treaties, however, the Swedes soon afterwards invaded Pomerania, but were entirely defeated by the elector near the town of Fehrbellin. Three thousand were left dead on the field, amongst whom were a number of officers; and a great many were made prisoners. The elector immediately pursued his victory, and, gaining many advantages over the Swedes, deprived them of the cities of

Stralsund and Greiphswald. The Swedes, however, hoping to oblige the elector to evacuate Pomerania, which he had almost totally subdued, invaded Prussia at the head of sixteen thousand men, who advanced from Livonia, and entering the country, burned the suburbs of Memel, and took the cities of Tilse and Insterburg. The elector, to oppose the invaders, left Berlin on the 10th of January 1679, at the head of about nine thousand men. The Swedes retired at his approach, and were much harassed by the troops on their march, losing almost one half their army. At last, having crossed the bay of Frisch-Haff and Courland on the ice, the elector, on the 19th of January, arrived with his infantry within three miles of Tilse, where the Swedes had established their head-quarters. The same day, General Trefenfeldt defeated two regiments of the enemy near Splitter; and the Swedes who were in Tilse having abandoned the place, retired towards Courland. They were pursued by General Gortz, and entirely defeated with great slaughter, so that scarcely three thousand of them returned to Livonia. Yet, notwithstanding these victories, the elector, being pressed on the other side by Turenne and the Prince of Condé, was obliged to make peace with the Swedes. The conditions were, that the treaty of Westphalia should serve as the basis of the peace; and that the elector should have the property of the customs in all the ports of Further Pomerania, with the cities of Kamin, Gartz, Greiffenburg, and Wildenbruck; whilst, on his part, he consented to give up to the Swedes all that he had conquered from them, and to afford no assistance to the king of Denmark, upon condition that France should deliver up to him his provinces in Westphalia, and pay him three hundred thousand ducats as an indemnification for the damages done by the French to his states. This treaty was styled the peace of St Germains.

With the treaty of St Germains terminated the military exploits of Frederick William, who passed the last years of his administration in tranquillity. Few sovereigns ever attained greater celebrity, or enjoyed more fully the affections of his subjects and the respect of foreign countries. An embassy was sent him by Murad Geray, the khan of the Tartars, soliciting his friendship; and he received other marks of the estimation in which he was held. In 1684, he admitted into his dominions great numbers of Protestants who had fled from France after the revocation of the edict of Nantes by Louis XIV.; twenty thousand of whom are said to have settled in the electorate, where they introduced those arts and manufactures which proved of the utmost benefit to the country. Before his time, Prussia was held as a fief of Poland; but in 1656 he compelled the Polish monarch to declare it an independent state. Puffendorf thought the life of this prince a subject not unworthy of his pen; and Frederick the Great regards him[1] as the principal founder of the power and influence of the house of Brandenburg.

Prussia erected into a kingdom. Frederick I.

In 1688, the elector Frederick William died, and was succeeded by his son Frederick III. This prince was remarkably fond of show and ceremony, which, during the course of his government, involved him in great expense. The attainment of the regal dignity seemed to be the great object of his ambition. To accomplish this object, he joined with the emperor in the alliance against France, in which he was engaged by William III. king of Britain. He also yielded up the circle of Schwibus, which had been given to his predecessor; and, in 1700, he obtained from the emperor the royal dignity which he had so earnestly desired. The terms on which it was obtained were, that Frederick should never separate from the empire those provinces of his dominions which depended on it; that he should not, in the emperor's presence, demand any other marks of honour than those which he had hitherto enjoyed; that the ministers which he sent to Vienna should be treated like those of other crowned heads; that the elector should maintain at his own expense six thousand men in Italy, in case the emperor should be obliged to make war by reason of the succession of the house of Bourbon to the crown of Spain; and that the troops in question should continue there whilst the war lasted.

Such were the principal terms upon which Prussia was erected into a kingdom, through the friendship of the emperor, with whom Frederick I. (so called as being the first king of Prussia), continued all his life in strict alliance. He was a pacific and patriotic prince; and having always preserved his dominions in peace, consulted more effectually the true interest of his subjects than those monarchs who have dazzled the world by the splendour of their military exploits.

Frederick II.

Frederick I. died in the beginning of 1713, and was succeeded by his son Frederick William, sometimes called Frederick II. He was in almost everything the reverse of his father. His dispositions being altogether martial, he applied himself entirely to the augmentation of his army, and perfecting them in their exercises, by which means they became the most expert soldiers in Europe. His foible was an ambition of having his army composed of men above the ordinary size; but as these could not be procured, he composed a regiment of the tallest men he could find; and as his officers made no scruple of picking up such men wherever they could find them for his majesty's use, the neighbouring states were frequently offended, and a war was often likely to ensue from this ridiculous cause. However, his Prussian majesty never engaged in any martial enterprise of consequence; but having placed his army on the most respectable footing of any in the world, and filled his coffers with cash, for he was of a very saving disposition, he put it in the power of his son to perform those exploits which proved matter of astonishment to all Europe.

In this king's reign Prussia first perceived that her natural enemy and rival was the house of Austria, and not France, as had been formerly supposed. Hence frequent disputes took place between these two powers, for which the persecution of the Protestants by some of the Catholic states of the empire afforded a pretence; and although a war never actually took place, yet it was easy to perceive that both were at heart mortal enemies. But when Frederick William died in 1740, this enmity broke out in full force.

Frederick the Great.

This king was succeeded by his son Frederick III., commonly styled Frederick the Great, who ascended the throne in 1740. He was born on the 24th of January 1712, and in his infancy intrusted to the care of Madame de Rocoule, who spoke no language but French, and thus probably inspired him at once with a taste for that language and a dislike of the German. As he advanced in years, he was put under more accomplished tutors; but as his father's object was to inspire him with a love of military glory, and to teach him the art of war in all its departments, he at first made little progress in science and literature; and, in fact, his erudition was at the best but limited. The branches in which he excelled were the belles lettres and ethics. He was also an adept in music, of which he was passionately fond. But his father not reckoning such an accomplishment compatible with the profession of a soldier, forbade him to cultivate it; and his disobedience of the paternal restriction was the cause of the misunderstanding which existed between him and his father till the death of the latter. Finding himself disgraced at court, he retired to the castle of Rheinsberg, where he devoted his time to study, and to the society and conversation of learned men of different countries. When he ascended the throne in 1740, he was welcomed by the unanimous acclamations of his subjects, who entertained sanguine hopes of his future greatness and celebrity. In accordance with the uniform policy of his family, the early and great object of his life was to increase his dominions; and the first step he took in the accomplishment of this object was the invasion of Silesia upon the death of the emperor of Germany. The empress-queen was placed in a very disagreeable situation by the demise of her father; and of this Frederick took the advantage to do himself justice, as he said, with regard to Silesia, of which his ancestors had been unjustly deprived. The province in question he accordingly seized; but it cost him dear; for the empress, having at last overcome all difficulties, formed against him the most powerful combination that was ever known in Europe.

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[1] See Memoirs of the House of Brandenburg.

Combina- tion against Fr.

The treaty by which the empress reluctantly yielded up to the king of Prussia the province of Silesia, and with it a clear revenue of L.800,000 a year, had scarcely been concluded, when she entered into another with the court of St Petersburg, which was concluded on the 22d of May 1746. This treaty, as far as it was made public, was merely of a defensive nature; but six secret and separate articles were added to it. By one of these it was provided, that in case his Prussian majesty should attack the empress-queen, or the empress of Russia, or even the republic of Poland, it should be considered as a breach of the treaty of Dresden, by which Silesia had been given up. It was also stipulated, that notwithstanding that treaty, which, in fact, had been dictated by the king of Prussia himself, the right of the empress-queen to Silesia still continued, and for the recovery of that province the contracting powers engaged mutually to furnish an army of sixty thousand men. To this treaty, called the treaty of St Petersburg, the king of Poland was invited to accede; but being in a manner in the power of the king of Prussia, he did not think proper to sign it. However, he verbally acceded to it, so as to convince the other parties of his design to co-operate in all their measures; and in consideration of such intention, it was agreed that he should have a share in the partition of the king of Prussia's dominions, in the event of the successful issue of their enterprises.

Invasion of axony.

In consequence of these machinations, every art was used to render the king of Prussia personally odious to the empress of Russia; the empress-queen made vast preparations in Bohemia and Moravia; and the king of Poland, under pretence of a military amusement, drew together sixteen thousand men, with whom he occupied a strong post at Pirna. The empress-queen, still further to strengthen herself, concluded a treaty with the court of France, dated at Versailles on the 1st of May 1756. In the mean time the king of Prussia, understanding from his emissaries what was going forward, resolved to be beforehand with his enemies; and, to keep the war out of his own country, he entered Saxony with a considerable army. At first he affected only to demand a free passage for his troops, and an observance of the neutrality professed by the king of Poland; but having good reasons to doubt this neutrality, he demanded, as a preliminary, that the Saxon troops should immediately abandon the strong post they occupied, and disperse themselves. This demand being refused, Frederick blockaded the Saxon camp at Pirna, resolving to reduce it by famine, since its strong situation rendered an attack dangerous. At that time there were in Bohemia two Saxon armies; one under the command of Marshal Brown, and the other under that of General Picolomini. To keep these in awe, the king had sent Marshal Schwerin with an army into Bohemia, and Marshal Keith penetrated into the same kingdom on the side of Misnia. But still the king of Prussia did not entirely confide in these dispositions; and therefore fearing lest Brown might afford some assistance to the Saxons, he joined his forces under Keith, and on the 1st of December 1756 attacked and defeated the Austrian general at Lowositz. The latter thus found it impossible to relieve the Saxons, and, after a vain attempt to retire from their post, they were all taken prisoners. The king of Poland quitted his dominions in Germany, and the Prussians took up their winter-quarters in Saxony. Here they seized upon the revenues, levied contributions, and obliged the country to supply them with recruits. At the same time the king of Prussia made himself master of the archives of Dresden, by which means he procured the originals of those documents which, when produced to the world, showed the combination that had been formed against him, and consequently justified the measures he had taken in his own defence.

The king put to the ban of the empire.

No sooner had the king entered Saxony in the manner already related, than a process was commenced against him in the Aulic Council, and before the Diet of the Empire, where he was soon condemned for contumacy, and put to the ban of the empire. The various circles were then ordered to furnish their respective contingents of men and money to put this sentence in execution; but these came in so slowly, that, had it not been for the assistance of the French under the Prince de Soubise, the army would probably have never been in a condition to act. The Austrians, in the mean time, made great preparations, and raised a hundred thousand men in Bohemia, whom they placed under the command of Prince Charles of Lorraine, assisted by Marshal Brown. The Czarina sent a body of sixty thousand men under Apraxin to invade ducal Prussia, whilst a strong fleet was equipped in the Baltic to cooperate with that army. The king of Sweden also acceded to the confederacy, in hopes of recovering those possessions which his ancestors had enjoyed in Pomerania; and the Duke of Mecklenburg followed the same course, promising to join the Swedish army with six thousand men as soon as it should be necessary. On the side of the king of Prussia appeared nobody excepting an army of between thirty and forty thousand Hanoverians commanded by the Duke of Cumberland; and these were outnumbered and forced to yield to a superior army of French commanded by D'Etrées.

Invasion of Bohemia, and defeat of the Austrian army.

In the mean time, his Prussian majesty, finding that he must depend for assistance solely upon his own abilities, resolved to make the best use of his time. Accordingly, in the spring of 1757, his armies poured into Bohemia from two different points, whilst the king himself prepared to enter it by a third. Marshal Schwerin entered from Silesia, and the Prince of Bevern from Lusatia, where he defeated an army of twenty-eight thousand Austrians who opposed his passage. As the intentions of the king himself were not known, the Austrians detached a body of twenty thousand men from their principal army to observe his motions. This was no sooner done than the king cut off all communication between the detachment and the main body; and having joined his two generals with incredible celerity, he engaged the Austrians near Prague, totally defeated them, and took their camp, military chest, and cannon; but he lost the brave Marshal Schwerin, who was killed at the age of eighty-two, with a colonel's standard in his hand. On the Austrian side Marshal Brown was wounded, and died in a short time, though it is supposed more from the chagrin he suffered than from the dangerous nature of the wound itself.

Siege and bombardment of Prague.

About forty thousand of the Austrian army took refuge in Prague, whilst the rest fled in different directions. The city was instantly invested by the king, and all succours were cut off. The great number of troops which it contained made an attack unadvisable, but seemed to render inevitable its reduction by famine; however, the king, to accomplish his purpose the more speedily, prepared to bombard the town. On the 29th of May, after a most dreadful storm of thunder and lightning, four batteries began to play upon the city. From these were thrown every twenty-four hours, 288 bombs, besides a vast number of red-hot balls, so that it was soon on fire in almost every quarter. The garrison made a vigorous defence, and one well-conducted sally, which, however, was repulsed with great loss. The magistrates, burghers, and clergy, seeing their city on the point of being reduced to an heap of rubbish, earnestly supplicated the commander to capitulate; but he was deaf to their entreaties, and drove twelve thousand of the most useless mouths out of the town, who were quickly driven in again by the Prussians.

Count Daun. Battle of Kollin.

The affairs of the empress-queen seemed thus to be verging to destruction, when Leopold count Daun took upon him the command of the army. This general, having arrived within a few miles of Prague on the day after the great battle there, immediately collected the scattered fugitives with the greatest diligence, and retired with them to a strong post in the neighbourhood, whence he gave the troops in Prague hopes of speedy relief. It was now the king of Prussia's business, either to attempt making himself master of the city by one desperate effort, or entirely to abandon the enterprise, and drive Daun from his position before his troops had recovered from the terror of their late defeat. But, by attempting to do both, he rendered himself incapable of doing either. Though the army of Daun already amounted to sixty thousand men, and though they were strongly intrenched, and defended by a vast train of artillery, his majesty thought proper to send against them no more than thirty-two thousand men. On the morning of the 18th of June, the Prussians marched by the left along the great road which leads from Prague to Kollin, intending to assail the enemy's right wing as soon as the necessary dispositions had been made for the attack, and the flank sufficiently developed; but various circumstances conspired to render ineffectual the plan which Frederick had formed. Daun had drawn up his army in order of battle upon the very ground which the Prussians intended to occupy, and the flank movement of the latter, being executed too close to the enemy's line, indeed within the range of their artillery, was arrested, at the critical moment, by several brigades stopping to return the enemy's fire. This effectually deranged the whole combination; and though the Prussians did all that human courage and steadiness could do in the circumstances, and the king himself at last charged at the head of his cavalry, they were driven from the field with a loss in killed, wounded, and missing, of nearly fourteen thousand men of all arms.[1]

Siege of Prague raised.

The immediate consequence of the battle of Kollin was, that the king found himself obliged to raise the siege of Prague, and to take refuge in Saxony. The Austrians harassed him as much as possible in his retreat from Bohemia; but, notwithstanding their superiority, they could not make any decisive attempt against him, as the frontiers of Saxony abounded with positions easily defended. In the mean time the Russians, who had hitherto been very dilatory in their movements, began to exert themselves, and entered Prussia under Apraxin and Fermor, where they committed innumerable cruelties and excesses. A large body of Austrians also entered Silesia, penetrated as far as Breslau, and then laid siege to Schweidnitz; whilst another body entered Lusatia, and made themselves masters of Zittau. An army of twenty-two thousand Swedes also entered Prussian Pomerania, took the towns of Anclam and Demmein, and laid the whole country under contribution. The French, too, being freed from all restraint by the capitulation of the Duke of Cumberland at Closter-Seven, made their way into Halberstadt and the Old March of Brandenburg, first exacting contributions, and then plundering the towns. The army of the empire, being reinforced by that of the Prince de Soubise, at length marched to occupy Saxony, and thus left the Austrians at liberty to exert the greater part of their force in the reduction of Silesia.

Berlin la under con tribution. Defeat of Lehwald.

General Haddick penetrated through Lusatia, passed by the Prussian armies, and suddenly appeared before the gates of Berlin, which city he laid under contribution. He retired on the approach of a body of Prussians; yet he still found means to occupy such a position as interrupted the king's communications with Silesia. The destruction of the king of Prussia therefore seemed to be inevitable. Every exertion which he had made, though able and well conducted, had been unsuccessful. His general, Lehwald, who opposed the Russians, had orders to attack them at all events. He obeyed his instructions, and with thirty thousand men attacked sixty thousand of the enemy strongly intrenched at a place called Norkitten. The Prussians behaved with the greatest valour; but after having killed five times more of the enemy than they themselves lost, they were compelled to retire, although more formidable after their defeat than the Russians after their victory. The king, in the mean time, exerted himself on every side, and his enemies fled everywhere before him; but whilst he pursued one body, another gained upon him in an opposite direction, and the winter fast approached, whilst his strength decayed, and that of his adversaries seemed to increase in every quarter.

Battle of Rosbach.

The Prussian monarch, however, though beset with the greatest difficulties, did not abandon himself to despair, or lose that wonderful presence of mind which so eminently distinguished him in all his military enterprises. He purposely delayed a decisive action until the approach of winter, when at length, upon the 5th of November 1757, he, after a variety of skilful movements, encountered at Rosbach the united army of his enemies, commanded by the Prince of Saxe-Hilburghausen and the Prince de Soubise. The allied army amounted to fully fifty thousand men, but most of the troops of the Circles were newly raised, and many of them not well affected to the cause. The Prussians did not exceed twenty-five thousand men; but they were superior to any troops in the world, and inspired, by the presence of their king, with the most enthusiastic valour. The imperialists were attacked whilst in full march, their cavalry was overthrown at the first shock; and being thus prevented from forming a regular order of battle, or bringing their battalions into action except in succession, they were defeated with the loss of three thousand killed, eight generals, two hundred and fifty officers of different ranks, and six thousand private soldiers taken prisoners. Night alone prevented the total destruction of the allied army.

Battle of Breslau.

By this battle the king was set free from the enemy on one side; but this only gave him an opportunity of renewing his efforts on another. The Austrians had collected a great force, and now began to make proportional progress in Silesia. After a siege of sixteen days, they had reduced the strong fortress of Schweidnitz, and obliged the Prussian garrison of four thousand men to surrender as prisoners of war. Hearing of the victory at Rosbach, and learning that the king of Prussia was in full march to relieve Silesia, they resolved to assault the Prince of Bevern in his strong camp under the walls of Breslau. The attempt was made on the 22d of November; but their attack was sustained with the greatest resolution. The slaughter of the Austrians was prodigious. A great part of the enemy had retired from the field of battle, and the rest were preparing to follow their example, when all at once the Prussian general took the same resolution. His army had suffered much in the engagement, and he became apprehensive of a total defeat in case the intrenchments should in any part be forced; for which reason he quitted his strong position and retired behind the Oder. Two days afterwards, the Prince of Bevern, going to reconnoitre without an escort, attended only by a groom, was taken prisoner by an advanced party of Croats, a small body of whom had crossed the Oder.

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[1] See Jomini, *Traité de Grande Tactique*, vol. ii. chap. 10.

slau n by Aus- ns.

Upon this the town of Breslau immediately surrendered; and there, as well as at Schweidnitz, the Austrians found great quantities of provisions, ammunition, and money. In fact, all Silesia was on the point of falling into their hands, and the Prussian affairs were fast getting into the utmost distraction, when the king, by a rapid and able march, passed through Thuringia, Misnia, and Lusatia, in spite of the utmost efforts of Haddick and Marshal, who were sent to oppose him, and, entering Silesia upon the 2d of December, joined the Prince of Bevern's corps, which repassed the Oder to meet him. The garrison of Schweidnitz, who, as we have already observed, had been made prisoners of war, also joined the king's army unexpectedly; and their presence contributed not a little, notwithstanding the smallness of their number, to raise the spirits of the whole army. They had submitted with the greatest reluctance; but as the Austrians were conducting them to prison, they happened to receive intelligence of the victory at Rosbach, upon which they immediately rose on the escort that conducted them, and entirely dispersed it; and afterwards marching in such a direction as they thought would most readily lead them to their king, they accidentally met with his army.

n de- ed at then.

His Prussian majesty now approached Breslau; on which the Austrians, confiding in their superiority (for they exceeded seventy thousand, whilst the Prussians scarcely amounted to thirty-six thousand), abandoned their strong camp, which the Prince of Bevern had formerly occupied, and advanced to give him battle. The king did not intend by any means to disappoint them, but on his part advanced with the greatest celerity. The two armies met on the 5th of December, near the village of Leuthen. Marshal Daun made the best dispositions possible. The position occupied by his army was a plain, with small eminences, which he covered with artillery; and as the ground was also interspersed with thickets, the Austrians sought to turn these likewise to their advantage. On their right and left were hills, upon which they planted batteries of cannon. The ground in their front was intersected by many causeways; and, to render the whole more impracticable, the Austrians had felled a great number of trees, and scattered them in the way. At the commencement of the engagement it was found almost impossible for the Prussian cavalry to act, on account of these impediments; but in consequence of a judicious disposition made by the king himself, all difficulties were overcome. His majesty, foreseeing that General Nadasty, who was placed on the enemy's left with a corps de reserve, designed to assail him in flank, had placed four battalions immediately behind the cavalry of his right wing, to support them in case of attack. No disposition could have been more fortunate. It happened just as the king had foreseen. Nadasty's cavalry attacked the Prussian right wing with great fury; but they were received with such a severe fire from the four battalions above mentioned, that they were obliged to retire in disorder. The king's flank, then, well covered and supported, was enabled to act with such order and vigour as repulsed the enemy. The Austrian artillery was also silenced by that of the Prussians. Still the Austrians continued to make a gallant resistance during the whole of the battle. After having been thrown into disorder, they rallied all their forces about Leuthen, which was defended on every side by intrenchments and redoubts. The Prussians attacked them with the utmost impetuosity, and at last became masters of the position; upon which the enemy fled on all sides, and a total rout ensued. In this battle the Austrians lost six thousand men killed on the spot, fifteen thousand taken prisoners, and upwards of two hundred pieces of cannon.

Breslau retaken.

The consequences of this victory were very great. Breslau, being immediately invested, surrendered on the 29th of December, and the garrison, amounting to thirteen thousand men, were made prisoners of war. The blockade of Schweidnitz was likewise formed, whilst detached Prussian parties overran the whole country of Silesia, and reduced every place of importance. Meanwhile the Russians, having ravaged and destroyed the country in such a manner that they could not subsist in it, thought proper to retire from the Prussian dominions. General Lehwald being thus left at liberty to act against the Swedes, quickly drove them out of Prussian Pomerania, the whole of which he recovered, and also overran some part of Swedish Pomerania. The duchy of Mecklenburg being thus left quite exposed, the king took ample vengeance on it, by exacting severe contributions of men and money. To complete this monarch's good fortune, the French, who had retired after the battle of Rosbach, were now opposed by the Hanoverians under Prince Ferdinand, who kept them so well employed that, during the remainder of the war, the king of Prussia had no more trouble from them.

Schweidnitz retaken. Siege of Olmutz.

The beginning of the year 1758 proved favourable to the arms of his Prussian majesty. On the 3d of April he commenced his operations against Schweidnitz, and pushed the siege so vigorously that the place surrendered in thirteen days. He then disposed his forces in such a manner as might best guard his dominions against his numerous enemies. For this purpose Count Dohna commanded a body of troops on the side of Pomerania; whilst another considerable body was posted between Wohlau and Glogau, in order to cover Silesia from the Russians, in case they should make their inroad that way. A little time afterwards an army was formed in Saxony, commanded by the king's brother, Prince Henry. This army consisted of thirty battalions and forty-five squadrons, and was designed to make head against the army of the Circles, which, by great efforts during the winter, and the junction of a considerable body of Austrians, was again in a condition to take the field. Between all these armies a ready communication was kept up by a regular chain of posts. After the reduction of Schweidnitz, the king, having made a show of invading Bohemia, suddenly burst into Moravia, where in a short time he made himself master of the whole country, and on the 27th of May laid siege to Olmutz, the capital. Of this Daun no sooner got information than he marched to Moravia through Bohemia; and though he was not in a condition to risk a battle, yet, by placing himself in a strong situation, where he could not be attacked, by harassing the king's troops and cutting off their convoys, he at last obliged him to abandon the enterprise. The king, however, who frequently owed much of his success to the impenetrable secrecy in which he shrouded all his designs, gave not the least hint of his intention to raise the siege of Olmutz. On the contrary, the very day before the siege was raised, the firing continued as briskly as ever; but in the night of the 1st of July, the whole army took the road to Bohemia in two columns, and gained an entire march upon the Austrians. Thus, notwithstanding the utmost efforts of his enemies, the Prussian army reached Bohemia, where the king seized upon a large magazine at Lieutomissel; defeated some corps of Austrians who had attempted to interrupt his progress; and arrived at Königsgratz, of which he took possession, after driving from it seven thousand Austrians who were intrenched there. This city and several other districts he laid under contribution; but he soon afterwards entered Silesia, and marched with the utmost rapidity to encounter the Russians, who having united their forces under Brown and Fermor, had entered the New March of Brandenburg, and laid siege to Custrin.

Battle of Zorndorff.

The king arrived in this city at a very critical period. The Russians had laid siege to it on the 15th of August; and though they were not well skilled in managing artillery, yet, by furious and unremitting discharges at random, they threw in such a number of bombs and red-hot balls, that the town was soon on fire in every quarter. Some of the wretched inhabitants were burned; others were buried in the ruins of their houses, or killed by the balls which fell like hail in the streets; whilst many of the survivors abandoned their habitations, and fled out of the town on the side where it was not invested. The governor did everything for the defence of the place; but as the walls were built after the ancient manner, it was impossible that the town could have made a lengthened defence, especially as the principal magazine of the besieged had been blown up. The stern avenger of all these injuries, however, was now at hand. The king came in sight of the Russians on the 25th of August, after a march of fifty-six days, in the course of which he beheld the country everywhere desolated, and the villages in flames. At his approach the enemy raised the siege, and retired towards the neighbouring village of Zorndorff, where they were almost immediately attacked. At nine o'clock in the morning a terrible fire of cannon and mortars poured destruction on the right wing of the Russian army for two hours without intermission. The slaughter was such as might have been expected; but the Russians kept their ground with astonishing resolution, new regiments pressing forward to supply the places of those that fell. When the first line had expended all their ammunition, they rushed forward on the Prussians with their bayonets; and these brave troops, although encouraged by the presence of their king, gave way and fled before an enemy already half defeated. The Russian generals ought now to have attacked with their cavalry the disordered infantry of the enemy, which would have completed the defeat, and in all probability given the finishing stroke to the king of Prussia's affairs. This opportunity, however, they lost. But the king was not so negligent. By a very rapid and masterly movement, he brought all the cavalry of his right wing to the centre, and falling upon the Russian infantry, uncovered by their cavalry, and even disordered by their own success, drove them back with horrible slaughter, at the same time that the repulsed battalions of infantry, returning to the charge, decided the victory. The Russians were now thrown into the most dreadful confusion. The wind blew the dust and smoke into their faces, so that, unable to distinguish friends from foes, they fired on each other, plundered their own baggage, which had been placed between the lines, and intoxicated themselves with brandy; the ranks fell in upon one another, and being thus crammed together into a narrow space, the fire of the Prussians produced dreadful effect, whilst their enemies kept up only a scattered and ineffectual discharge. Yet even in this dismal situation the Russians did not fly, but suffered themselves to be slaughtered till seven in the evening, when their generals having caused an attack to be made on the Prussian right wing, the attention of the enemy was drawn to that quarter, and they had thus time to retire a little from the field of battle to recover their order. In this engagement the Russians lost twenty-one thousand five hundred and twenty-nine men, whilst that of the Prussians did not exceed two thousand. A vast train of artillery was taken, together with the military chest, and many officers of high rank. The consequence was, that the Russian army retreated as far as Landsperg, on the frontiers of Poland, and the king was left at liberty to march with his usual expedition to the relief of Prince Henry in Saxony.

Operations of Daun rendered abortive.

The prince was at this time severely pressed by Marshal Daun. As soon as the king had left Bohemia in the manner already related, Daun, considering it of no use to follow him, resolved to turn his arms against Saxony. Towards that country, therefore, he marched through Lusatia, by Zittau, Gorlitz, and Bautzen. On the 3d of September he invested the strong fortress of Sonnestein, which unaccountably surrendered, after a single day's resistance, to one of his generals, named Macguire. He then directed his movement so as to favour the operations of General Laudon, who had advanced through Lower Lusatia to the confines of Brandenburg; and, by drawing the attention of the Prussian forces which had been left in Silesia to the northward of that duchy, he facilitated the progress of Generals Karsch and Deville in the southern parts. He then proposed that Prince Henry should be attacked by the army of the Circles, whilst that of the Austrians should pass the Elbe, and, falling at the same time on the Prussians, second the attack of the imperialists, and cut off the retreat of their enemies from Dresden. The sudden appearance of the king of Prussia, however, put an end to his plan. General Laudon abandoned all his conquests in Lower Lusatia, and retired towards Daun, whilst that general himself retired from the neighbourhood of Dresden as far as Zittau. The army of the empire kept its ground in the strong position at Pirna, formerly mentioned, but did not undertake any thing. As for the Swedes, who had directed their movements by those of the Russians, they no sooner heard of the victory of Zorndoff than they retreated with much more expedition than they had advanced.

Surprise of the Prussian army at Hohenkirchen.

The affairs of the king of Prussia seemed to be thus pretty well retrieved, when, by an unfortunate oversight, he was brought to the verge of ruin. Marshal Daun had taken up an advantageous position at Stolpen, by which he preserved a communication with the army of the empire. On the other hand, the king of Prussia, having taken possession of an important post at Bautzen, extended his right wing to the village of Hohenkirchen, by which he preserved a communication with Prince Henry, protected Brandenburg, and had the power, if necessary, of throwing succours into Silesia. The two armies kept a watchful eye on each other's movements; and as the principal aim of Daun was to cut off the king's communication with Silesia, and that of the king to intercept Daun's communication with Bohemia, a battle seemed inevitable. In this posture of affairs the Austrian general formed a design of attacking the Prussian camp in the night; and in point of fact he succeeded, under cover of the darkness, prolonged by a thick mist, in surprising his usually vigilant enemy, who obviously never contemplated such an enterprise on the part of his opponent. Soon after midnight, the Austrian army began its march in three columns towards the camp of the king of Prussia. The night was exceedingly dark, and they had a considerable way to march; yet all the columns arrived simultaneously, without being discovered, or the least confusion having occurred; and at five in the morning they began a regular and well-conducted attack upon one extremity of the Prussian line, which was at the same time taken in reverse by the Austrian left wing formed *en potence*. Nothing could withstand the sudden attack thus made. The battalions, as they hastily formed, were swept away by the overwhelming fire of the Austrians; the Prussians were thrown into confusion; and Marshal Keith, one of their best generals, having received two musket-balls, fell dead on the spot.[1] Prince Francis of Brunswick had his head shot off by a cannon-ball as he was mounting his horse; and everything seemed to announce the total destruction of the army. Still, however, the king preserved his wonderful presence of mind, which indeed never forsook him, even on the most trying occasion. He ordered some detachments from his left wing to support the right; but the moment that these orders were received, the left itself was furiously attacked. General Ketzow, who commanded in that quarter, repulsed the Austrians with difficulty, but was not able to afford any considerable assistance to the right, which alone was obliged to sustain the weight of the principal attack. The Austrians, in the beginning of the engagement, had driven the Prussians out of the village of Hohenkirchen; and as the fate of the day depended upon the possession of that post, no effort was spared to recover it. The Prussians made three bloody and unsuccessful attacks on the village; in the fourth they carried it; but the Austrians continually pouring in fresh troops, they were at last driven out with great slaughter. The king then ordered a retreat, which was conducted in good order, without being pursued; nevertheless, this bloody action cost him seven thousand men, together with a great number of cannon. The Austrians computed their own loss at five thousand.

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[1] Frederick's position was not good, and of this he was made fully aware. Two days before the battle, Marshal Keith said to him, "Si les Autrichiens nous laissent dans ce camp, ils méritent d'être pendus." The king, smiling at the observation, replied, "Il faut espérer que Daun aura plus peur de nous que de la corde." This anecdote is eminently characteristic. The king relied on the resources of his genius, and if light, which the ancient hero prayed for when beset by his enemies, had been vouchsafed to Frederick, Daun would never have gathered the bloody and bootless laurels of Hohenkirchen.

His Prussian majesty, having thus happily escaped such imminent danger, took every possible measure to prevent the enemy from gaining any considerable advantage from his defeat.[1] Perceiving that the only advantage which they wished to derive from it was to cover the operations of their armies in Silesia, and that he had now nothing to fear on the side of Saxony, he reinforced his own army from that of his brother Prince Henry, and hastened into Silesia to raise the siege of Neiss, which had been completely invested on the 4th of October. On the 24th of that month, therefore, he quitted his camp, and by a circuitous route, to avoid obstruction from the enemy, arrived in the plains of Gorlitz. A body of the Austrians had in vain attempted to secure this post before him, and some who arrived after him were defeated with the loss of eight hundred men. From this place the king pursued his march with the utmost diligence, but was followed by Laudon at the head of twenty-four thousand men, who constantly hung upon his rear, and harassed his army. The king, however, knowing the importance of his expedition, continued his march without interruption, and suffered his antagonist to obtain some trifling advantages without molestation. Daun, however, not content with the opposition given by Laudon, sent a large body of horse and foot by another route to reinforce Karsch and Deville, who had formed the siege of Neiss and the blockade of Cosel, whilst he himself passed the Elbe, and advanced towards Dresden.

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All these precautions, however, were of little avail. Generals Karsch and Deville, notwithstanding their reinforcement, no sooner heard of the king's approach than they raised the siege of both places, and retired, leaving behind them a considerable quantity of military stores. The object of the march being thus accomplished, the king instantly returned, and hastened to the relief of Saxony, the capital of which was in great danger from Marshal Daun. The place was but indifferently fortified, and garrisoned only by twelve thousand men; so that it could not hold out long against a numerous and well-appointed army. It was besides commanded by a large suburb, of which, if once the enemy got possession, all defence of the city would then be vain. For this reason Schmettau, the Prussian governor, determined to set these suburbs on fire, which was actually done on the 10th of November, to the incredible loss of the inhabitants, as in the suburbs were carried on most of those valuable manufactures which render the city of Dresden remarkable. This disappointed the designs of Daun; but, though the act was conformable to the laws of war, and had been executed with all the caution and humanity possible, yet the Austrians exclaimed against it, as a piece of the most unprovoked and barbarous cruelty recorded in history.

Saxony oppressed by the king of Prussia.

After the king of Prussia had approached Dresden, all the Austrian armies retired into Bohemia, where they took up their winter quarters, as did also the king of Prussia in Saxony. This unhappy country he said he would now consider as his own by right of conquest. But instead of treating the conquered people as his lawful subjects, he oppressed them in all possible ways, by levying the most severe and exorbitant contributions, surrounding the exchange with soldiers, and confining the merchants in narrow lodgings on straw beds, till they drew upon their correspondents for such sums as he wanted.

Operations in Bohemia.

As early as the 23d of February 1759 the Prussians commenced military operations. General Wobersow marched with a body of troops into Poland, where he destroyed several large magazines belonging to the Russians, and returned into Silesia, without any loss, on the 18th of April. In the mean time, by certain movements on the part of the king, the greater part of the Austrian troops had been drawn towards the frontiers of Silesia. Prince Henry immediately took advantage of this opening, and on the 15th of April entered Bohemia with his army divided into two columns. One, commanded by himself, marched towards Peterswalde; the other, under General Hulsen, passed by the towns of Pasberg and Kommotau. That commanded by Prince Henry himself penetrated as far as Loboschutz and Leitmeritz; the enemy flying everywhere before them, and burning or abandoning the vast magazines which they had amassed. The division under General Hulsen had more active employment. A strong pass at Pasberg was defended by a considerable body of Austrians. General Hulsen, having conducted his cavalry by another road, so as to fall directly upon their rear, attacked them in front with his infantry, drove them out of their intrenchments, and totally defeated them with the loss of a great number killed, and two thousand taken prisoners, whilst that of the Prussians did not exceed seventy in killed and wounded. After this exploit they returned into Saxony, with hostages for the contributions which they had freely exacted during the course of their expedition.

Prussians defeated at Zulichau.

Some other successes obtained by Prince Henry cleared Franconia of the enemy; but the approach of the Russians seemed once more to bring the affairs of the king of Prussia to a crisis. Notwithstanding the destruction of their magazines, they had continued to advance into Silesia, where they were opposed by Count Dohna; but as the troops he had under him were far inferior to the enemy, he found it impossible to do more, at least with any appearance of success, than to observe their motions and harass them on their march. This was so displeasing to the king, that he disgraced this general, and appointed Wedel to succeed him, with orders to attack the Russians at all events. To enable Wedel, however, to comply with his desperate order, he sent him some reinforcements, which increased his army to about thirty thousand men. With these, on the 23d of July 1759, Wedel attacked seventy thousand Russians posted in the most advantageous manner at Zulichau, and defended by a numerous artillery. Though the Prussians marched on to almost certain defeat, they sustained the attack for a long time with unparalleled resolution. At last, however, they gave way, and were obliged to retire with the loss of four thousand seven hundred killed or taken prisoners, and three thousand wounded.

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[1] When Frederick had retired to the camp of Doberschutz, he said to his generals, "Daun nous a laissé sortir de l'échiquier; la partie n'est pas perdue; nous nous reposerons ici, et nous marcherons ensuite en Silésie pour délivrer Neiss." This sally betrays a mind independent of and superior to events. A king who, situated as Frederick then was, preserves coolness enough to compare his operations to a party at chess, the field of desolation which he had just quitted to a chess-board, and his whole existence to the turn of a game, is capable of performing the greatest actions in war. It is such men that triumph over fortune. He had been surprised under circumstances most favourable to the assailant, all of whose movements were completely concealed till the last moment by a dense fog; the extremity of his line had been attacked, and almost at the same instant taken in reverse, by the main body of the Austrian army; yet, in spite of these fearful odds, he maintained the contest for hours with nearly balanced chances, and inflicted such a severe loss on the enemy as deprived him not only of the ability to pursue, but also of the fruits which he might have expected to reap from his victory.

Crossen and Francfort on the Oder taken.

The consequences of this victory were, that the Russians penetrated into the Prussian territories, and took possession of the towns of Crossen and Francfort on the Oder, which rendered it absolutely necessary for the king to go in person to oppose them. Accordingly, on the 4th of August he joined Wedel with a considerable body of forces, having left the greater part of his army in Saxony under Prince Henry. But as Marshal Daun had sent to the assistance of the Russians under Soltikof a body of twelve thousand horse and eight thousand foot under General Laudon, the king still found himself unable to fight them, since with this and some other reinforcements their army now amounted to upwards of ninety thousand men. He therefore recalled General Finck, whom he had sent into Saxony with nine thousand men; but with all his reinforcements he found it impossible to augment his army to little more than forty thousand men of all arms. His situation, however, was now so critical that a battle had become inevitable; and therefore, on the 12th of August, with this inferior force, the king attacked his enemies, strongly intrenched, and defended by a prodigious number of cannon.

Battle of Kunersdorf.

In this action his principal effort was directed against the left wing of the Russian army. He began the attack, according to custom, with a heavy cannonade; and having produced the desired effect, he then assailed the left wing with several battalions disposed in columns. The Russian intrenchments were forced with great slaughter, and seventy-two pieces of cannon were taken. But still there was a defile to be passed, and several redoubts which covered the village of Kunersdorf remained to be carried. These were attacked with the same resolution, and one after another taken. The enemy made another stand at the village, and endeavoured to preserve their ground there by pushing forward several battalions of horse and foot; but this also proved unsuccessful, and they were driven from post to post quite to the last redoubts. For upwards of six hours the Prussians were successful, and everywhere broke the enemy with prodigious slaughter; they drove them from almost all the positions they had occupied before the battle, took more than half their artillery, and scarcely anything seemed wanting to render the victory complete. In these circumstances, the king wrote the following billet to the queen: "Madam, we have beaten the Russians from their intrenchments. In two hours expect to hear of a glorious victory." But at this very instant victory abandoned the Prussian standards. The enemy, defeated in almost every quarter, found their left wing, shattered as it was, more entire than any other part of their line. Soltikof, the Russian general, immediately assembled the remains of his right wing, and collecting as many as he could from his centre, reinforced the left, and made a stand at a redoubt which had been erected on an advantageous eminence in a cemetery. All the king's generals are said to have been of opinion that he ought to allow the Russians to retain peaceable possession of this post. Their army had already suffered so much, that it would have been impossible for them to attempt any enterprise of consequence after the battle; besides, their artillery was still numerous, the post was very strong, and the Prussian troops were greatly fatigued. These reasons for a few moments weighed with the king; but the natural impetuosity of his temper getting the better of his reason, he led on his wearied troops to renew the combat.

Within the limits to which we are restricted, it is impossible to give any adequate military details of this terrible battle. Suffice it to state, that, wherever the storm of the conflict raged most fiercely, there was the king haranguing the troops, leading in person the battalions to the charge, and exposing himself with all the hardihood of the merest soldier of fortune. The carnage was truly horrible, the combatants mutually discharging showers of grape at the distance of fifty paces, and musketry even closer. The battle had already lasted six hours with inconceivable obstinacy; the Prussians were harassed, and scarcely in a condition to sustain themselves; whilst sixteen thousand men killed or wounded attested their courageous efforts, but deprived them of the means of maintaining the conflict. At this moment some Austrian squadrons charged the right flank of Finck's division; the king, in attempting to cover the retreat, received a contusion, and two battalions were taken behind him. The disorder now became dreadful, and the total destruction of the army was only prevented by that extraordinary presence of mind which had never for a moment failed him, even in the midst of this terrible conflict. Such was the memorable and sanguinary day of Kunersdorf, on which the Prussians lost half their number in killed and wounded, besides a hundred and sixty-five pieces of cannon, abandoned in the battle and the retreat. The loss of the enemy in killed and wounded amounted to sixteen thousand Russians, and three thousand Austrians. Soltikof, in writing to the empress an account of the battle, dryly observed, that "if he gained another such victory, he would himself be obliged to carry the tidings on foot, with a staff in his hand." The king, when he found the victory totally lost, is said to have sent another billet to the queen, expressed in the following manner: "Remove from Berlin with the royal family; let the archives be carried to Potsdam; the town may make conditions with the enemy."

Immediately after this defeat, the king set himself about repairing his losses with the utmost diligence; and in a few days everything was again put in order in his camp. He replaced his artillery from Berlin; recalled General Kleist with five thousand men from Pomerania; detached six thousand from his own army to the defence of Saxony; and with the remainder threw himself between the Russians and Great Glogau, covering that city, which had been the chief object of their designs. In a word, notwithstanding their victory, he obliged the Russians to return to Poland without accomplishing any thing besides the barren victory of Kunersdorff, purchased at so fearful an expenditure of human life.

Surrender of General Finck.

The misfortunes of the Prussian monarch, however, were not at an end. Prince Henry, indeed, by a most extraordinary and well-conducted march, entered Saxony, which had been totally overrun by the armies of the enemy; and strong detachments having been sent into that country under Generals Finck and Wunsch, the whole except Dresden was in a short time recovered. Towards this place Marshal Daun retired, and in all probability he would soon have been obliged to quit Saxony, had Frederick been content with attaining this object. But the king's impatience could not be satisfied without cutting off Daun's retreat, and forcing him to a battle; and for this purpose he sent General Finck, with upwards of twelve thousand men according to the Prussian account, but with twenty thousand according to that of the Austrians, to seize some passes through which alone Daun could make his way towards Bohemia. This commission was executed with the greatest exactness; but the Prussian general, having probably advanced too far into these defiles, and neglected to preserve his communications with the main army, gave the enemy an opportunity of surrounding him, and at last forcing him and his whole army to surrender prisoners of war. Nor was it long before this disaster was followed by another. General Durceke occupied a position on the right bank of the Elbe, opposite to Meissen; and on the approach of a large body of Austrians he prepared to retreat across the river, into a place where he hoped to be more secure; but having been obliged by a hard frost to withdraw the bridge of boats, a thaw supervened, and when the Prussians were attempting to lay a bridge of pontoons, their rear-guard was attacked with great fury by the Austrians, and the whole either killed or taken. The loss of the Prussians on this occasion was computed at nearly three thousand men.

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The year 1760 showed the Prussian monarch in a more dangerous situation than he had ever before stood. His affairs, indeed, seemed to be altogether desperate. His losses were not to be measured by the number of the killed or prisoners, but by armies destroyed or taken. Forty generals had died or been slain in his service since the beginning of October 1756, exclusive of those who were wounded or taken prisoners. This of itself would have been an irreparable loss, had not the very wars which destroyed these men furnished others equally capable of filling their places. But another deficiency, which could not be remedied, still remained. The king, by his indefatigable industry and exertions, had supplied all the deficiencies of men in his armies; but they were not the same men as before. The hardy veterans, with whom he had originally taken the field, were now no more, and their places were supplied by others who had neither the same experience nor the same discipline; so that he was obliged to supply the deficiency by his own genius and heroism.

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But whatever abilities the Prussian monarch might possess, and he undoubtedly exerted them to the utmost, it seemed only to be contending against fate. His enemies gained over him still greater and greater advantages. General Laudon, with whom none but the king himself seems to have been able to cope, by a series of artful movements drew Fouquet, one of the Prussian generals, who commanded a strong body of forces, into a disadvantageous situation near Landshut. Perceiving it impossible for the Prussians to escape, Laudon then attacked their intrenchments on the night of the 23d of June. The Prussians made a gallant defence, but at last were all either killed or taken prisoners, except about three hundred. Of the Prussians four thousand were killed, and seven thousand taken prisoners; fifty-eight pieces of cannon, and a great number of colours, were also lost. The victory, however, was dearly bought; for the Austrians lost in killed and wounded above twelve thousand men, whom, however, they could better spare than the Prussians, on account of their great superiority of numbers.

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Laudon failed not to improve this victory to the utmost. He instantly turned back from Landshut, and fell upon the city of Glatz, which he took in a very short time, with the garrison who defended it, consisting of two thousand men. In this place were found a hundred and one pieces of brass cannon, with immense quantities of provisions and military stores. From thence he marched against Breslau, and immediately invested it. But, in the mean while, the king of Prussia, whose motions had been all this time counteracted by Marshal Daun in Saxony, marched with his usual rapidity towards Silesia. By this means he drew Daun out of Saxony; and indeed the Austrian general used such expedition that he gained two days' march on the king. This was no sooner known to his Prussian majesty than he returned with the same expedition as he had advanced, and sat down before Dresden.

Dresden besieged without success by Frederick.

Daun soon received intelligence of the king's retrograde movement, and also returned. In the mean time, however, the buildings of the city were terribly shattered by the king's cannon and bombs, which continually played on it. But his endeavours to reduce it before the arrival of Daun proved ineffectual. The siege had been begun on the 13th of July, and on the 19th Daun appeared within a league of Dresden. The Prussians then redoubled their efforts. They had that day received reinforcements of heavy cannon and mortars, with which they battered the place incessantly. The cathedral church, several principal streets, some palaces, and the noble manufactory of porcelain, were entirely destroyed. The siege was continued till the 22d; but on the night of the 21st Daun had thrown sixteen battalions into the city, which rendered it impossible for the king to continue longer before it with any prospect of success. He therefore raised the siege, and retired without molestation, though there were three considerable armies of the enemy in the neighbourhood. Breslau was fiercely bombarded by Laudon; but the approach of Prince Henry obliged him to desist from his enterprise on the 5th of August.

The Austrian generals unite their forces against the king.

Meanwhile the fortune of the king seemed likely to be terminated by one fatal stroke. Finding it impossible for him to carry on a defensive war, he marched towards Silesia with such astonishing rapidity, that before the middle of August he had advanced two hundred miles, leaving Marshal Daun with his army far behind him. The object he had in view by using such expedition was to engage Laudon before he could have time to effect a junction with Daun, and Lascy, another Austrian general; a union which seemed to threaten him with unavoidable destruction. This, however, he found it impossible to prevent; and the three armies, when united, formed a tremendous line of encampments, extending no less than thirty English miles, at the same time that every one of their posts was strong, and the communication between them easy. The king was strongly encamped at Leignitz, and for several days employed all his military skill in attempting to induce one of the bodies to detach itself from the rest, or to attack them at some disadvantage; but without the least effect.

Battle of Leignitz.

At last the Austrian generals, having maturely weighed all circumstances, resolved to attack the king's camp itself, strong as it was; and Marshal Daun, remembering the advantage he had gained at Hohenkirchen by an attack in the night-time, resolved to follow a similar plan on the present occasion. The whole army, as soon as it became dark, were to march from their several stations to such positions as were marked out for each corps; they were to strike their tents, but still to keep up the fires in their camps, and to cause the drums to beat the tattoo as usual, by which means they hoped to surprise the enemy; and, even if they failed in this, they judged it impossible for him to escape them, should he be ever so much on his guard. The king, having completed his dispositions for the night, had seated himself and begun to doze near a bivouac fire, when Major Hund, who, with five squadrons of Zeithen's hussars, had been sent in reconnoissance as far as Polschildern, returned at full speed, calling out, "Where is the king? Where is the king?" Frederick having demanded what was the matter, the major said, with an animated air, "Sire, the enemy is *there*," pointing in the direction; "he has repulsed my videttes, and is not more than four hundred paces from this." The king having ordered this officer to retard as much as possible the advance of the Austrians, proceeded to issue orders, and make dispositions for defeating the design of the enemy. He indicated to General Schenkendorf, who commanded the brigade of the extreme left, an eminence situated near Binowitz, on which he was to form; he gave orders to the second line to prolong itself to the left, to prevent the enemy from attacking the army in flank; and he immediately brought to the front several regiments of cavalry, in order to gain the time necessary for the execution of all these dispositions.

General Schenkendorf marched immediately by the left flank, gained the hill, and there established a battery of ten twelve-pounders, at the moment when the Austrians were about to occupy the position. The latter, in fact, were so near, that the Prussians opened on them a heavy fire of grape, which caused great havock in the columns, while attempting to form, but unable to do so. As soon as the Prussian army was drawn up, Frederick divided it, leaving his right on the ground where it had been formed, to observe Marshal Daun, and to maintain their post; whilst with his left he turned in order to fall upon the corps under General Laudon. In the mean time, that commander, ignorant of the fate which was awaiting him, advanced with the utmost expedition towards the place which had been assigned him, in order to share in the glory of destroying the Prussian monarch; when, at three in the morning, on the 15th of August, a thick fog which covered the ground suddenly clearing up, discovered, like the opening of a mighty scene, the front of the Prussian army regularly drawn up in order of battle, and advantageously posted. Laudon, though surprised, made the best dispositions that circumstances would admit of, and an obstinate engagement ensued. After five successive attacks, executed by the Prussians, against as many different lines, he at length resolved to yield them the field of battle. It was not quite five in the morning when the battle was decided. It cost the Austrians more than ten thousand men, of whom six thousand were prisoners, and eighty-six pieces of cannon; but the loss of the Prussians did not exceed two thousand men, because all the advantages were clearly on their side.

The king did not venture to pursue Laudon, conceiving that he would require his victorious troops to support his right wing against Daun, and even Lascy. Conformably to his plan, and in order to attack by day-break the right of the camp at Leignitz, the marshal had in the evening of the 14th marched in six columns, intending to approach as far as the Katzbach. A detachment of partisans passed the river at eleven o'clock at night, to dislodge the Prussians from a village which they had occupied on the other bank, but which the enemy's troops were astonished to find they had abandoned. Daun was not apprised of this circumstance until two in the morning, when he gave orders that the army should immediately pass the Katzbach; but this operation, retarded by the darkness, the construction of bridges, and the false direction given to some of the columns, was not effected until five in the morning, when it was no longer time to support Laudon, who had already sustained a defeat. The marshal having learned the fate of his colleague, and observing the firm countenance maintained by the victorious Prussians, retired to his original position between Neudorf and Cosendau.

The victory of Leignitz, though complete, gave but a partial relief to the king of Prussia. The most essential service it did was the preventing the Russians from joining those enemies which he already had before him. Count Czernichef had been advancing with twenty-four thousand men, and had even passed the Oder; but he was so intimidated by the result of this battle, that he instantly repassed that river, even although Daun had sent him a strong body of troops in order to encourage him to advance. Soon after this battle, the king joined his brother Prince Henry, and marching against Daun, who had begun to form the blockade of Schweidnitz, fell upon a corps under General Beck, made two battalions of Croats prisoners, and dispersed the remainder, which obliged the enemy to abandon the enterprise they had just undertaken. About the same time, General Hulsen gained a considerable advantage over the imperial army in Saxony, with very trifling loss on his part; by which he effectually prevented them from cutting off his communications with Torgau.

By these successes the affairs of his Prussian majesty seemed to revive; but his enemies were still formidable and menacing. The recent manœuvres had drawn him so far into Silesia, that his communication with Brandenburg was almost wholly intercepted. The Russian army, which, after it had repassed the Order, began to quit Silesia, sent forward a powerful detachment under Count Czernichef towards the March of Brandenburg. A body of fifteen thousand Austrians, under the generals Lascy and Brentano, and the united body of Austrians and imperialists which acted in Saxony, began their march in concert with the Russians, and proposed to unite at the gates of Berlin. These armies amounted to forty thousand men. To oppose this formidable force, General Hulsen called to his assistance General Werner, who had been detached with a body of troops to Pomerania; but, after being joined by him, their united forces were found not to exceed fifteen or sixteen thousand men. To attempt a defence of the capital with this force would have been little short of madness. These commanders were therefore obliged to leave Berlin to its fate, which, indeed, considering the barbarity of the Russians and the animosity of the Austrians, seemed to be a dreadful one. However, by the powerful mediation of several foreign ministers, the town obtained terms which were not altogether intolerable; but the magazines, arsenals, and founderies were destroyed, and an immense quantity of military stores was seized, with a number of cannon and other arms. The city was first obliged to pay eight hundred thousand guilders, after which a contribution of one million nine hundred thousand crowns was imposed; yet, notwithstanding this, many acts of violence were committed, and the king's palace was plundered, the furniture being abused in a scandalous manner.

Berlin taken by the Austrians and Russians.

Extreme embarrassment of the king.

The combined armies remained only four days in Berlin. Dreading the vengeance of the king of Prussia, who was rapidly advancing, they deemed it prudent to make their stay as short as possible. But so great were the embarrassments which now beset that monarch, that it seemed almost beyond human power to retrieve his affairs. The imperialists, on their return from Berlin, having no army to oppose them, made themselves masters of Leipzig, Torgau, Meissen, and Wirtemberg, in which last city they found the grand magazine of the Prussian army. Stainville also, at the head of a detachment from the French army, laid both the city and duchy of Halberstadt under contribution. In Eastern Pomerania, the Russians had besieged Colberg both by land and by sea. In Western Pomerania, the Swedes advanced with the greatest celerity, hoping to share in the plunder of Berlin. In Silesia, the king no sooner began his march to the northward, than Laudon advanced, and laid siege to the important fortress of Cosel; and, to complete his distress and embarrassment, the king himself was attended at every step by Daun with a superior army, prepared to take every advantage.

In this situation the king, being joined by Hulsen and the Prince of Wirtemberg, with the corps under their command, advanced along the Elbe, whilst Daun fell back in order to cover Leipzig and Torgau; but the latter finding that the Prussians directed their march towards the Elbe, encamped within reach of Torgau, one part of his army extending to the Elbe, by which he was protected on one side, whilst on the other he was covered by hills and woods, thus occupying a most advantageous position. The Prussian army did not amount to fifty thousand men, whilst that of the Austrians exceeded eighty-six thousand; yet such were the unfortunate circumstances of the king, that he was obliged to fight under all these disadvantages. He therefore caused his army to be informed that he was now to lead them to a most desperate attempt, that his affairs required it, and that he was determined to conquer or die. His soldiers unanimously declared that they would die with him.

The 3d of November 1760 was the day upon which this important action was fought. The king divided his forces

Iarshal Daun de- eated at orgau.

into three columns. General Hulsen was directed to take post with one in a wood which lay on the left of the Austrian army, with instructions not to move until he found the rest of the Prussians engaged; General Zeithen was to charge with the right; and the grand attack in front was to be conducted by the king in person. His forces were disposed in such a manner that either his right or left wing could take the enemy in rear and reverse, so as to disable them from undertaking any thing against the part where he intended to direct his principal attack. On the other hand, Marshal Daun, perceiving that the king was serious in his design of fighting, in order to prevent confusion, sent all his baggage across the Elbe, on which he had established three bridges, in the event of a retreat being necessary. The Austrian army then changed front, and passed to the rear, its left being placed on the heights of Zinna, and its right amongst the vines in rear of Siptitz; the reserve was stationed near Groswig, the division of the grenadiers of the left wing at Weidenhain, and that of the grenadiers and carabineers of the right in rear of Neiden. Lascy retired from Schilda, on Loswig and Torgau; whilst Ried with the light troops took a position on the extreme right towards Mokrena. In this formidable position he was found, when, about two o'clock in the afternoon, the king began the attack. The latter was received by the fire of two hundred pieces of cannon, which were disposed along the Austrian front. The Prussians were thrice led to the attack; but every time they were repulsed and broken. The king at length commanded a fresh body of cavalry to advance, which at first compelled the Austrians to retire; but as fresh reinforcements continually poured in, this cavalry was in its turn obliged to fall back; and the Prussians maintained themselves with extreme difficulty, until General Zeithen, with the right wing, attacked the enemy in the rear, repulsed them, and took possession of some eminences which commanded the whole Austrian line. Encouraged by this success, the Prussian infantry once more advanced, carried several of the enemy's intrenchments, and made way for a new attack of the cavalry, which broke in with irresistible fury amongst the Austrians, and threw several bodies of them into irreparable disorder. It was now about nine o'clock, and consequently both armies were involved in darkness; yet the fire continued without intermission, and the battalions with a blind rage discharged at one another, without distinguishing friend from foe. Daun received a dangerous wound in the thigh, and was carried from the field, which probably hastened the defeat of his troops. The command then devolved on Count O'Donnell, who, finding the greater part of his troops in disorder, the night advancing, and the enemy possessed of some eminences which commanded his camp, and whence it was in vain to think of driving them, ordered a retreat, which was conducted in perfect order and dead silence; few were lost in passing the Elbe, and by far the greater part of their artillery was preserved. The loss of the Prussians was estimated at ten thousand in killed and wounded. That of the Austrians in killed and wounded is not known; but eight thousand were made prisoners, along with two hundred and sixteen officers, amongst whom were four generals.

Sax- y except esden overed.

The result of the victory gained at Torgau was, that the king recovered all Saxony except Dresden; whilst General Werner having in the mean time marched into Pomerania, the Russians raised the siege of Colberg, and retired into Poland, without having effected any thing further than wasting the open country. Werner then marched to the assistance of Western Pomerania, where he defeated a body of Swedes, and at last drove them out of the country. Laudon too abruptly raised the blockade of Cosel; and afterwards, abandoning Landshut, he retired into Austrian Silesia, leaving the Prussian portion free from molestation. Daun placed one part of his army in Dresden, and the other in some strong positions which lie to the south and west of the city, by which he commanded the Elbe, and preserved his communications with Bohemia. The army of the empire retired into Franconia, and established its head-quarters at Bamberg.

Though these successes had apparently retrieved in some measure the affairs of the king, yet his strength was in reality nearly exhausted; and in the campaign of 1761 he made no such vigorous efforts as he had formerly done. The Russians, dividing themselves into two bodies, invaded Silesia and Pomerania. In the former country they laid siege to Breslau, and in the latter to Colberg. Tottleben, who had commanded the Russian armies, was now removed on a suspicion of having corresponded with the king of Prussia, and General Romanzof appointed in his stead; a measure which, it was expected, would render the Russian operations this year more vigorous and consistent than they had ever yet been.

Schweidnitz and Colberg retaken.

The king continued strongly encamped near Schweidnitz, where he was so closely watched by Daun and Laudon that he could not attempt anything. However, he defeated the designs of the Russians against Breslau, by sending General Platen to destroy their magazines; which the latter accomplished with great success, at the same time cutting off a body of four thousand of their troops. But this only brought the more certain destruction upon Colberg, against which the body of the Russian army immediately marched, cruelly wasting the country as they advanced. The king of Prussia was unable to do any thing but send small detachments, which, although they could not oppose their enemies in the field, yet, he hoped, by cutting off their convoys, might distress them to such a degree as to oblige them to abandon the siege, or at least protract it till the severity of the winter should render it impossible for them to carry on their operations. He thus weakened his own army so much, that it was found requisite to draw out of Schweidnitz four thousand men to reinforce it; and no sooner had this been done, than Laudon suddenly attacked and took that fortress by a coup-de-main. Colberg made a brave defence; but the troops sent to its relief being totally unable to cope with the Russian army, consisting of fifty thousand men, it was, on the 3d of December, obliged to surrender; and thus the fate of the Prussian monarch, almost every part of whose dominions lay open to the invaders, seemed to be decided.

Peace between Russia, Sweden, and Prussia.

In the midst of these gloomy appearances, the empress of Russia, the king's most inveterate and inflexible enemy, died on the 2d of January 1762. She was succeeded by Peter III. who, instead of being the king's enemy, was his most sanguine friend. As early as the 23d of February, in a memorial delivered to the ministers of the allied courts, he declared that, "in order to the establishment of peace, he was ready to sacrifice all the conquests made in this war by the arms of Russia, in hopes that the allied courts will on their parts equally prefer the restoration of peace and tranquillity, to the advantages which they might expect from the continuance of the war, but which they cannot obtain but by a continuance of the effusion of human blood." This address was not much relished by the allies. They were very willing to make peace, provided it should prove for their own interest to do so; but they recommended to his attention fidelity to treaties, which constitutes no less valuable a part of the royal character than humanity and disinterestedness. This answer made no impression upon the Czar. A suspension of hostilities took place on the 16th of March, which was followed by a treaty of alliance on the 5th of May. In this treaty the Czar stipulated nothing in favour of his former confederates; on the contrary, he agreed to join his troops to those of the king of Prussia, in order to act against them. Sweden, which had for a long time acted under the direction of Russian councils, now followed the example of her mistress, and on the 22d of May concluded a peace with Prussia.

Successes of the king of Prussia.

It is not to be supposed that the king of Prussia would remain long inactive after such an unexpected turn of fortune in his favour. His arms were now everywhere attended with success. Prince Henry drove the imperialists from some important positions in Saxony, by which he secured all that part which the Prussians had possessed; and though the Austrians frequently attempted to recover the ground thus lost, they were constantly repulsed with great slaughter. The king was not joined by his new allies till towards the end of June; after which he drove Daun before him to the extremity of Silesia, leaving the town of Schweidnitz entirely uncovered, and which the king immediately prepared to invest. In the mean time, different detachments of Prussians, some on the side of Saxony, and others on that of Silesia, penetrated into Bohemia, laid many parts of the country under contribution, and spread universal alarm. A considerable body of Russian irregulars also made an irruption into Bohemia, where they practised on the Austrians the same cruelties which they had long been accustomed to exercise on the Prussians.

A new revolution in Russia.

But whilst the king was thus making the best use of his time, he was all at once threatened with a fatal reverse of fortune by a new revolution in Russia. The emperor was deposed, and his deposition was soon afterwards followed by his death. The empress, who succeeded him, suspected that her husband had been misled by the councils of his Prussian majesty, against whom, therefore, she entertained a mortal enmity. In the very beginning of her reign, however, she could not again undertake a war of so much importance as that which had just been concluded. She therefore declared her intention of observing the peace concluded by the late emperor; but she nevertheless resolved to recall her armies from Silesia, Prussia, and Pomerania, which indeed the unsettled state of the kingdom rendered in some degree necessary. At the same time a discovery was made regarding the king of Prussia himself, which turned the scale greatly in his favour. The Russian senate, flaming with resentment against this monarch, as well as against their late unfortunate sovereign, and the empress, full of suspicion that the conduct of the latter might have been influenced by the councils of the former, searched eagerly amongst the papers of the late emperor for an elucidation of this point. Many letters from the Prussian monarch were indeed found, but these were conceived in a strain absolutely different from what had been expected. The king had, as far as prudence would permit, kept a reserve and distance with regard to the rash advances of this unhappy ally; and, in particular, had counselled him to undertake nothing against the empress his consort. The reading of these letters is said to have produced such an effect upon the empress, that she burst into tears, and expressed her gratitude in the warmest terms towards the Prussian monarch. Still, however, the Russian army was ordered to separate from the Prussians; but all the important places which the former had taken during the war were faithfully restored.

Total defeat of Laudon.

The king, finding that the Russians were no more to take an active part in his favour, resolved to profit by their appearance in his camp; and, therefore, the day after the order for their return had arrived, he attacked the Austrian army, drove their right wing from all its positions, and entirely cut off their communication with Schweidnitz, so that nothing could be attempted for its relief. Prince Henry kept them in continual alarms for Bohemia; whilst a great share of their attention, and no small portion of their forces, were engaged on that side. Marshal Daun, now finding himself rendered almost incapable of undertaking any thing, detached Laudon, with a force greatly superior, to attack the Prince of Bevern, and drive him from the advantageous position which he occupied. But the prince defended himself with such resolution, that all the efforts of Laudon were baffled before the king could come to the aid of his lieutenant. The Austrians, being then placed between two fires, were routed and pursued with terrible slaughter; after which the king met with no further interruption in his preparation for the siege, and the trenches were opened on the 18th of July. Marshal Daun did not even attempt to relieve the place; but the garrison being very strong, it held out for nearly two months from the date of the opening of the trenches. It is said that the attack was directed, and the defence conducted, by two engineers who had written on the subject of the attack and defence of fortified places; and they were now practically engaged in proving the superiority of their systems. At last, however, the garrison, to the number of eight thousand men, surrendered prisoners of war; and the whole of this body, except nine, were soon after drowned at the mouth of the Oder, on their passage to their intended confinement in Königsberg.

Austrians defeated at Freyberg. Peace.

The king of Prussia, having thus become master of Schweidnitz, turned his attention towards Saxony, where he reinforced his brother's army, and made preparations for laying siege to Dresden. In this country the Austrians had lately met with some success, and driven back Prince Henry as far as Freyberg; but on the 29th of October they were attacked by the Prussian army thus reinforced, and totally discomfited. After various tactical combinations, of no great importance, a simultaneous attack made by three Prussian divisions, in which they were ably supported by the cavalry, decided the fortune of the day. The loss of the imperial army amounted to four thousand prisoners, and about three thousand men *hors de combat;* that of the Prussians did not exceed fifteen hundred men of all arms, and they signalized their gallant achievement by the capture of twenty-eight pieces of cannon and nine standards. This affair does them the more honour that they had in the field only twenty-nine battalions and sixty squadrons, or scarcely eighteen thousand men, whilst the enemy had forty-nine battalions and sixty-eight squadrons, or more than twenty-six thousand men. The victory of Freyberg proved decisive. The empress-queen, finding herself deserted by all her allies, was glad to conclude a treaty, upon the principle of mutual restitution and oblivion; and thus, at the end of a bloody war, both parties were content to adopt the *status quo ante*, and sit down in the same situation in which they respectively stood before a sword had been drawn. This treaty has been called the peace of Hubertsburg.

The war was no sooner terminated than the king of Prussia turned his attention to domestic policy, and the recovery of his dominions from those innumerable calamities which had befallen them during the contest. He immediately distributed lands to his disbanded soldiers, and gave them the horses of his artillery to assist them in their cultivation. By his wise and prudent management, the horrors of war were soon forgotten; and the country ere long became as flourishing as ever. But notwithstanding this pacific disposition, the king never slackened his endeavours for the defence of his states, but kept on foot a respectable army, which might be able to act with promptitude on any emergency.

A new war commenced, but soon terminated.

In the year 1778, a new difference arose with the house of Austria, concerning the duchy of Bavaria. But though great warlike preparations were made upon both sides, and immense armies brought into the field, nothing of consequence was effected. Any little advantage obtained seems to have been on the side of the Prussians, who made themselves masters of several towns, and carried on the war in the enemy's country. However, the emperor acted with so much caution, and showed so much skill in defensive tactics, that all the manœuvres of his Prussian majesty could gain no material advantage; whilst, on the other hand, Frederick was too wise to venture an engagement. A peace therefore was soon concluded; and since that time the history of Prussia, during the remainder of this great king's reign, affords no remarkable event which has not been mentioned in other parts of the present work. (See particularly the article POLAND.)

Character of Frederick.

A few general remarks, however, may not be deemed altogether out of place in concluding this imperfect sketch of the military career of Frederick. He was undoubtedly a great captain, and to him belongs the high merit of having demonstrated how much success in war depends upon scientific combinations, executed with corresponding celerity and precision. But still he is not entitled to rank with the greatest masters of the art; and, compared with Napoleon, he was as much surpassed by the latter in all the higher attributes of a great commander as he excelled the captains of his own time. He was opposed to generals far inferior to those with whom Napoleon had for the most part to contend; and his tactics were frequently arranged upon the knowledge he possessed of their respective characters, rather than in conformity to the established principles of the art. Nor did he possess the invaluable secret, which Napoleon first revealed to the world in his Italian campaigns, of promptly following up his successes, and gathering in the fruits of victory, before the enemy could have time to recover from the shock of defeat. This, which is the last and highest endowment of a great general, was reserved for his immortal successor, whose campaigns afford ample and instructive examples of all that is most finished, not only in grand military combinations, but also in the still more difficult and important art of deriving from them every result which they seemed calculated to afford. Upon every occasion, however, the personal character and conduct of Frederick in the field stamped him the hero of the age in which he lived, and cannot but be viewed with admiration by every succeeding one. His presence of mind was almost supernatural; nothing could shake, nothing could for a moment disturb, the cool and steady composure with which he regarded the most frightful scenes of war. Amidst the perils of surprise at Hohenkirchen, when the fog rendered the enemy perceptible only by the murderous fire they were pouring amongst his battalions; as well as when destruction and ruin stared him in the face at Kunersdorf, where the men lay dead or dying around him in sections, and the carnage appalled even his most veteran officers; he remained as collected and steady as at a review at Potsdam, cheering and animating the troops by his voice and example, rallying them when broken or driven back, and leading them back to the charge with a standard in his hand. In a word, he was greater in defeat than in victory; and it is as much, perhaps, to his personal conduct in the field, as to his superior tactics and the natural bravery of his troops, that his principal successes are to be ascribed.

But Frederick was not continually engaged in war. He enjoyed many intervals of tranquillity, many years of profound repose. Nor did he waste these in the unworthy indulgence of luxurious ease or sensual gratification. On the contrary, every moment of his time was spent in promoting the interests and the welfare of his subjects. He occupied himself in adopting measures for promoting the advancement of agriculture and manufactures, commerce, literature, and the arts; he founded academies and seminaries of learning; he invited learned men from every country in Europe to settle in his dominions; he cleared waste lands, constructed canals, rebuilt and repaired the cities that had been dilapidated by the enemy, rewarded men of merit in every department of enterprise; in a word, he spared no labour or expense in promoting the internal improvement of his kingdom. One of his chief objects was a reform in the courts of justice, and this he effected, as far at least as regards the delay and expense of legal proceedings, the great evils that obstruct or rather defeat the administration of justice. Nor can it be doubted that the *Code Frederick*, published in 1746, and afterwards adopted throughout the Prussian dominions, if regarded as the result of one reign and the wisdom of one individual, is entitled to the hearty applause and commendation of every legal reformer. But unfortunately the soldier was uppermost in everything. The learned men whom he invited from other countries were treated by him rather as a regiment of soldiers than a body of philosophers; and even in matters of taste and literature he sought to introduce a sort of military regulation. The army was naturally enough his favourite object of attention, and in seeking to improve it he carried discipline amongst the troops to a degree of severity unknown in Europe until his time, and which subsequent experience has rendered it necessary to relax, or at least to simplify greatly in its more oppressive details. Nor, amidst all his avocations, did he lay aside his early attachment to letters and to study. To this pursuit he, in times of peace, devoted a portion of every day; and he is the author of various works which the influence of his high rank and famè was not necessary to introduce to the notice of the world.[1] The foulest stain on his memory consists in first suggesting, and then participating in, the dismemberment of Poland. Frederick planned the robbery, the Russian monarch executed it, and then the leagued plunderers divided the spoil between them.

Frederick William II.

Frederick died in 1786, at the age of seventy-five, and was succeeded by his nephew Frederick William II. This prince, on his accession, found the most effectual securities for the preservation of his dominions; the finest army in the world, a people enthusiastically loyal, and a treasury replenished with seven millions sterling. Nor with these advantages was the new king wanting to himself. The predilection of Frederick for the French language and French literature was not grateful to his subjects. The new sovereign began his reign with declaring in council, "Germans we are, and Germans I mean we shall continue;" at the same time giving directions that their native language should resume its natural rank and station, from which for nearly half a century it had been degraded by the French. This was a very popular measure, and it was followed by another still more so. Observing that he had marked with great concern the progress of impiety and profaneness on the one hand, and that of blind enthusiasm on the other, he declared that he would not have his subjects corrupted either by fanatics or atheists, and strictly prohibited all publications tending to excite a contempt for or indifference about religion.

The stadtholder assisted against the states of Holland.

On his accession to the throne, this pacific conduct upon the part of the new king endeared him to his subjects, and commanded the approbation of all good men. And an opportunity soon occurred in which he was thought to have displayed talents in negotiation and military arrangements, which rendered him in every respect a worthy successor of his uncle. The states of Holland, which had long been jealous of the power of the stadtholder, and inclined to a republican government without any permanent chief, had gained such an ascendency in the states-general, that in 1786 and 1787 they in effect divested the Prince of Orange of all his prerogatives. They proceeded even to the seizure and imprisonment of the princess, sister of the king of Prussia; and, depending upon support from France, they treated with insolence every power connected with them in Europe. The court of Berlin did not witness these proceedings without indignation; and the king formed a plan for restoring the power of the stadtholder, with such secrecy and prudence, that perhaps nothing could surpass it, except, indeed, the facility with which it was carried into execution. In the short space of one month, the Duke of Brunswick led eighteen thousand Prussians to Amsterdam, and restored the ancient prerogatives of the Prince of Orange.

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[1] The principal works of Frederick the Great are, 1. Memoirs of the House of Brandenburg; 2. Memoirs of his own Time, from the year 1740 to the Peace of Dresden; and 3. a History of the Seven Years' War. His poem on the Art of War, at first published separately, was afterwards reprinted with other poems and epistles in a volume entitled Miscellaneous Works of the Philosopher of Sans Souci.

Frederick William III.

The affairs of Prussia during the early period of the French revolution, and especially the active but unsuccessful part which that monarch took against it, are interwoven with the historical details of that period given in the articles BRITAIN and FRANCE, to which the reader is therefore referred. Taking a just view of the true interests of Prussia, he availed himself of the first favourable opportunity to withdraw from the contest with republican France, in which the honour of his arms had suffered abasement; and he died in the year 1797, when his son, Frederick William III., ascended the throne of Prussia.

Perfidious policy of the Prussian cabinet.

During the early part of this reign, nothing occurred deserving of commemoration. Besides the most sedulous attention to the discipline of the army, which it was his object to maintain in a state of perfect efficiency, the king occupied himself in promoting the internal improvement of his states; and in this judicious course of policy he persevered until the year 1806, when his own rapacity and perfidy involved him in a war with France, which terminated in the almost total extinction of his kingdom. Seeing the power of the French arms rapidly increasing, and admonished by the stunning blow which the Austrians had received at Austerlitz, he formed an alliance with Napoleon, and even shared in the distribution of the spoil by invading Hanover, which he annexed to his dominions, whilst he shut the northern ports of his kingdom against the British flag. The result of this base proceeding may easily be anticipated. The British minister immediately quitted Berlin, and this was soon followed by a declaration of war on the part of his Britannic majesty. His situation now became embarrassing and critical in the highest degree. Some time before the battle of Austerlitz, Napoleon had ascertained, by an intercepted correspondence, that the king of Prussia had been deeply implicated in the counsels of his enemies, and that he fully intended, in the event of the emperor sustaining a reverse in that campaign, to fall upon the rear of the French army, and complete its destruction. But the unparalleled victory of Austerlitz, which at one blow humbled Austria and staggered Russia, rendered his position one of great difficulty and danger. His treachery had been detected by a man who duly appreciated both its character and extent; and henceforward his Prussian majesty found himself treated by Napoleon as little better than a vassal prince, whose rights he disregarded, and whom he intended to punish whenever he should have accomplished the more important enterprise of thoroughly humbling Austria. The eyes of the king were further opened to the precarious nature of his situation by the confederation of the Rhine, which was now instituted, and afforded to France a secure basis of operations in any attack which Napoleon might think proper to direct against Prussia. Had the latter taken a decided part against France before the battle of Austerlitz, the independence of Europe might have been preserved. But after this auspicious moment had been allowed to pass unimproved, every chance of success was lost; and the disasters which followed were no more than might have been foreseen by any person of ordinary observation and sagacity.

Campaign of 1806. Its results.

In crises of imminent peril, weak minds generally choose the part which most certainly and directly leads to destruction. Early in October 1806, Prussia declared war against France, and in less than a month thereafter the monarchy had ceased to exist. Napoleon, having foreseen this step on the part of the enemy, was fully prepared to meet it. By a most rapid and skilful march on the Saale, he threw himself upon the communications of the Prussian army under the Duke of Brunswick; and this decisive movement, one of the most masterly in the whole history of war, led to the simultaneous battles of Iena and Auerstadt, in which the Prussians lost twenty thousand men, including some twenty generals, and the commander-in-chief, who was mortally wounded. This double conflict took place on the 14th of October, a memorable day in the annals of the Prussian monarchy; and with the rapidity of lightning Napoleon followed up the blow. The Prussians having lost their communications, were obliged to retire on diverging lines, which rendered mutual support impossible, and their destruction more certain. They were pursued with incredible vivacity. Erfurt, Magdeburg, and Stettin were reduced; and on the 27th of the same month, being only thirteen days after the battle, Napoleon entered the capital at the head of his victorious legions. In the mean time, the king of Prussia retired, first to Custrin, and afterwards to Königsberg. The Russians had by this time come to his aid, and on the 26th of December another dreadful battle took place at Pultusk, where the allied armies were totally defeated. The French afterwards invaded Silesia; took Stralsund, Colberg, and Dantzig; and carried with them victory and conquest in every direction. And to such a state of distress was Frederick William at length reduced, that, with all his dominions except East Prussia in the hands of the enemy, the British envoy, Lord Hutchinson, on his arrival at Memel in March 1807, found it necessary to advance eighty thousand pounds for the support of his family and domestic household;[1] and this having been intimated to the British ministers, his majesty recommended it to parliament to enable him to fulfil the agreement entered into by our ambassador.

Campaign of 1807. Peace of Tilsitt.

The campaign of 1807 was in all respects glorious for the French arms. The mighty battle of Friedland proved a conquest rather than a victory. By it the Russians were completely defeated and humbled; whilst the king of Prussia, as the consummation of his misfortunes, had the mortification to find himself at the mercy of the conqueror, to be disposed of as the latter might think fit. The Russians having retired beyond the Niemen, conferences took place at Tilsitt, and were eventually followed by a treaty of peace, which left Frederick William little more than a nominal sovereignty. By this disastrous arrangement the Prussian monarch, who had formerly ceded to France the duchies of Cleves and Berg, renounced the whole of his dominions situated between the Rhine and the Elbe, part of Lusatia, the city of Dantzig, all the provinces which formerly constituted part of Poland, and further agreed to shut his ports against the trade and navigation of Great Britain; in a word, he gave up about ten thousand square miles of territory, containing a population of about five millions of souls, and had the additional humiliation of being forced to assist in carrying out the continental system of Napoleon. Nor was this the utmost extent of his abasement. He had to support the armies of France stationed in his territories, to pay immense contributions to the French emperor, and not only to promulgate, but enforce, in his provinces, every decree issued in Holland against the commerce of this country. Frederick William, thus humbled and reduced, endeavoured to submit with patience to his fate, and to alleviate the sufferings of his subjects by effecting great reductions in his civil and military establishments.

Peace.

This peace, which, as Napoleon fulfilled none of his engagements, could only be regarded as nominal, continued nevertheless for six years, during which time all the calamities attendant on foreign occupation by an exasperated conqueror were accumulated on this kingdom. Hence the ardour with which the Prussians ran to arms in 1813, their courage under the reverses at the outset of the campaign, and their perseverance in its prosecution. They had been excited and prepared to take arms, whenever the favourable moment for doing so should arrive, by means of secret associations formed for the purpose, and more especially by the agency of the *Tugenbund*, or Bond of Peace, whose ramifications extended to every town and village in the kingdom. Nor was Frederick, notwithstanding the thraldom under which he laboured, inattentive to the discipline and improvement of his army, in which the military spirit had nearly sunk under accumulated reverses. At one time the number of his troops was but small, scarcely exceeding 20,000 men; yet, by successive enlistments, and continually drilling levy after levy, so as not apparently to augment his force, whilst he was in reality training to arms all the youth of the kingdom, he could bring into the field, at the critical moment, more than 200,000 regularly-instructed soldiers. The French had indeed deprived the kingdom of arms, which they carried off from the arsenals; but this loss was promptly supplied by the assistance of Great Britain and other powers.

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[1] By this time peace had been re-established between Great Britain and Prussia.

ampaigns f 1812, 813, 1814, nd 1815.

Meanwhile, the disastrous termination of the Russian campaign proved the signal for the desertion of Napoleon, first by Prussia, and afterwards by Austria. It was now felt that his star had passed the culminating point, and already begun to wane. General d'Yorck took the earliest opportunity to withdraw with the Prussian contingent; a declaration of war followed; and Europe prepared to rise in arms against the military despotism of Napoleon. In the campaigns of 1813 and 1814, the Prussian army, led by Blucher, Bulow, and other able officers, distinguished itself in all the great battles, at Lutzen, Juterboch, Leipzig, in the recovery of Silesia, and also in the plains of Champagne, where, though several times defeated with great loss by the masterly combinations of Napoleon, it displayed a noble perseverance, and fought with all the spirit of a truly national army. Hostilities were for a short time suspended by the negotiations which took place at Châtillon; but Napoleon having, from confidence in his own genius, refused the terms offered, the allies decided to advance against the heart of his power, and at Montmartre, where the Prussians again distinguished themselves, the struggle ended, and was soon followed by the treaty of Paris. The abdication of Napoleon was followed by his retirement to the island of Elba, which had been assigned as the place of his exile. But early the following year he returned to France, and by a march from Fréjus to Paris expelled the Bourbons, at the same time reseating himself on the imperial throne. This extraordinary conquest, which is perhaps without a parallel in history, produced the campaign of 1815, in which the Prussians, it must be confessed, added nothing to their laurels. On the 16th of June, their army was not only defeated at Ligny, but so completely broken up, that out of more than 90,000 men of which it consisted on the morning of the battle, not 30,000 ever afterwards re-assembled. Yet this remnant having, by the united talents and energy of Blucher and Bulow, eluded the corps of Grouchy at Wavre, and appeared on the field of battle at Waterloo on the evening of the 18th, materially contributed to render the victory there achieved by the British arms decisive of the fate of Napoleon, France, and Europe.

ongress of ienna.

The immediate consequence of this mighty achievement was the settlement of the different nations of Europe according to the views of the conquerors, and in the circumstances in which they have ever since continued. The congress of Vienna had the delicate and difficult task of assigning acquisitions and boundaries to the various powers which had been engaged in the struggle; and some strange dislocations naturally resulted from this attempt to effect a general settlement at the close of a war which had been productive of so great vicissitudes of fortune. To Prussia were secured generally the restitution of the provinces formerly wrested from her, excepting part of Poland, destined to be united with the duchy of Warsaw, and ample indemnification for this partial sacrifice, in Saxony and the Lower Rhine, by the addition of such territories as were deemed consistent with the stability and security of the balance of power in Europe. The acquisitions which Prussia thus made, through the grace and favour of the congress of Vienna, were, from France, the Lower Rhine, and part of Juliers, Cleves, and Berg; from Westphalia, Munster, and the remaining part of Juliers, Cleves, and Berg; and from Saxony, Thuringia, Upper and Lower Lusatia, and Menneberg; large indemnities, it must be confessed, for parting with a portion of territory originally acquired by robbery and spoliation. In this year also, Prussia, partly by exchange, and partly by purchase, obtained from Denmark that part of Western which is commonly called Swedish Pomerania, together with the island of Rugen. And thus, after experiencing violent shocks and vicissitudes, by which the kingdom had been broken in pieces, and little more than the name of the monarchy saved from the wreck, we behold Prussia, after a series of unparalleled changes in another direction, again raised from the condition of a second-rate power, and taking her station amongst the first sovereign states of Europe, as formidable as in the days of Frederick the Great, and with a territory and population far exceeding any thing he could boast of.

Effects of the settlement of 1815.

In fact, the settlement of 1815 invested Prussia with a degree of power which she had never possessed before, and we need not wonder that it should have exercised a marked influence on the general character and conduct of her government. In the agony of the struggle against Napoleon, when a sudden freak of fortune, or some bold stroke of his trancendent genius, might have disconcerted all the schemes formed for his overthrow, everything was promised to the people, and amongst the rest representative institutions. But, according to the morality of kings, "vows made in pain are violent and void," and hence impose no obligations on royal consciences. So, at least, it happened in the case of Prussia, which, so far from redeeming its pledge, has strenuously resisted every attempt made to urge its fulfilment on the government, which, if not essentially hostile to political liberty, might, from the general character of the people, have safely granted them the boon that they so much desire. But the fact that such hostility exists on the part of the government, is proved by the whole tenor and spirit of its policy, external as well as internal. To say nothing of the circumstance, that its closest political ties are with governments purely despotic, particularly with Russia, no sooner did the demand for representative institutions become general in Europe, and Spain, Naples, and Piedmont, successively extort constitutions, than his majesty Frederick William III. joined the Holy Alliance, and entered with eagerness into all the views by which that confederacy was distinguished. Having repression for its object, it was prepared to crush liberty, wherever it ventured to raise its ensign; to arrest the progress of political improvement, and to employ military force to punish all who were afflicted with any undue zeal in favour of a cause which freemen are accustomed to consider as sacred. In time, however, the Holy Alliance, with all its apparent power, yielded to the influence of events, and gradually vanished as completely as if it had never existed and domineered over the Continent. But the spirit still survives, at least in the Prussian government, which, with all its ostentatious pretensions to a species of liberality, and with the merit of having introduced some wise measures and useful improvements, nevertheless carries despotism to a height which in this or in any other free country would be intolerable. This, we think, is very evident from the conduct which the Prussian cabinet has pursued in the formation of the German Commercial League, a measure of decided hostility against the interests of this country.

Prussian Commercial League.

The extent to which this confederacy has already (1839) been carried, will astound those who have not been closely observant of the policy of Prussia during the last twenty years. The Commercial League of Germany comprises the vast territory included between the river Niemen and the Baltic at one extremity, and the Alps and the Lake of Constance at the other. On the east it is bounded by Russia, Poland, and Austria, and on the west by Belgium, Holland, and France. It consists of the union of four kingdoms, one electorate, three grand dukedoms, and more than twenty smaller states, the whole comprising 8654 German square miles, and 27,728,000 inhabitants, a population surpassing by several millions that of Great Britain and Ireland, and nearly double that of Spain. The dominions of the Commercial League comprehend the residences of twenty-six sovereign princes, several of whom, however limited in domains, exhibit a splendour approaching to that of the greatest empires. The army consists of 246,168 soldiers in time of peace, and in the event of war may be augmented to 550,000. The amount of the annual taxes paid by the population of those provinces is nearly L.17,000,000 sterling, by far the greatest part of which is derived from the custom-house duties and the excise.

Prussia created this league for the purpose of advancing her political projects, the nature of which was manifested by her sovereign as early as the Congress of Vienna. The enthusiastic efforts of the Prussian people having materially contributed to the overthrow of the common enemy, their king founded on their merit in this respect a pretension to unite under his dominion the greater part of Germany. The whole kingdom of Saxony, all the country between the Weser and the Elbe, the territory which formerly belonged to the Orange family, and that which had formed the electorate of Mayence, were all claimed by the Prussian monarch, as a reward for the sacrifices that had been made by his people. Austria resisted, however, and her resistance proved successful. Prussia was obliged to content herself with certain parcels of the principalities she coveted, and which assorted ill with the rest of her dominions. The kingdom of Prussia is, in fact, composed of incongruous and dislocated pieces. Her Saxon and Westphalian provinces are separated from each other by the territories of Hanover and Cassel, and the rest are interlaced by a number of small principalities, which offer serious obstacles to the unity and efficiency of an administrative system. Accordingly, the desire of finding an opportunity to annihilate these principalities, and unite their territories with the Prussian dominions, induced the court of Berlin to employ unscrupulous means, and resort to dangerous expedients, in order to accomplish its object.

These and other analogous intrigues, however, never interrupted the principal aim of Prussia, which seems to have been that of becoming arbiter of Germany; and it must be confessed that she has made a grand step in advance towards the attainment of that object, by imposing upon the whole German nation her commercial laws and institutions. The grand duke of Hesse-Darmstadt was the first German prince who consented to enter into a commercial league with Prussia. This was in the year 1825; and since that period Prussia has steadily pursued her great scheme of a commercial union, with a degree of success which has probably outrun her most sanguine expectations.

The acquisition of Hesse-Darmstadt served the Prussian government as a means of transit to the southern provinces of Germany. There existed already a commercial alliance between Bavaria and Wurtemberg, founded on just and equal terms, and highly advantageous to both countries. Prussia, having succeeded with the electorate, now endeavoured to prevail on both of these states to enter into the league; but for a time all her efforts were baffled by the talents of the Bavarian minister, Count Armansperg. The conferences, however, were carried on during several years; and at length, in the year 1828, a commercial contract was agreed to on both sides. This contract, however, did not stipulate the establishment of a commercial union, though it facilitated the intercourse between the southern and northern parts of Germany, by fair and moderate duties. But Prussia never for an instant lost sight of her grand object; and having effected the removal of Count Armansperg from the Bavarian ministry, her conditions were at length accepted by both states, and the southern league, consisting of Bavaria and Wurtemberg, entered into a complete commercial union with the northern league, composed of Prussia and Hesse. The contract was concluded in the beginning of 1832; and although the ruling power of Prussia was not so explicitly acknowledged in the articles of the new contract as it had been in that with Hesse, yet it was Prussia that dictated the laws of the union in all essential points, and became the arbiter in all questions of difficulty.

Bavaria and Wurtemberg being thus gained, it became an easy task to prevail upon the remaining principalities. The kingdom of Saxony was the only one from which resistance was anticipated. But the commercial union, being principally calculated for obtaining an open market in Southern Germany, Saxony, which abounds in manufactured products, profited by the opportunity to share in the advantages which Prussia had prepared for herself; whilst the example of the royal government was immediately followed by the smaller Saxon countries, and by all those numerous states which are neither wealthy nor extensive enough to maintain an independent commerce, and a system of internal industry. The free city of Frankfort, however, was found much less tractable. Proud of its republican constitution, and powerful by its wealth, it for a time maintained its independence; but the struggle was too unequal to continue long between a powerful confederacy and a small isolated state. By a mixture of intrigue and violence, akin to that which had been exercised against the Polish commonwealth of Cracow, the senate was at last obliged to yield, and consent to the union; at the same time declaring, that its resolution was taken, not from any conviction of its being beneficial to the republic of Frankfort, but in consequence of its federative dependence, and the greatly superior strength of its antagonist.

After the acquisition of Frankfort, the territory included in the league seemed to be sufficiently compact; but it nevertheless wanted two additional states to render it complete (*teres atque rotundus*), namely, the duchy of Baden in the south, and the territories of Hanover, Brunswick, and Oldenburg, in the north. Both were equally important for the full attainment of the objects contemplated by Prussia in securing the command of the right bank of the Rhine, and also in furthering the schemes of Russia respecting the navigation of the Baltic, and the exclusion of the British mercantile navy from that sea.

In the case of Baden, resistance, though strenuously offered, proved as unsuccessful as in that of the free town of Frankfort, and of the smaller states generally. The grand duchy was forced to enter the Prussian union; and Baden is now an integral member of the league, notwithstanding the hatred of the people against everything bearing the name of Prussia, or originating from that country. With respect to Hanover and the northern principalities of Germany, however, their position rendered it impossible for the Prussian cabinet to proceed against them in a similar way. Hanover, Brunswick, and Oldenburg were united with Hesse-

Cassel in a separate league, and thus remained independent of Prussian influence. Unable to surmount the difficulties opposed to her schemes by the circumstance of the connection of Hanover with England, Prussia now endeavoured to separate that kingdom from its commercial allies; and succeeded as far as concerned the electorate of Hesse-Cassel, which, openly violating the compact it had formed with its allies, withdrew from them, and joined the Prussian union. This was one point gained; whilst the accession of King Ernest to the throne of Hanover has excited hopes, we fear not altogether groundless, of drawing him into the confederacy.

At the same time it is but right to observe, that whatever may have been the original views of Prussia in the formation of the union, the immediate results deserve the acknowledgments of all Germany. Internal trade has received a new impulse; the custom-house lines, which formerly separated the German states from each other, have been abolished; and a great stimulus has been given to manufacturing industry. From Aix-la-Chapelle on the confines of the Netherlands, to Tilsitt on the borders of Russia, and from Stettin and Dantzig on the north to Switzerland and Bohemia on the south, there is nothing to interrupt the freedom of commerce: a commodity having once passed the frontier of the league, may be conveyed without hindrance throughout its whole extent. But this internal trade is governed and directed by a protector and ruler, namely, Prussia; and it has for its main object to extend throughout Germany a monopoly of Prussian manufactures, to the exclusion of all foreign competition. The same power also profits by this union for obtaining a predominant influence in the political affairs of Germany, and even endeavours to exercise this influence at the expense of the independence of the smaller German states, and of those constitutional rights which some of them have employed to the greatest advantage in improving their internal condition. Freedom in trade and commerce throughout the united German states is not alone sufficient. This is no doubt excellent in itself, inasmuch as it is regarded by the inhabitants of Germany as a patriotic institution, which strengthens the national union of their father-land, and improves the social condition of its people. But it would have been more consistent with sound commercial policy, and productive of greater advantage to the majority of the German states, if such an union had been constructed on the double basis of internal freedom, and the maintenance of an amicable intercourse with foreign countries, instead of excluding the commerce and manufactures of the latter from the German markets. As matters stand, however, the system of exclusion introduced by, and essentially connected with, the commercial league, has no other object than the establishment of a Prussian monopoly in Germany, which it consequently deprives of all the benefit that might be obtained under a more liberal and enlightened commercial policy.[1] It must, however, be admitted, that Prussia is not without good grounds of complaint against Britain, on account of her commercial policy towards the German states. Prussia has only three great staple articles of export, namely, corn, timber, and wool. In ordinary years we exclude the first of these from our markets; and on Prussian timber we levy a duty of fifty-five shillings a load, and admit American timber on payment of a duty of ten shillings; whilst the government of Prussia has always expressed its willingness to place its intercourse with foreign states on the basis of reciprocity.

The Rhenish provinces.

The Prussian government does not appear to understand thoroughly the important maxim, *pas trop gouverner;* at least, in its conduct towards the Rhenish provinces, it has exhibited a busy, vexatious, intermeddling spirit, productive of no good whatever to itself, and the occasion of much discontent amongst the people. This tendency to interfere with details which are beyond the natural competency of any government, or which, at all events, it would be wiser to let alone, has displayed itself not only in accidental and isolated acts, but in legislative enactments and solemn transactions. The concessions which the French government had made in favour of the industry of the Rhenish provinces whilst they formed part of the French empire, were cancelled by a royal ordinance dated the 17th of September 1817; and this proceeding, avowedly intended to advance the prosperity of the eastern provinces at the expense of those on the Rhine, has since been followed by a series of others, all calculated, not only to keep alive, but to embitter the irritation which it first excited in the minds of the people. Nor has even the religion of these provinces, though ostensibly acknowledged and protected by the state, escaped the interference of the government, which, in attempting to regulate everything, has involved itself in great difficulties, and gone far to alienate the affections of the people. This is exemplified in the affair of the Archbishop of Cologne, which, after forming for several years a principal subject of its diplomacy, has at length terminated, as far as that prelate is concerned, in his forcible expulsion from his diocese, and the virtual abrogation of all ecclesiastical authority in the archiepiscopal province over which he presided.[2]

STATISTICS.

The kingdom of Prussia is situated in the northern part of Germany. It is bounded on the north by the Baltic Sea and a small portion of the duchy of Mecklenburg; on the east by Russia, and its dependent kingdom, Poland; on the south-east by Austria; on the south by the kingdom of Saxony and the Saxon duchies; on the south-west by Bavaria and part of France; and on the west by France and the kingdom of the Netherlands. In describing these boundaries, it is, however, necessary to remark, that some parts of the kingdom are small detached portions entirely insulated by the dominions of other powers, such as Neufchatel in Switzerland, Suhl in Saxony, and Rahnis in Saxe-Weimar. The whole boundary by land is in length 735 Prussian miles, equal to 3439 English miles. There is no communication between the eastern and western provinces of Prussia without passing through the dominions of other princes. Hanover, on the north, is interposed between its eastern and western provinces; and in the southern parts of it the territories of the sovereigns of Brunswick, Waldeck, Hesse-Cassel, Hesse-Darmstadt, Nassau, Saxe-Weimar, and Saxe-Gotha, intercept the direct communication.

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[1] See an article on this subject in the Foreign Quarterly Review, No. xliv. p. 306, *et seq.*

[2] We had intended to give a pretty full narrative of this extraordinary occurrence; but considering that, in one sense at least, the affair is not ended, the Prussian government having again opened negotiations with the Court of Rome, we deem it the wisest course to abstain altogether from attempting to give an exposition of a transaction which is still incomplete. It is sufficient to say, that the Prussian government seems to feel its situation to be anything but a comfortable one; and, if a judgment may be formed from the notes addressed to the Cardinal Secretary, Lambruschini, by its envoy, Bunsen, since the expulsion of Baron Droste from the archiepiscopal see of Cologne by military force, it would gladly retrace its steps, and fall back from the aggressive position it has assumed, if it could do so without humiliation and disgrace. By the last accounts, however, the sovereign pontiff, Gregory XVI., had refused to listen to any compromise. "Restore the archbishop to liberty, replace him in the full exercise of his ecclesiastical functions, and then I will hear you," said Gregory, "but not till then."

Statistics.

The great division of Prussia is into those provinces which are in Germany, and form a part of the Germanic confederation, and into those states which have no connection with that alliance.

	Extent in British Statute Acres.	Population in 1834.	Children at School.	Proportion of Children at School to the Population.	Capitals.
				One out of	
German Provinces.					
Brandenburg	11,025,280	1,651,320	280,658	5·88	Berlin.
Pomerania	8,331,520	941,193	150,404	6·26	Stettin.
Silesia	10,598,400	2,547,579	446,061	5·71	Breslau.
Saxony	6,663,040	1,490,583	291,811	5·11	Magdeburg.
Westphalia	5,534,720	1,292,566	225,954	5·72	Munster.
Provinces of the Rhine	6,365,120	2,392,743	370,764	6·45	Coblentz.
Russian Provinces out of Germany.					
East and West Prussia	17,178,240	2,073,378	336,757	6·16	Dantzig.
Posen	7,919,360	1,120,668	132,950	8·43	Posen.
	73,615,680	13,510,030	2,235,359	6·04	

Of the children at school, 1,159,434 were males, and 1,075,925 females.

The duchy of Neufchatel is not included in the above statement, because its situation and constitutional laws differ materially from the rest of the Prussian dominions. In 1831 it contained a population of 54,080. In the same year there was an average population per square mile,

In the province of Prussia, of.........1689 inhabitants.
Posen, of............1951 ...
Brandenburg, of....2103 ...
Pomerania, of......1567 ...
Silesia, of...........3269 ...
Saxony, of.........3100 ...
Westphalia, of.....3380 ...
Provinces of the Rhine.....4633 ...

Consequently in the whole kingdom there were on an average 2576 inhabitants to every square mile.

The population has increased very rapidly within the last twenty years. In 1819 there were, in 937 towns, 2,730,487 inhabitants. In 1831 the same towns contained 3,229,473, the increase being more than 18 per cent. The increase in the towns in the province of Brandenburg was about 23 per cent., in the province of Pomerania nearly 22 per cent., whilst in the province of Prussia it was only about 13 per cent. The population of the whole kingdom from the year 1819 to the year 1831 increased from 11,084,993 to 13,510,030, or about 21$\frac{3}{4}$ths per cent.

In 1829 there were in the whole kingdom, of marriages, 108,881; of births, 495,382; and of deaths, 388,255. During the fifteen years from 1820 to 1834 inclusively, there was an yearly average of births, males 260,436, females 245,765; of deaths, males 187,650, females 176,164.

The inhabitants of Prussia are of different races. The most numerous body are of German origin, divided by language and customs into the High and Low Germans. These, except in the province of Posen, form everywhere the great majority. The Low German or *Platt Deutsche* language is generally spoken in the countries between the Rhine and the Elbe, on the north side of the Hartz Mountains, and prevails along the Baltic through part of Bandenburg and Pomerania. In Silesia, in the southern part of Saxony, in the trans-Rhenish provinces, and in East Prussia, dialects, or rather differing idioms, of the High German, are spoken, but all far removed from the pure language of Saxony, or, as it is called, *Der Meissnichen Dialect.* The Walloons, in the vicinity of the Forest of Ardennes, and the colonists descended from French refugees at the time of the revocation of the edict of Nantes, are now much mixed with the German inhabitants; but many of them have confused the two languages, and speak a kind of German-French *patois.* Amongst the higher classes in every part of the kingdom the pure High German language is spoken, generally with the peculiar idiom and pronunciation of Berlin; and that language is universally used in books, in the churches, in the courts of law, and in the more important transactions of commerce.

There are about 10,400,000 Germans, Sclavonians, Poles, Lithuanians, &c. Those of Sclavonian origin amount to nearly two millions, and retain their original language. The greater part of these are usually denominated Poles, and are the inhabitants of parts of Posen, West Prussia, and Silesia. About 50,000 people in Lithuania have a peculiar language of their own. The *Wenden* or Vandals have also a different language from all the other subjects of Prussia. They are between two and three hundred thousand in number, and are settled, a few in the province of Brandenburg, and the remainder in the province of Pomerania, and the districts of Leignitz and Kassubon in East Prussia. The Jews, according to the census of 1828, amounted to nearly 170,000 individuals; they are to be met with in every part of the Prussian territory, but principally in the province of Posen.

The established religion of Prussia is the Protestant, now denominated the Evangelical Confession, comprehending Lutherans, Calvinists, Hernhutters or Moravians, and Hussites. The professors of it amounted in 1828 to 7,738,664 individuals. They were formerly divided into two sects, the Lutheran and Reformed, but are now united into one, and form a large majority in the circles of Königsberg, Gumbinnen, Dantzig, Berlin, Potsdam, Frankfort, Stettin, Koslin, Stralsund, Breslau, Reichenbach, Leignitz, Magdeburg, Merseburg, Erfurt, and Minden. At the same period the Roman Catholics amounted to 4,816,813, and formed the majority in the districts of Marienwarden, Bromberg, Posen, Oppeln, Munster, Arensberg, Cologne, Duseldorf, Cleves, Coblentz, Nachen, and Treves. The United Brethren, or Hernhutters, may be reckoned at between 10,000 and 12,000 souls. The Mennonites, a species of Anabaptists, amounted to 15,655; and the Jews, as before stated, to about 170,000. The proportion of each religious denomination was in 1825 calculated in the following manner: Supposing the whole population of the Prussian kingdom to be unity, the various religious divisions are, Evangelical Christians, 0·6067; Roman Catholics, 0·3795; Mennonites, 0·0013; Jews, 0·0125; or, in other words, in every 10,000 inhabitants there are 6067 Protestants, 3795 Romanists, 13 Mennonites, 125 Jews. These different sects are all equal in the eye of the law, have the same protection for their worship, and are all alike eligible to every civil, judicial, and military office.[1]

The different classes of inhabitants in Prussia may be divided into nobles, landed proprietors, burgesses, with more or less extensive privileges, and peasants. At the head of these the nobles are of two kinds practically, though not legally. The high nobility are the princes, who were formerly petty sovereigns on their own estates, but whose independence has merged in the general government; they amount to about fifty families. The lower nobility, consisting of about two hundred thousand individuals, have preferable claims to certain offices in the army, the state, and the church; but their privileges have been gradually contracting, and they are now in almost every point only equal to the burghers or citizens. Some of the Prussian nobles are the descendants of the Teutonic knights, who renounced their monastic vows; but other noble families came at a later period from the north of Germany. The Prussian aristocracy is not a wealthy order; their estates are of little value; it is supposed that the greatest income derived from the land of any one noble does not exceed L.2500. The higher ranks of nobility, the princes, dukes, counts, earls, viscounts, and some of the ancient barons, are not subjected to military duty by conscription, and pay no personal taxes. The higher clergy, namely, the bishops, abbots, provosts, &c. have all these prerogatives, and the same rank as the nobility. The burgesses are a numerous and respectable class of inhabitants, but they differ according to their origin and the size of their towns; the descendants of the German colonists being more enlightened than those sprung from the Poles and the Wendes. Traces of the ancient freedom enjoyed by the Hanseatic towns may still be observed in Memel, Königsberg, Elbing, Dantzig, and Thorn. The burgesses of Dantzig are peculiarly distinguished for their general intelligence, and their active and industrious habits. The power of the guilds in the cities has been gradually diminished, and they are now scarcely obstacles, as they were formerly here, and still are in other parts of Germany, to the exercise of industry and ingenuity in any profession which individuals may select for themselves. The largest class is composed of the *baueren* or peasants. They were formerly slaves, and were usually sold, as in Russia, with the estates to which they were attached; but their lot has been progressively ameliorated, and during the reign of the present king the last vestiges of this barbarism have been totally abolished. The final extinction of personal slavery was not decreed till September 1811; and, from the military events which speedily succeeded, it was not practically destroyed till several years afterwards. At present the peasantry, who amount to two thirds of the whole population, are a species of copyholders, with customary quitrents and herriots to the landowners; but they may purchase land and become themselves proprietors, a benefit only recently conferred upon them, and which those who are industrious and economical very eagerly avail themselves of. The condition of the peasantry varies considerably throughout the different provinces of which the Prussian monarchy is composed. In some they are slothful, ignorant, and superstitious, whilst in others the efforts of the Prussian administration to improve their moral and intellectual condition have been attended with success. The peasants on the werders, and the inhabitants of the new colonies, are the wealthiest and most intelligent of the peasantry. Their houses are not destitute of elegance, and their children are well educated. The other extremity of the country is inhabited by Lithuanian peasants, the descendants of the ancient Pruczi; they retain their native dialect, and are still ignorant and slothful. The coarse cloth with which they are clad is manufactured by themselves; and all of them wear a sort of scarf, or, as it is called, a *margin*, which appears to be the same as the plaid of the Scottish Highlanders. The boots and the hats of the women are nowise different from those of the men. "The German millers form almost a distinct caste; the happy inhabitants of a romantic country, possessing numerous flocks, abundantly provided with fish, poultry, and game, they make up the class between the peasantry and the nobles, and neither associate with the one nor the other, all of them intermarrying amongst themselves." (Malte-Brun.)

Soil and climate.

In so extensive a territory as Prussia, there will necessarily be great inequalities in soil, productions, and climate. The greater part of the country is a sandy soil, generally very level, and often covered with heaths. The woods of it are nearly one fourth of the whole surface, and only certain portions near the rivers, or in particular situations, can be considered as fertile, or even grateful soils. Many barren sandy plains are to be found, which are deemed to be more expensive to bring into cultivation than could be repaid by their productions. This is especially the case in the Churmark, in Lower Lusatia, and in some of the Westphalian provinces, where large spaces are occupied by heaths, such as the heaths of Minden, which extend over ten thousand acres, those of Lippstadt, of twenty thousand, and the still larger ones of Senner and Fuhling. In East Prussia there are several very extensive morasses, which require draining to render them productive. In the fruitful district of Magdeburg, the bog of the Dromling covers more than a hundred thousand acres. A part of it indeed is in the Hanoverian and a part of it in the Brunswick territory, which prevents the necessary drains from being executed, which would make it one of the most valuable tracts of land in that part of Germany.

The most fruitful corn-land in the kingdom of Prussia is the vicinity of Tilsitt, and some other districts of East Prussia, and the greater part of the duchy of Posen. That province forms physically a part of Poland; the same plains, the same kind of sand intermixed with clay and black loam, the same fertility in corn, and the same sort of forests, may be observed in the two countries. But many large marshes covered with weeds and brushwood are still undrained in the province, particularly along the winding course of the Obra. In West Prussia, the district of the Netz, the country around Marienburg, and that near Dantzig and Elbing, are excellent corn countries. That part of Silesia which is on the east of the Oder forms a very large plain, slightly undulated by hills, and differs in no respect from the plains in Poland. But in the western districts the land is more unequal, and that portion of Silesia is bounded by high mountainous chains. This province also contains several large and humid meadows and marshes. The land in Brandenburg is low, and in general sandy. Its inclination is so inconsiderable, that a great many marshes and small lakes are formed by the inundations of rivers. In this province only some districts, such as the mark of Prignitz, and the Ukermark, are celebrated for the quantity and quality of their grain; but the country abounds in forests of fir, pine, oak, beech, and ash. In Pomerania the soil is almost entirely formed by accessions from the sea, and alluvial deposits from rivers and streams. A great part of the country is covered with forests and extensive heaths, and it is only the banks of the rivers and of the lakes that can be advantageously cultivated. The soil is very favourable for all kinds of grain in the duchies of Saxony and Magdeburg, in Thuringia, and in the principalities of Halberstadt and Quedlinburg. These divisions, in favourable seasons, may be considered as the real granaries from which the less fertile parts of Prussia draw their supplies of corn.

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[1] According to an act passed in 1817, the Protestant clergy in each province are regulated by a synod composed of all the superintendents, headed by a president. They meet once or twice a year in a General Assembly, and consult on the internal affairs of the churches belonging to the province. They also superintend all schools, and take especial cognizance of the religious instruction given in them. Their decisions are sent to the minister of the interior, furnished with the approval of the consistory of the province. The Roman Catholics are divided into two archbishoprics, the one of which comprehends the eastern, the other the western provinces, nine dioceses, and about 3200 parishes. Gnesen is the metropolitan see of the eastern, Cologne that of the western districts. No archbishop or bishop can be elected without the sanction of the king. The annual stipend of the archbishops is about L.1720 sterling, that of the bishops about L.1150 sterling, besides perquisites. Public pilgrimages out of the country are entirely prohibited, and none allowed within the state which extend to more than one day's journey. It is worthy of notice, that in Silesia the number of Roman Catholics has diminished, and still continues to diminish. Like the Society of Friends, the Mennonites are opposed to the use of offensive arms. They are, therefore, by the act of 1815, exempted from military service; but, to counterbalance this privilege, they are obliged to contribute a sum amounting to about L.720 a year towards the support of the military academy at Culm. The Jews are acknowledged as Prussian subjects, and enjoy the same rights and privileges with the Christians. They can fill any post or office, and can hold real estates of all kinds, and follow all lawful callings. They are of course obliged in return to contribute to the support of the state, and are subjected to military service by conscription. They are, however, not admitted as teachers in the public academies and universities, owing to some impediments which arise in the discharge of these functions. Apostacy from Christianity to Judaism is not tolerated.

The western parts of the Prussian dominions are far less productive than the eastern. A few only of the Westphalian provinces are highly fruitful. The districts most eminent for fertility are the vicinity of Minden and of Paderborn, the borders of the Soester, and the circles of the Lieg and the Wupper. In the Rhenish provinces, the neighbourhood of Juliers, Bonn, Cologne, Coblentz, Kreusnach, Bacharach, and the banks of the Meuse, are tolerably fertile. The principality of Neufchatel is very mountainous. Six or seven valleys, some of which, such as those of Rutz and Travers, afford rich pasture, make up the greater part of the land.

The climate varies considerably in the different districts. It may generally be described as temperate and healthy, though, from the great variety of situations, there are many exceptions. On the borders of the Baltic the winters are severely cold, and the weather changeable, raw, and foggy. The greatest degree of cold in the last century was from the 21st to the 25th January 1795, when Reaumur's thermometer was at 24° below zero. The greatest heat of that century was in the following summer, when the same thermometer was at 36° above zero. The middle provinces of Posen, Brandenburg, Silesia, Saxony, and the whole western parts of the monarchy, possess a more mild and less variable climate, but very different in the several localities. The atmosphere of Brandenburg, though mild, is humid, and subject to frequent variations in temperature; and is, besides, often exposed to violent storms from the south and the east. On the sandy plains of that province the heat is in the summer very oppressive, and the air, from the abundance of stagnant water, frequently unhealthy, whilst in the vicinity of the Hartz the cool mountain breezes are enjoyed. Silesia suffers great disadvantages from snowy winters and rainy autumns. The air is in many parts salubrious, but the southern districts, from the thick forests, and the elevation of the soil, are exposed to long and severe winters. The climate is milder in the northern part of the country; but the lakes and marshes infect the air in several places, and render it unwholesome. The banks of the Rhine and Moselle are covered with verdure before the inhabitants of Riesengebirge, and of the Lithuanian heaths, have laid aside the fur pelisses of the winter.

Rivers.

Few of the countries of Europe have been more favoured by nature than Prussia with streams that contribute to fertility and intercourse; and the labour of the inhabitants has been advantageously directed to several public works, which have facilitated the communication between the different rivers. As the slope of the whole Prussian dominions is towards the west and north, all the rivers that rise in or pass through them empty themselves either into the Baltic Sea or the German Ocean. The streams that merge in the first of these are the Niemen, which rises in Lithuania, and becomes navigable at Schmaleninken; about ten miles below Tilsitt it divides into two branches, which, through the maritime lake of Curisch-Haf, empty themselves into the sea. The German name of the Niemen is derived from the town of Memel, which is built at the outlet of the same lake. During its short course through the Prussian territory, the Niemen receives on its right side the waters of the Schesschappe, and on its left those of the navigable river Jura. The river of the hills, the ancient Prussian Prigolla, the modern Pregel, is composed of the united streams of the Pisa, Ranet, Russe, Augerap, and Inster; after it assumes its name it receives the Deimenear, Tappiau, and the Alle near Wehlau. It becomes navigable near Gottenburg, and, passing Königsberg, discharges its streams by the Frisch-Haf into the Baltic. The Vistula, the Polish Wisla, or the German Weichsel, rises in the Austrian part of Silesia. It passes through Poland, where at Cracow it becomes navigable. On its entrance into the Russian territories it divides into two branches, the eastern of which takes the name of the Nogat, and joins the Baltic near Elbing; the western is again subdivided into two arms, one of which is lost in the Frisch-Haf, and the other reaches the sea near Dantzig. Its course after entering Prussia is about 140 miles, and during its progress it is augmented by the streams of the Ossa, the Brahe, and the Mottlau. Geographers have been led to suppose, and not without probability, that the Vistula is not so deep as it once was; it is certain that it may be forded in the vicinity of Thorn. The Oder, which in the German dialect of Pomerania is called the *Ader*, and of which the ancient Wendo-Slavonic name is the Wiadro, a word that signifies a *pitcher*, has its source in the mountains of Moravia, in the ancient circle of Olmutz; but the Elsa, which rises from the base of the Carpathians, is in reality the principal source. It becomes navigable near Ratibor soon after entering the province of Silesia, and, after passing through Brandenburg and Pomerania, divides into two branches, and enters the great estuaries which communicate with the Baltic Sea through the three mouths of Peene, Swine, and Divenou. Its course in the Prussian states is 370 miles; the general rate of its current is languid, forming in many places large fens and turbid lakes; and it is prevented from overflowing by embankments. It receives near Oderberg the waters of the Oppa, near Breslau those of the Ohlau, near Grosglogau those of the Bartsch, near Neuzelle those of the Neisse, and at Custrin those of the Wartha. This last is the most valuable of all the secondary rivers of Prussia, because it affords the means of a communication between the Oder and the Vistula. The rivers of Prussia which empty themselves into the German Ocean are, the Elbe, which rises in the Riesengebirge, or Giant's Mountains, and is known at its source by the Slavonic name of the *Labbe*. It receives from the south of Bohemia the Moldawa or the Bohemian Oritza, which, as it is deeper and broader than the Elbe, ought perhaps to be considered as the principal river. It is navigable at Muhlberg, where it enters Bohemia. It receives the Elster near Wittenberg, the Muldau near Dessau, the Saale near Saalhorn, and the Havel near Werben; soon after which, in its passage to the ocean, it quits the Prussian dominions. The Weser enters but a small portion of the territory of the Prussian kingdom, though it forms the boundary on the eastern side of the Westphalian provinces, from Holtzminden to Carlshafen. The only part where both its banks are in Prussia is near Minden, where it has forced its way through the range of mountains, and formed the celebrated passage well known to the ancients as the Porta Westphalica. The Rhine enters the lately acquired provinces of Prussia at Bingen, a little below Mentz, and quits them at Kerkerdom, above Nimeguen. From Bingen to the country above Coblentz it is confined by mountains, and small islands and headlands are formed by the rocks. It receives within the Prussian territories the streams of the Nahe; the Lahn, that is concealed under mountains; the Moselle, which, free from shallows and every incumbrance, resembles in its meandering course a canal fashioned by the hand of man; the Ahr, the Erft, the Ruhr, and the Lippe. The Ems, though it rises in the province of Westphalia, is a small stream, not navigable till it enters the kingdom of Hanover.

Canals. Most of the rivers of Prussia are so advantageously connected with each other by means of navigable canals, that an uninterrupted communication is maintained by them from Halle and Magdeburg to Elbing, and the surrounding districts have the benefit of those facilities for exchanging their various productions. The Fredericksgraben Canal, in East Prussia, is formed to avoid the dangerous navigation of the Curisch-Haf, in the intercourse between Tilsitt and Memel. The Bromberg Canal joins the Netze and the Brahe, and by their means the Oder and the Vistula. It is the most expensive of all the Prussian canals, having within eighteen miles ten locks. The commerce on it furnishes freight to about 600 barges annually, each of thirty tons burden, besides smaller boats. The Finnow Canal, which unites the Oder and the Havel, is about twenty miles long, and has on it about 4000 small, and from 1600 to 1700 large boats. The new Oder Canal shortens the navigation of that river, and serves also for the purpose of draining the meadows through which it passes. The Plauen Canal connects the Havel with the Elbe, and is the channel of intercourse between Berlin and Hamburg. The Friedrich-Wilhelm, or Mullros Canal, unites the Oder and the Spree. Besides these, there are others of less importance, as the Storkow, the Werbellin, the Klodnitz, the Saxon, and the Munster Canals, all of which are of local benefit; and the Rhine Canal, begun in 1809.

Lakes. The lakes of Prussia, especially in the eastern portions of the kingdom, are numerous and extensive. On the coast of the Baltic the two fresh-water lakes, denominated the Curisch-Haf and Frisch-Haf, may be considered as the most remarkable phenomena in the physical geography of Prussia. The former, which received its name from the ancient Cures or Coures, who inhabited its banks, is sixty-six miles in length, and varies from fifteen to thirty in breadth. It is divided from the sea by a narrow stripe of land. The sand-banks and shallows on this lake are so numerous that it is only navigable for boats, and they, too, are exposed to frequent hurricanes. The Frisch-Haf, or fresh-water lake, is about sixty miles in length, and from six to fifteen miles in breadth. It is separated by a chain of sand-banks from the Baltic Sea, with which it communicates by a strait called the Gatt. The Stettin-Haf is of nearly the same extent. Besides the lakes on the shore, those in the interior of the country are stated to exceed 1000, many of them from ten to twenty miles in length. In East Prussia are 300, in West Prussia 160, and in the province of Brandenburg 680. Many parts of these lakes have been contracted by embankments, and the soil which they covered gradually appropriated to agricultural purposes. At present they supply vast quantities of fish, the right to take which is in many instances farmed at very high rates.

gricul- ure. The cultivation of the soil is the employment of three fourths of the inhabitants of the Prussian dominions. The wants and the industry of the inhabitants, aided by a rigid parsimony, directed and stimulated by a paternal though absolute government, have changed, in the course of the last century, the most sterile and unproductive kingdom of Europe into a territory which more than supplies the demands of its own inhabitants, and leaves a surplus quantity of corn in most years for exportation to other countries. In the three provinces which communicate with the Baltic Sea, viz. East Prussia, West Prussia, and Pomerania, it is calculated that four fifths of the inhabitants subsist wholly by producing food. In these provinces, in the sense of the term as it is used in our country, *farmer* is still almost unknown. Almost every proprietor, whether a large or a small one, cultivates his own land; and all the operations of agriculture are performed in a slovenly and indolent manner. The general course of cultivation is to fallow every third year, by ploughing three times if intended for rye, and five times if for wheat, the land being allowed to rest the whole of the year from one autumn to another. The extent of land sown with wheat does not amount to one tenth of that on which rye is grown. After the wheat or rye is harvested, oats or barley are sown in the succeeding spring. This rotation completes the course, which is again succeeded by a whole year's fallow, so that the land only bears corn two years out of every three, and the soil is so poor that the last crop is considered as a good one if it yields three times the seed. The implements of husbandry correspond with the state of agriculture and the nature of the soil. They are almost wholly formed of wood, and are constructed in a very rude and clumsy manner.

In the province of Brandenburg the soil is unproductive, but the husbandmen are industrious; and since the encouragement given to agriculture by Frederick the Great, uncultivated lands have been covered with harvests, thick forests have been changed into rich meadows, many unwholesome marshes have been drained, and, in consequence, the land throughout the province has risen in value. The crops in Silesia are inadequate for the numerous population, and a quantity of grain is imported into the province from Poland and Austria.

The principal grains of Prussia are wheat, rye, barley, and oats. The quantity of rye far exceeds that of every other kind of corn; it forms the principal aliment of the inhabitants, amongst whom wheat is seldom eaten in bread. Pease, both white and gray, are extensively raised, and especially that description of them known in England by the name of "Prussian blues." Beans of all varieties are cultivated in the soils on the borders of the rivers, which are suitable to their growth. Buckwheat is much sown in some places, and forms an important part of the sustenance of the labouring classes. An article for food is collected in Prussia, especially in Brandenburg, from the seeds of the grass called *festuca fluitans*. It is manufactured into a substance called *manna grits*, and is far more agreeable to the taste, though employed for the same purposes, than oat-meal with us. The cultivation of potatoes has for many years past been gradually extending, and is become so great as to supply almost the sole aliment of a very great proportion of the labouring population.

Table of the Average Prices of the four principal sorts of Grain in the different Provinces of Prussia in the year 1836.

	Wheat.		Rye.		Barley.		Oats.	
	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
Rhenish Provinces............	26	8	20	2	16	7	11	8
Westphalia......................	24	9	19	1	15	8	10	11
Prussian Saxony...............	23	6	17	4	14	6	11	0
Brandenburg and Pomerania	23	0	16	1	13	1	10	3
Silesia	21	0	12	0	10	5	7	5
Posen.............................	21	1	12	2	11	2	8	5
East and West Prussia.......	20	11	12	6	10	3	7	1
The whole kingdom...........	23	0	15	7	13	1	9	6

The most productive branch of rural economy next to corn is that of breeding and fattening cattle. The practices in this branch are, however, of a very imperfect kind; and though the different races, especially of cows, are to be found in Prussia, yet so little attention has been paid, by crossing them, to obtain the most perfect animals, that they are almost all very indifferent. The proportion which the number of cattle of every description bears to the land is much too small. It appears, from an official account published in 1819, that the stock of cattle in the maritime provinces of Prussia at the end of that year was as follows:—asses and colts, 556,839; oxen, cows, and calves, 1,171,434; sheep and lambs, 2,049,801; swine, 617,310.

According to the lowest estimate relative to the stock of cattle in England, there are more than three times the number of horses, and upwards of four times the number of oxen and sheep, in the same extent of land. The sheep generally are bad, but of late years very great improvements have been made in their fleeces by the introduction of the Merino and Paduan rams. It is supposed that the sheep increased in the Prussian provinces between the years 1819 and 1824 at the rate of twenty-five per cent. and that the finer sort of sheep have increased in a still greater ratio. The fine-woolled sheep are now pretty numerous, and supply the manufacturers with that raw material, which used formerly to be furnished principally from Spain.[1] The monied value of the live stock on the farms is very low. The best flocks of Merino sheep, exclusive of the wool, do not bring more than six shillings or six shillings and eightpence a head. Cows are worth from thirty to sixty-five shillings, and the variation in their price is much greater than in that of sheep. The races of horses are not good, though great efforts have been made by the government to improve them; and establishments of stallions, for gratuitous propagation, are fixed in several parts of the kingdom. The breeding of swine is a very considerable employment, and the hams, bacon, and sausages made from them form a large proportion of the animal food of the inhabitants of the Prussian dominions.

The great deficiency in the rural economy of Prussia, as in most parts of the Continent, is the small portion of land appropriated to pasture. Hence the number of cattle maintained is small in proportion to its extent; and the effect of the deficiency of manure is to be found in the small increase upon the different crops of grain. The average increase is stated to be six for one of wheat, five and three quarters for one of barley, four for one of rye, and four and a half for one of oats. The land of the kingdom is thus appropriated.

	English Acres.
Under the plough	29,224,741
In garden culture	295,302
Vineyards	36,908
Meadows and pasture	14,672,000
Woods, forests, and plantations	17,574,294
	61,803,245

The remaining 11,800,000 acres are either in lakes, ponds, rivers, canals, roads, the sites of cities, towns, and villages, or of so bad a soil as not to be deemed worth cultivation.

Besides articles for food, the soil of Prussia produces many for commerce. The principal of these is flax, which is grown in every village, and almost by every peasant. Besides what is used by the growers for their own domestic manufactures, the quantity annually brought to market is very considerable. Two thirds of this quantity is produced from Silesia alone. It is generally of a good quality, with a fine and long fibre, especially when raised from foreign seed. This change of seed is found so essential, that large quantities are annually imported from Livonia and other Russian provinces; and the seed preserved at home is mostly used for making oil and oil-cake, with the latter of which the oxen are fattened. Thread is also made from felwort, a plant of which the cultivation is rapidly increasing. Tobacco, madder, woad, saflour, and hops, have been much grown, especially during the continental restrictions of Napoleon; and though the opening of foreign commerce has greatly discouraged their cultivation, they are still continued upon a small scale. Chicorium or succory, as in other parts of Germany, is much used as a substitute for coffee; and though the peace has reduced the price of the latter article, the succory finds an extensive sale, and is still cultivated very largely in many districts. It was in Prussia that the experiments of Margrave concerning the extraction of sugar from beetrave were first put into practice upon a great scale; and works were erected long before the process was generally known in France. And although commercial transactions are now facilitated by the communications that have been opened during peace, the making of sugar from beetrave has become an important branch of industry in Prussia. The wine made in Prussia before the acquisition of the Rhenish provinces was of a bad quality, and scarcely superior to vinegar; but these territories yield wine of good flavour and great strength. The annual quantity is calculated to vary from six to eight millions of gallons. Prussia, like the rest of Germany, is well provided with alimentary vegetables of excellent quality. The culture of cabbages, and the different sorts of turnips, carrots, pease, and beans, has been carried to a great degree of perfection. The silk raised in Silesia and some other districts is too inconsiderable to be of much value; but the bombex or silk-worm succeeds well in the province of Brandenburg, and the quantity of silk derived from it is very considerable. The forests, amounting to nearly two sevenths of the whole country, furnish large quantities of timber for building and for exportation; fuel, tar, pitch, rosin, and potash, are more valuable, from the great facilities which the rivers and canals afford to internal navigation, by which their products can be easily conveyed to the borders of the sea. Game is rare or abundant, according as the districts are well or ill wooded. The bear and the elk, the wild boar and the stag, are frequently seen in the woods and the forests of Prussia proper; but the elks and the wild oxen are very rare in the other provinces. The lynx is sometimes seen on the mountains, where are also met the wild cat and the badger. The wolf is now rare; and the fox, the marten, and the beaver, are not nearly so common as they formerly were. The fish that abound in the rivers afford the means of subsistence to many of the inhabitants. Some of them are of an excellent quality, and there are several kinds in the Spree that are so much prized as to form a lucrative branch of exportation. The salmon abounds most in the Rhine; but it is by no means rare in the Elbe and the Weser. The sturgeon, of which the length is sometimes from twelve to fourteen feet, the sparns, the glanis, that weighs from forty to fifty pounds, are often taken in the Oder, and the finest trouts in the rivers that flow from the Hartz and the Erzgebirge. The lamprey and the loach are not uncommon; and numerous marshes or lakes abound with pike, murenæ, and trouts.

Minerals.

The mines of Prussia are by no means worked to the extent of which they are capable. Every province possesses iron, which is prepared in forges and blast-furnaces in their vicinity. They are principally worked with charcoal from the neighbouring forests; but in some instances with fossil coal. Little or no iron is exported, as it can be made cheaper in countries which have more easy access to the ocean. The mines of rock-salt, and the salt springs, are sufficiently worked to supply the consumption of their vicinity; but the provinces in the Baltic Sea find it more advantageous to draw their supply from the mines of Cheshire. Coals are found in Silesia and Saxony, Westphalia and Brandenburg; but the mines are not extensively worked. From the unproductive state of the gold-mines in Silesia, they were abandoned in 1798. The silver-mines are those of Tarnowitz and Rudelstadt in Silesia, and of Mansfeld and Rothenburg in Saxony. In Tarnowitz there is an extensive and valuable lead-mine, in which the silver is found. It is supposed that in ancient times the mine yielded about fifteen or sixteen thousand quintals of lead, and between three and four thousand marks of silver; and it has been affirmed that the annual produce of the mine is at present greater. In Silesia there are found also slate, mill-stones, marble, serpentine, porphyry, rock-crystal, jaspers, carnelians, onyxes, agates, and a particular sort of chrysoprasus. The other minerals of Prussia are copper, cobalt, calamine, arsenic, alum, vitriol, and saltpetre; but they do not yield sufficient for the internal consumption. Amber is almost an exclusive production of Prussia. It is found in mines, as well as procured by the fishermen on the shores of the Baltic. Its value is at present much less than it was in ancient times; but in some manufactories in Prussia workmen are still employed in making from it small jewels, scented powder, spirituous acid, and a fine oil that is used as a varnish. Part of the raw material is exported by the Danes and Italians; but Turkey is the staple market for the commodity. The quantity which is found in Prussia amounts annually to more than two hundred tons, and the revenue which the crown derives from it is equal to three or four thousand pounds.

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[1] In Silesia the flocks are shorn twice a year, and the summer's wool is considered as the most valuable. The number of sheep throughout that province is upwards of two millions three hundred thousand, and their annual produce varies from three millions five hundred thousand to four millions of pounds.

Ianufac-
ures.

Prussia is a manufacturing country, though these branches of industry give employment to a far less portion of its inhabitants than the cultivation of the soil. The most natural and important manufacture is that of linen cloth, the raw material of which, and all the articles that contribute to its perfecting, are produced at home. It has long been established, and extensively spread. In Silesia especially, the habit of spinning fine thread has given to the females a delicacy of tact that is only excelled in some parts of the Netherlands. Besides the common articles for personal and domestic use, Prussia manufactures the finest and most beautiful damask services for the table, which are generally preferred to all others, in the higher circles, throughout nearly the whole of Europe. Before the continental war, the produce of the linen from Silesia amounted to L.1,689,915 sterling, of which L.970,000 was destined for foreign consumption. In the western provinces the linen cloth is principally made for home consumption. Large quantities of linen goods were formerly exported to Spain, and from Cadiz to the former Spanish colonies in South America; but that trade was destroyed by the submission of the continent to the prohibitions imposed by Napoleon, and has not since been recovered, as the markets are now supplied by Great Britain and Ireland.

The increase of Merino sheep has given a great stimulus to the fine woollen manufactures, especially to those in the newly-acquired provinces on the French frontiers, where some of the best superfine cloths that Europe can exhibit are made. In the late department of the Roer, or, as it is now denominated, the circle of Aachen, in the towns of Eupen, Aachen, Montjoie, Stolberg, and Montmedy, fine cloths and cassimeres are manufactured, which are estimated to amount to a million and a half sterling, and afford employment to upwards of 50,000 workmen, as well as to every kind of machinery that has been invented in England or in any other country. The cloths for the dress of the middle and lower classes are wholly made within the kingdom from their native wools. The woollen manufactories throughout the kingdom, on an average from 1829 to 1831, yielded annually about L.4,525,000 sterling.

Cotton goods have been made to a considerable extent. In some instances the yarn is spun in foreign countries, and the weaving, bleaching, and dyeing only executed in Prussia; and as the raw material, a foreign article, cannot be procured so cheap as in England, this branch of industry has much diminished since the general peace. During the period from 1829 to 1831, the cotton manufactures produced to the state about L.4,250,000 sterling yearly, after deducting the prime cost of the materials. The iron manufactures are more than sufficient for the domestic consumption, and furnish to the value of about L.300,000 sterling for exportation. There are three hundred paper-mills, which furnish the common kinds of paper in quantities sufficient for the consumption of the country; but the finer sorts are supplied either from Great Britain or from France. Silk goods, and mixed goods either of silk and cotton or silk and woollen, are chiefly made in the capital, in which, and in some other places, they give employment to about 20,000 looms. The various kinds of leather are made from skins produced at home, as far as they are found sufficient, and the deficiency is supplied from Buenos Ayres, through the intervention of Britain or Spain. Copper and brass wares for all domestic purposes are made, partly from the copper and calamine of their own mines, but chiefly with copper furnished by other countries. The amount of these wares is estimated at about L.200,000 sterling. Tobacco, snuff, sugar, soap, candles, cabinet-ware, earthen-ware, porcelain, tin goods, and almost every article of common consumption, are made within the kingdom. As no wine is made in the eastern part of Prussia, the common beverage is either beer or brandy, distilled from the native grains. The establishments for brewing and distilling are consequently very numerous; but none of them approach in magnitude to the larger concerns of a similar kind in England. The whole quantity of beer brewed is between four and five million casks, of fifty gallons each. The consumption of corn brandy is upwards of 8,000,000 gallons. In the larger cities the letter-founders, printers, engravers, musical, optical, and mathematical instrument makers, gold and silver smiths, jewellers, watchmakers, and other similar artificers, are to be found as numerous and as skilful as in the other countries on the Continent. With regard to the respective trades, Prussia contains, on an yearly average, 328,317 mechanics, artisans, and craftmen, with 181,054 assistants. The number of printing-offices is 327, with 709 presses; tile and brick manufactories, limekilns, glass-houses, tar manufactories, 5406; iron, copper, and other smelts, 1932; watermills, 13,949, with 22,693 lets; 10,451 windmills, 1184 mills worked with horses, and 9422 oil-mills; fulling-machines, tan, saw, and paper-mills, looms for shawls, stockings, and tissue of all sorts, 87,558; 5614 drivers of teams for the transportation of goods by land, employing 11,994 horses; the licensed hotels, cook-shops, taverns, wine and spirit retailers, amount in the whole country to 74,721.

Foreign commerce.

The commerce of Prussia with foreign nations is much less than the extent of the country and the number of the inhabitants would lead us to expect. It is loaded with many restrictions, which, however necessary they may be deemed in a fiscal view, are vexatious and harassing. The commerce by land, by internal navigation, is principally with Austria and Russia. From Austria she receives salt and wine, and sends linen-yarn in exchange. From Russia she draws hemp, corn, hides, tallow, and some other productions of the soil, and sends in return both linen and woollen cloths. The provinces on the Rhine carry on very considerable traffic in wine and manufactured goods with the adjoining provinces in the kingdom of the Netherlands, and with several of the states of Germany.

As Prussia possesses no seaports except on the Baltic, and as none of its harbours enjoy good entrances, or are calculated to receive ships of a great draught of water, there is very little commerce carried on beyond the limits of Europe.

The greater part of the exports from Prussia are conveyed by foreign ships, of which the British exceed in number those of all other nations together. Dantzig, once a Hanse town, and the seat of extensive commerce, has much declined since it has become subject to Prussia, notwithstanding its favourable situation for exporting the productions raised on the banks of the Vistula and its tributary streams. It still, however, exports corn, wood, potashes, linen, wool, wax, honey, horse-hair, and feathers; and imports colonial wares and some few manufactured goods. The vessels which entered the port of Dantzig during the year 1835 amounted to 621, having a tonnage of 94,534; and those which cleared out to 621, having a tonnage of 95,079. The imports by sea during the same year amounted to L.495,909, and the exports to L.373,700. Königsberg exports corn, but the vessels to be loaded with it can approach no nearer than to Pillau. The number of vessels inwards during the year 1835 amounted to 246, and the tonnage to 18,028; those outwards to 249, and the tonnage to 18,786. The imports during the same year amounted to L.265,203, and the exports to L.275,642. Elbing has lately increased by dividing the commerce with Dantzig, and the articles imported and exported are of the same description as constitute the trade of that city. Memel is the largest exporting city, and corn, ship-timber, and masts, pot and pearl ashes, with flax-seed, are its chief commodities. Stettin has the greatest portion of the import trade, as, from its position on the Oder, it is best calculated to receive colonial produce, and forward it to the capital and to the centre of the kingdom. It is also the port in which the greater part of the vessels for the fisheries are equipped. The estimated value of its exports in 1834 amounted to L.374,800, in 1835 to L.280,000; and that of its imports in 1834 to L.714,050, and in 1835 to L.841,670. Stralsund, though it possesses a good harbour, has but little trade, from being destitute of water-communication with the interior of the kingdom. The other ports of Prussia, Colberg, Rugenwalde, Stolpe, Barth, Swinemunde, and Wolgast, carry on some trade, and though not to a great extent, it is valuable, from being almost exclusively conducted in national vessels. The whole exports of Prussia, both by land and by sea, amount to about L.4,500,000 sterling, the whole of the imports to about L.3,750,000; but in the latter is not included the products of their own oil and herring fisheries. The duties on imported goods vary from ten to twenty-five per cent. *ad valorem*, besides an additional tax, never exceeding ten per cent., for the consumption of imported goods. With very few exceptions, all exportations are duty free. For transit goods a certain import and export duty is paid. According to the commercial treaty with Great Britain, concluded 2d April 1824, a perfect reciprocity is established respecting the duties levied on ships belonging to either country visiting the ports of the other. Coasting is only permitted to ships belonging to Prussia.

A Statement of the Extent of each of the States composing the German Commercial Union, in German and English Square Miles, in the month of October 1836.

The German Commercial Union, in its present extent, contains a surface of 174,627·34 square miles, which is thus distributed :—	Square Miles.			
	German.		English.	
1. Prussia (kingdom of), without the principality of Neufchatel, but including those countries whose population is added to this state upon the division of the revenue being made, and who are indemnified by Prussia	5,157	21	109,126	56
2. Bavaria (kingdom of), including some Saxon enclaves	1,477	26	31,258	82
3. Saxony (kingdom of)	271	68	5,748	74
4. Wurtemberg (kingdom of), including the principalities of Hohenzollern-Sigmaringen and Hohenzollern-Heckingen	385	15	8,149	77
5. Hesse-Cassel (electorate of)	182	10	3,853	23
6. Hesse (grand duchy)	179	25	3,792	93
7. The countries belonging to the Thuring confederation	233	49	4,940	64
8. Baden (grand duchy), including a part of the principality of Hohenzollern-Sigmaringen	279	54	5,915	06
9. Nassau (duchy)	82	70	1,749	93
10. Frankfort (free town of)	4	33	91	62
Total	8,252	71	174,627	34

The frontiers comprise an extent of 4,896·65 square miles, which, by the last returns, namely, in the year 1836, are thus divided :—	Square Miles.			
	German.		English.	
1. Prussia	774	99	3,564	95
2. Bavaria	151	56	697	17
3. Saxony	58	0	266	80
4. Baden	60	50	278	30
5. Hesse-Cassel	16	40	75	44
6. Wurtemberg	3	10	14	26
Total	1,064	49	4,896	65

A Recapitulation of the States composing the Prussian Commercial Union, with the Population of each State.

States of the Prussian Confederation.	Surface in German Square Miles, Fifteen to a Degree.	Number of Inhabitants.	Deductions for Military and Independent Districts.	Number of Inhabitants, by which the Revenue is regulated.	Per-Centage Proportion on the Joint Revenue.
1. Prussia and its dependencies	5,157·21	13,800,126	109,473	13,690,653	54·56
2. Bavaria	1,477·26	4,252,813	1,695	4,251,118	16·94
3. Saxony	271·68	1,595,668	...	1,595,668	6·36
4. Wurtemberg	385·15	1,631,779	...	1,631,779	6·50
5. Electorate of Hesse	182·10	700,327	59,653	640,674	2·55
6. Grand duchy of Hesse	179·25	769,691	...	769,691	3·07
7. Thuringia	233·49	908,478	...	908,478	3·62
8. Grand duchy of Baden	279·54	1,232,185	...	1,232,185	4·91
9. Duchy of Nassau	82·70	373,601	...	373,601	1·49
	8,248·38	25,264,668	170,821	25,093,847	100·
10. The free city of Frankfort	4·33	60,000	...	60,000	...
	8,252·71	25,324,668	...	25,153,847	...

Govern-ment.

The government of Prussia is an unlimited monarchy; for though in some of the provinces, by ancient custom, the states still exist, they seldom assemble, and only for such inferior purposes as regulating the debts or expenses of their respective provinces. They have no legislative powers, and scarcely even the right to make representations to the monarch. By the act of the 5th of June 1823, an assembly was instituted, composed of provincial members, to meet alternately at Berlin, Königsberg, Dantzig, or Stettin. The qualifications for membership are ten years' possession of an estate, connection with one of the Christian churches, to be thirty years of age, and to have a blameless reputation. The electors must be twenty-four years of age, and no one can give his vote by proxy. The crown is hereditary in the oldest member of the royal family, whether male or female. The monarch is of age when he arrives at his eighteenth year. The natural guardian of the royal minor is the nearest and oldest princely relation of the house. The king professes the evangelical religion, but he may, if he chooses, follow the Roman Catholic faith. The sole executive and legislative power is vested in him, and his authority is less restrained by the ancient privileges and usages of his subjects than that of any other European monarch. The administration is vested in a council of state, consisting of members of the royal family, and of the ministers of foreign affairs, of the finances, of justice, of public instruction, of trade, of the public debt, of police, and of war. The state chancellor is president of this council, and to him all the heads of the different departments are accountable, and make their weekly reports. He is uncontrollable by his colleagues, and directed solely by the king. In the details of the administration, through all the inferior departments there is much simplicity, and a degree of economy in remunerating public services which scarcely finds a parallel under any other government.

The canton of Neufchatel enjoys peculiar privileges, and a form of government altogether different from that by which the rest of the Prussian dominions is regulated. It forms a part of the Swiss confederation; and though it acknowledges the king of Prussia as its sovereign, his influence is very inconsiderable. He receives only the revenue of some domains, and a very moderate land-tax, which cannot be augmented. The inhabitants who choose the military profession may enter into the service of any state not actually at war with Prussia. Every profession and every trade are free, and no customs are levied, and no duties imposed on any goods which enter or leave the territory.

Knighthood.

The orders of knighthood established in Prussia are, the order of the black eagle, founded 18th January 1701, by Frederick I.; the order of the red eagle, founded 1734, by the Margrave Frederick Charles of Baireuth; the order *pour le mérite*, founded 1740, by Frederick II.; the royal Prussian new order of St John, founded 1812, in commemoration of the ancient order of St John, dissolved 1811. During the war with France in 1813 and 1815, the Iron Cross was given to those who either had actually fought against the enemy, or else done some meritorious act, either civil or military, during that period. The king also founded, in 1814, the order of Louise for females who distinguished themselves in the cause of their country during the war. There are, besides, various other marks of distinction given for different degrees of military service. All orders are distributed by the king alone.

Revenues.

The revenues of Prussia are derived from taxes upon the land, upon persons, upon patents, and licenses, which are denominated direct contributions; and from an excise, or rather a custom-duty, on foreign productions. A small sum is derived from stamped paper. In those provinces which were taken from the French empire, the taxes on land, on trades, on doors and windows, as then established, are still continued, and will remain till the whole of these provinces are brought under the simple regulations established in the other dominions. More than one fourth of the revenue of the monarchy is derived from the royal domains, and the hereditary rights or royalties which are exercised over the mines, the salt-springs, the game, the coinage, the posting, and the postage, with some other branches. Though the higher branches of the administration appear to be benefited by parsimony in the salaries, yet in the inferior departments it appears to be injurious, as the petty officers, who are very numerous, are too poor to refuse bribes; and they are not deterred by the apprehension of dismission from offices whose fair emoluments scarcely equal the wages of a day-labourer.

Statistics.

The following is a Statement of the Average Annual Income of the Kingdom of Prussia, under its several heads, from 1829 *to* 1834, *and of the same prospectively from* 1834 *to* 1837, *inclusive.*

SOURCES.	From 1829 to 1831.	From 1832 to 1834.	From 1835 to 1837.
	P. Dollars.	P. Dollars.	P. Dollars.
1. From crown-lands and forests, after deducting the sum set apart for the king's civil list	4,524,000	4,280,000	4,212,000
2. From sold and regulated crown lands, for the more speedy extinction of the national debt	1,000,000	1,000,000	1,000,000
3. From mines, melting-houses, salt-works, and the porcelain manufactory at Berlin	1,014,000	714,000	717,000
4. From the post-office	1,100,000	1,100,000	1,200,000
5. From the lottery	684,000	574,000	669,000
6. From taxes, licenses, customs, excise, and salt monopoly	41,850,000	43,351,000	43,530,000
7. From the principalities of Neufchatel and Lichtenberg	26,000	26,000	80,000
8. From other minor revenues and receipts	598,000	242,000	332,000
Total	50,796,000	51,287,000	51,740,000

Before the reign of the father of the present king, Prussia had no public debt whatever, but usually a sufficient accumulation of money to meet any emergency that might occur. The present king, by economy and regularity, had reduced the debt which his predecessor had incurred, when the rupture with Napoleon in 1806 drew forth all his resources, and until the year 1815 the debt continued to increase. Since the restoration of general peace, due measures have been taken for the reduction of it. On the 12th of January 1833 it amounted to L.25,678,365, including a loan of L.6,000,000 from British subjects, and the debts assumed upon the cessions of territory from Sweden, Denmark, and Saxony. Besides this national debt, many of the corporate bodies have borrowed considerable sums, which were presented to the government in the most critical periods, and which are in the progress of being liquidated from their own incomes.

The expenditure of the government is upon a very low scale. No court can be less expensive than that of Berlin, and no monarch can be less attentive to his personal gratifications than the present king, who, like his predecessor, Frederick II., appropriates but a small portion of his patrimonial income to his private purposes, devoting it principally to the service of the state. The average annual expenditure from 1829 to 1837 inclusive was as follows:

HEADS.	From. 1829 to 1831.	From 1832 to 1834.	From 1835 to 1837.
	P. Dollars.	P. Dollars.	P. Dollars.
1. Administration of the national debt	10,937,000	10,890,000	8,918,000
2. Pensions, claims, and life annuities	3,158,000	2,887,000	2,550,000
3. Indeterminable annuities	277,000	391,000	963,000
4. The king's cabinet, the ministry of state office, board of control and of the public treasure, the mint, state and provincial records office, secretary of the council of state, heralds' office, statistical department	288,000	298,000	308,000
5. The ministry for clerical and medical affairs, and of public instruction	2,347,000	2,489,000	2,683,000
6. The home department, including the board of trade from 1829 to 1831	4,883,000	2,067,000	2,357,000
7. The board of trade, of works and roads	...	3,103,000	4,221,000
8. The ministry of foreign affairs	586,000	586,000	681,000
9. The army	22,165,000	22,798,000	23,462,000
10. The treasury	263,000	254,000	253,000
11. The ministry of justice	1,823,000	1,850,000	2,061,000
12. The provincial administration	1,830,000	1,788,000	1,766,000
13. The central and provincial studs	163,000	175,000	167,000
14. Extraordinaries	2,076,000	1,711,000	1,350,000
Total	50,796,000	51,287,000	51,740,000

In 1832 the Prussian army stood as follows:—

Royal guards—Infantry	16,280	
... Cavalry	3,820	
		20,000
Line—Infantry	118,540	
... Cavalry	19,100	
		137,640
Artillery and pioneers		17,720
		175,360
Landwehr		153,420

The regular ranks are filled by a conscription, which compels every young man, as he arrives at twenty years of age, to serve for a limited period. If the conscript can purchase his arms and accoutrements, and pay a small sum, he may at the end of one year pass into the landwehr, which is composed of this class of men, and of all others between twenty-five and forty years of age. In time of peace the landwehr is exercised but one day in the year, but in war it becomes a disposable force, and is marched wherever its services may be deemed necessary. The other militia force, the landsturm, is composed of all males capable of bearing arms, above forty years of age. This force is only called out in periods of great emergency, and then its duty is entirely domestic, being confined to guarding prisoners and maintaining internal tranquillity. But it is unnecessary to enlarge on this subject, as it is pretty fully treated of in the article ARMY, to which the reader is referred.

Soldiers who are maimed or severely wounded are admitted either into the hospitals at Berlin, Stolpe, &c. or into one of the twenty-four invalid companies, and receive board, lodging, clothes, and necessary medical attendance. Those who are less severely wounded, or who in consequence of their military service are incapable of entirely earning their livelihood, receive pensions proportioned to circumstances.

To the military establishment belong the institution for the education of the children of soldiers in Stralsund and Annaburg, and the Military Orphan Hospital in Potsdam, where the orphans of soldiers are maintained and educated.

The principal fortresses in the kingdom are, in the province of Prussia, Dantzig, with Weichselmunde, Graudentz, Pillau, and Thorn; in Pomerania, Colberg and Stettin; in Brandenburg, Kustrin and Spandau; in Silesia, Glatz, Glogau, Kosel, Neize, Schweidnitz, and Silberberg; in Saxony, Magdeburg, Wittenberg, Torgau, and Erfurt; in Westphalia, Minden; in the province of the Rhine, Wesel, Cologne, Gulick, Saarlouis, and Ehrenbreitstein, with Coblentz.

Administration of laws and police.

Prussia enjoys a peculiar code of laws, founded by Frederick the Great upon the ancient customs and usages of the people, and finally reduced to a more regular system in 1794. The magistracy in the rural districts is still a patrimonial right, vested in owners of particular estates; but the power formerly possessed by them has been contracted within narrower limits than formerly. The decision of these lower courts is not final, except in very trifling cases; and an appeal may be made to the tribunals of the second instance, which are established in the several provinces, and to whom is attached the superintendence of the colleges for imparting legal knowledge to pupils. To these tribunals of the second instance, or *Oberlandesgerichten*, is intrusted the duty of promulgating the laws, of watching over the interests of lunatics and minors, as well as of deciding processes. They are usually divided into two portions, one of which attends to the appeals from the inferior courts, and the other pronounces sentence on such civil and criminal cases as originate in them. From all the Oberlandesgerichten appeals may be brought before the High College of Justice in Berlin, whose decisions are final. The Prussian system of law is more simplified than most of those of feudal origin, and in its practice it is expeditious, economical, and uniform. The police is under separate jurisdictions; and in the country the *landraths* resemble in some measure our petty sessions of justices of the peace. In the cities there are peculiar boards appointed, under whose direction the regulation of buildings, sewers, and the supplies of water and of food, are placed. The police has the superintendence of the examination of those who are licensed to practise the medical profession, of the insurance offices against losses by fire, and of the engines and other implements to prevent fire from extending. To this is added the keeping a watchful eye on all individuals who have no visible means of subsistence. In all the cities the police is mildly and regularly administered, with more attention to the prevention than the punishment of crimes.

As to the amount of crime, it varies considerably in the different provinces. It appears from the returns, that crimes are most rare in the Protestant districts, and most common in those where the numerous festivals and holidays of the Roman Catholic Church are observed. It is certain, besides, that the most industrious countries are those in which there are fewest Romanists. In the territories of Aix-la-Chapelle one individual out of every 60,000 inhabitants has been found guilty of murder; in the province of Saxony and the country of Munster, one out of every 35,000; in the district of Marienwerder, one out of every 25,000; in Pomerania, one out of every 4760; in the towns of Cologne, Munster, Dusseldorf, and Aix-la-Chapelle, one out of every 400. As to the number of thefts and robberies, there is in Pomerania one for every 6432 inhabitants; in Western Prussia, Silesia, or Eastern Prussia, one for every 3000; in the neighbourhood of Coblentz and Trêves, one for every 800; in Cologne, Dusseldorf, Munster, and Aix-la-Chapelle, one for every 400.

Public instruction.

Few of the nations of Europe have, within the last two centuries, exceeded Prussia in the number and eminence of its men of learning, or in the variety and excellence of its establishments for the promotion of science and literature. In no other country is the instruction of the lower classes so sedulously provided for, and in none are there so few persons who are ignorant of the first rudiments of knowledge. In Prussia, as in other countries, public instruction long formed a part of the business of the minister of the interior; but in 1819 a special department of administration was devoted to this object. The minister of public instruction enjoys a rank and authority equal to those of any of his colleagues. Under him is a numerous council, divided into three sections; one for church affairs, composed of a certain number of councillors, chiefly ecclesiastics, with a director at their head; another for public instruction, also composed of a certain number of councillors, almost all laymen, with a director; and a section for medicine, with its councillors and director. All the members of this council receive salaries from the state. The same individual may belong to two sections, but he can in no case receive more than the salary of one. In each of the ten provinces into which Prussia is divided, under the direction of the supreme president of the province, is an institution called the Provincial Consistory, which is connected with and dependent upon the ministry of public instruction, and having its internal organization formed upon the same model. All the members are nominated directly by the minister of public instruction, and they are remunerated for their labours. Their duty is more peculiarly to superintend the secondary instruction, the gymnasia, and higher burgher schools. Every *gemeinde* (parish) must by the law of the land have a school; and the pastor or curate is, in virtue of his office, the inspector of this school, associated with whom is a committee composed of some of the most considerable persons of the parish. In the urban parishes the magistrates form a higher committee or board, which presides over all these schools with their several committees, and arranges them into one harmonious system. There is, moreover, in the chief town of the circle another inspector, whose authority extends to all the schools of that circle, and who corresponds with the local inspectors and committees. In the *regierung* (regency) of every department there is a special councillor for the primary schools, called *schulrath* (school councillor), who acts as a link between the public instruction and the ordinary civil administration of the province. He inspects the schools, quickens and keeps alive the zeal of the school-inspectors, school-committees, and the schoolmasters. He conducts the correspondence relative to schools in the name of the regency, with the local and superior inspectors, as well as with the provincial consistories and the minister of public instruction. Like all his colleagues, he is a paid officer.

In Prussia the state imposes on all parents the strict obligation of sending their children to school, unless they can prove that they are giving them a competent education at home. Children must remain at school from their seventh to their fourteenth year inclusive.[1] Neglect of this duty exposes parents or guardians to punishment by fine or imprisonment. The hours of lessons in the elementary schools are arranged in such a manner as to facilitate to parents the execution of this law, and at the same time not to deprive them entirely of the assistance which their children might afford them in their labours; and care is everywhere taken to furnish necessitous parents with the means of sending their children to school, by providing them with the things necessary for their instruction, or with such clothes as they stand in need of. Every parish, however small, is bound to have an elementary school, accomplishing at least the most indispensable part of the scheme of instruction prescribed by law; and every town is bound to have at least one burgher school or more, according to its population. In certain cases where a parish is absolutely unable to furnish the means of an elementary school of itself, several villages may unite together into one school association. The law provides also a suitable income for teachers, and certain provision for them when they are past service, a suitable building for the purposes of teaching and of exercise, furniture, books, &c. and pecuniary assistance for the necessitous scholars. The gymnasia, and other establishments of a similar kind, are principally supported by the general funds of the state, or of the province; but the inferior schools in towns and villages are supported by the towns, and by the school associations in the country. If, however, a town is unable out of its own resources to support the lower grade of instruction of which it stands in need, aid is given to it from the school funds of the department to which it belongs. The necessary funds are provided by an assessment levied on all the householders in the parish.

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[1] Five is the age fixed by the fundamental law, but seven is that at which education is rigidly enforced.

Every complete elementary school comprehends the following objects:—Religious instruction; the German language; the elements of geometry, together with the general principles of drawing; calculation and practical arithmetic, the elements of physics, geography, general history, and especially the history of Prussia; singing, writing, and gymnastic exercises; the simplest manual labours, and some instruction in husbandry. The instructions in religion, reading, writing, arithmetic, and singing, are indispensable in every school; and no school is considered as complete unless it fulfil the whole scheme of instruction just marked out. Next to the village are the burgher schools, where, in addition to the branches taught in the elementary schools, the pupils are instructed in Latin, and prepared for admission into institutions called gymnasia, similar to our grammar schools of Winchester, Eton, Westminster, and Edinburgh. In these institutions classical learning is pursued to a great extent, as preparatory to admission into the universities; some of them are under the direction of the Protestants, others under that of the Catholics, and some few under a combined direction of both sects. They have, according to their extent, from four to twelve masters; and the pupils are divided into five or six classes, the lower of which differ but little in their instructions from the burgher schools. In the larger and middle-sized cities schools are established for the instruction of the females, with which, in Silesia, are combined, amongst those of the lower class, the teaching the delicate art of lace-making.

The religious instruction given in the Prussian schools is always adapted to the doctrines of the church to which the school belongs. The children of a different persuasion, however, are subjected to no kind of annoyance or constraint on account of their particular creed. No attempt is made to proselytise them; and they are not obliged, against the will of their parents, or their own, to attend the religious instruction or exercises of the school, but private masters of their own creed are charged with their religious education. Every scholar of an elementary school must, when he leaves it, receive a certificate as to his capacity, and his moral and religious dispositions, signed by the masters and the school-committee. These certificates are always presented to the clergyman before admission to the communion, to master-manufacturers or artisans on being bound apprentices, or to housekeepers on entering service.

In order to provide schools with proper masters, primary normal schools have been instituted, in which those intended for the office of teachers receive instruction in the appropriate branches of education, and especially in the theory and practice of teaching. Pecuniary assistance is also given to a certain fixed number of poor scholars of good promise. The expenses of these establishments are defrayed partly by the general funds of the state, and partly by the departmental funds for schools. The age of admission is from sixteen to eighteen years, and the course of study extends to three years; and during that time no pupil is called out to active service in the army. Any person of mature age and irreproachable character may be appointed to the office of schoolmaster, if he is found, on examination, to possess the necessary qualifications; but preference is given to the pupils of the primary normal schools. The election of the schoolmasters for country schools is vested in the committee of superintendence; for town schools supported by a public rate, in the municipal authorities; but in all schools in towns founded by the king, the election to masterships is conducted by the provincial consistories. The election must, however, be ratified by royal authority before the teacher can be installed in his office, or be entitled to its revenues. Able and diligent schoolmasters are encouraged by promotion to places of a higher class, and even, on particular occasions, by extraordinary rewards; neglect of duty, and other offences, are punished by reprimands, fines, and deprivation of employment. Public schools are the basis of popular instruction in Prussia, but private schools are not prohibited. Those, however, who wish to establish schools for private education must undergo an examination, and receive a license from the provincial consistory; and the establishment is placed under the special supervision of one of the members of the school-committee of the town or district in which it is situated.

In 1831 it was estimated that, in Prussia, the children of from one day to fourteen years old amounted to 4,767,072. It is a rule in statistics, that out of a hundred children, those between seven and fourteen form three sevenths, which gives out of every hundred, forty-three of an age to go to school (or, to give the minutest fractions, 42,857 in 100,000), and consequently in Prussia 2,043,030. Now it has been found, according to the accurate calculation of the attendance lists, that the actual number of children who attended the public primary schools in the year 1831 was 2,021,421, exhibiting the slight difference of only 21,609 between the real and the normal number. And even this will vanish, if we consider that these calculations are founded only on the public primary schools, and do not include the private ones; and that no account is taken of the children educated at home, nor of the boys belonging to the lower classes of the gymnasia. Taking these circumstances into account, it is evident that the number of children under fourteen who receive in one way or another the benefits of education, is not only equal to three sevenths of the population, but that it must actually exceed that number; a circumstance which can be explained only by the fact, that in the most civilized provinces of Prussia the taste for instruction is so generally diffused, that parents anticipate the age fixed by law for sending their children to school. The following statement will show the relative proportion in each province, of the total number of children attending public schools:—

At the end of the year 1831, in every 100,000 children, the number who attended public schools was, in the province of Saxony, 54,515; in that of Westphalia, 47,386; in that of Brandenburg, 45,814; in that of Silesia, 45,042; in that of the Rhine, 41,002; in that of Pomerania, 40,775; in that of Prussia, 39,651; and in that of Posen, 22,283. The difference in the proportion of boys and of girls is inconsiderable. Out of 2,021,421 children attending school, there were, in 1831, 1,044,364 boys, or 43,694 in 100,000; and 977,057 girls, or 41,106 in 100,000. The total number of primary public schools was 22,612; of these, 21,789 are elementary and 823 middle schools, of which 481 are for boys and 342 for girls. The elementary schools are attended by 987,475 boys and by 930,459 girls, and the middle schools by 56,889 boys and by 46,598 girls. For the 22,612 public schools there are in all 27,749 masters and mistresses, who are distributed as follows, viz. 21,789 elementary schools, with 22,211 regular masters, 694 regular mistresses, and 2014 assistant masters and mistresses; 481 middle or burgher schools for boys, with 1172 regular masters and 360 assistant masters; 342 middle or burgher schools for girls, with 633 regular masters, 289 regular mistresses, and 471 assistant masters and mistresses.

In the year 1831 there were in Prussia thirty-three great primary normal schools, each of which contained from forty to 100 pupils; their total expenditure was L.16,583, and the grants from the state amounted to L.13,260. Besides these, there are a considerable number of small normal schools. The annual sum paid by the public treasury for the elementary and the burgher schools throughout Prussia amounted in 1831 to L.34,520.

As primary instruction belongs chiefly to the department and the parish, and secondary instruction to the provinces, so the universities are under the exclusive care of the state, and, like the universities in the other parts of Germany, are either endowed, or the expenses of the professors and the libraries are defrayed by the government. The course of study is left much to the choice of the students, and is therefore too much influenced by the temporary popularity of particular professors. The means of instruction in every branch of science and literature are abundantly furnished; and, in spite of the want of discipline which generally prevails, the foundation is laid in them of those eminent acquirements in which the students have afterwards distinguished themselves in the various walks of science and literature. The principal universities are those of Berlin, Breslau, Halle, Bonn, Königsberg, Munster, and Greifswald.

A Statement of the Average Number of Students in each Branch of Science, distinguishing Natives from Foreigners, in the several Universities and Catholic Seminaries of Prussia; also the Number of Professors in each, and the Average Number of Students to each Professor, in the Year 1834.

NAMES.	AVERAGE NUMBER OF STUDENTS.																		Total Number of Professors.	Average Number of Students to each Professor.
	Evangelical Theology.			Catholic Theology.			Jurisprudence.			Medicine.			Philosophy.			Total.				
	Natives.	Foreigners.	Total.	Natives.	Foreigners.	Total.	Natives.	Foreigners.	Total.	Natives.	Foreigners.	Total.	Natives.	Foreigners.	Total.	Natives.	Foreigners.	Total.		
Berlin........	439	126	565	...	...	...	442	140	582	246	141	387	192	106	298	1319	513	1832	149	12·3
Breslau......	203	3	206	213	1	214	224	5	229	108	5	113	111	2	113	859	16	875	72	12·1
Halle.........	412	78	490	...	...	...	99	20	119	78	33	111	48	9	57	637	140	777	74	10·5
Bonn..........	77	26	103	179	9	188	235	37	272	136	19	155	97	20	117	724	111	835	71	11·7
Könisberg...	152	10	162	...	...	...	80	5	85	71	11	82	96	5	101	399	31	430	60	7·1
Munster.....	...	...	...	146	38	184	...	...	...	...	...	...	67	4	71	213	42	255	16	16·
Greifswald...	80	6	86	...	...	...	36	1	37	60	6	66	14	1	15	190	14	204	41	5·
Total.....	1363	249	1612	538	48	586	1116	208	1324	699	215	914	625	147	772	4341	867	5208	483	10·7

Statement of the Total Average Number of Students in each Branch of Science, distinguishing Natives from Foreigners, in the Universities of Prussia, in each Half Year from 1830 *to* 1834.

YEARS.		Evangelical Theology.		Catholic Theology.		Jurisprudence.		Medicine.		Philosophy.		Total.		
		Natives.	Foreigners.	Natives.	Foreigners.	Natives.	Foreigners.	Natives.	Foreigners.	Natives.	Foreigners.	Natives.	Foreigners.	Total.
1830	Summer..	1750	394	660	153	1348	202	496	196	589	157	4843	1102	5945
	Winter....	1787	411	656	107	1353	241	502	203	667	175	4965	1137	6102
1831	Summer...	1657	311	650	103	1194	160	495	163	646	131	4642	868	5510
	Winter ...	1689	312	642	79	1308	213	553	176	656	163	4848	943	5791
1832	Summer...	1537	206	620	82	1163	130	546	165	683	114	4549	697	5246
	Winter....	1497	245	628	59	1219	164	579	196	705	131	4628	795	5423
1833	Summer...	1468	263	596	51	1170	205	608	185	716	146	4558	850	5408
	Winter....	1386	283	608	50	1246	243	684	216	646	151	4570	943	5513
1834	Summer...	1397	257	546	46	1169	213	717	221	602	154	4431	891	5322
	Winter....	1328	243	529	50	1062	200	681	210	645	140	4245	843	5088

The state makes annual allowances for the support of the various departments of the universities.

I.—The University at Berlin.

1	Medical establishment..........	Ry.1500	0	0
2	Chirurgic medical ditto.............	6700	0	0
3	Poleklin ditto.........................	2000	0	0
4	Midwife assistant ditto	5468	0	0
5	University widows' fund...........	5301	0	0
6	Theological seminary.................	630	0	0
7	Philological ditto.......................	500	0	0
8	University garden......................	500	0	0
9	Observatory..............................	100	0	0
10	Chemical laboratory..................	400	0	0
11	Herbarium..........................	Ry.1200	0	0
12	Anatomy and the anatomical museum............................	3167	22	6
13	Cabinet of minerals..................	1520	0	0
14	Ditto of chirurgical instruments and bandages........................	430	0	0
15	Mathematical-physical apparatus..	500	0	0
16	Seminary for schools of learning...	2000	0	0
17	Establishment for the improvement of cameralists............	1000	0	0
18	Library....................................	500	0	0
19	Zoological museum.....................	2994	0	0
20	Botanical gardens......................	11,228	0	0
21	Royal library..............................	15,102	15	0
	(@ 6 Ry. 25 sgr. L.9181. 3s. 1d.)	62,741	7	6

Statistics.

II.—UNIVERSITY AT BONN.

1	Library	Ry.4621	15	0			
2	Evangelic-theological seminary	400	0	0			
3	Catholic ditto ditto	300	0	0			
4	Convictorium for the Catholic theological students	7589	11	5			
5	Medical establishment	4017	0	0			
6	Chirurgic-medical ditto, united to the cabinet of chirurgical instruments and bandages	4091	20	0			
7	Midwife-assistant establishment	1773	10	0			
8	Anatomy and the anatomical museum	1500	0	0			
9	Botanic garden, including 60 Ry. for the guard	2560	0	0			
10	Museum for natual history	1150	0	0			
11	Technic-chemical laboratory	350	0	0			
12	Technological cabinet	100	0	0			
13	Physical ditto	400	0	0			
14	Pharmacitic laboratory	50	0	0			
15	Pharmacologic apparatus	50	0	0			
16	Seminary for the science of nature	400	0	0			
17	Museum of arts	200	0	0			
18	Philologic seminary	500	0	0			
19	Academical widow and maintenance institution	3571	15	0			
	(@ 6 Ry. 25 sgr., L.4920. 13s. 9d.)				33,624	11	5

III.—UNIVERSITY OF BRESLAU.

1	Library	Ry.5130	0	0			
2	Evangelic-theological seminary	300	0	0			
3	Catholic ditto ditto	300	0	0			
4	Homilitic establishment	50	0	0			
5	Academical ditto for sacred music	820	0	0			
6	Medical clinicum	2569	6	8			
7	Chirurgical ditto	2000	0	0			
8	Anatomical establishment	1898	6	0			
9	Instruction of midwifery ditto	400	0	0			
10	Midwife-assistant ditto	600	0	0			
11	Philological seminary	300	0	0			
12	Observatory	370	0	0			
13	Museum for the historical science of nature	868	0	0			
14	Botanic garden	2610	0	0			
15	Mineralogic cabinet	200	0	0			
16	Physical apparatus	368	0	0			
17	Mathematical-physical ditto	80	0	0			
18	Chemical laboratory	372	0	0			
19	Collection of moulds and agricultural apparatus	50	0	0			
	(@ 6 Ry. 25 sgr., L.2822. 5s. 1d.)				19,285	12	8

IV.—UNIVERSITY OF GREIFSWALD.

1	Library	Ry.1715	0	0			
2	Medical ambulation clinicum	200	0	0			
3	Chirurgic ditto ditto	46	0	0			
4	Medical chirurgic lazaretto	650	0	0			
5	Institution for the instruction of midwifery and midwife assistant	380	0	0			
6	Academical widows' fund	227	0	0			
7	Establishment for free boarders	2924	0	0			
8	Botanic garden	1010	0	0			
9	Riding school	150	0	0			
10	Astronomical cabinet	60	0	0			
11	Procuring of chemical apparatus	160	0	0			
12	Anatomical zootomic museum	677	0	0			
13	Cabinet of minerals	30	0	0			
14	Zoological museum	1000	0	0			
15	Cabinet of physical instruments	60	0	0			
16	Ditto of agricultural moulds	45	0	0			
17	Theological seminary	67	0	0			
	(@ 6 Ry. 25 sgr., L.1375. 15s. 1d.)				9,401	0	0

V.—UNIVERSITY AT HALLE.

1	Library	Ry.2820	0	0			
2	Botanic garden	1090	0	0			
3	Midwife-assistant establishment	1000	0	0			
4	Medical and ambulatory clinicum	3040	0	0			
5	Chirurgical ditto	1210	0	0			
6	Anatomical and zoological museum	1470	0	0			
7	Observatory	240	0	0			
8	Cabinet of natural curiosities	885	0	0			
9	Ditto of minerals	280	0	0			
10	Physical chemical laboratory	520	0	0			
11	Philologic seminary	530	0	0			
12	Cabinet of arts	115	0	0			
13	Riding school	280	29	1			
14	Institution for sacred music	130	0	0			
	(@ 6 Ry. 25 sgr., L.1991. 17s. 9d.)				13,610	29	1

Statistics.

VI.—UNIVERSITY OF KÖNIGSBERG.

1	Botanical garden	Ry.2100	0	0			
2	Medical establishment	2300	0	0			
3	Chirurgic ditto	2455	0	0			
4	Theological seminary	440	0	0			
5	Philologic ditto	400	0	0			
6	Pedagogic ditto	1060	0	0			
7	Library	3590	0	0			
8	Anatomy	1180	0	0			
9	Observatory	1570	0	0			
10	Zoological museum	1000	0	0			
11	University widow and orphan institution	1000	0	0			
12	Cabinet of physical apparatus	158	0	0			
13	Establishment for sacred music	164	0	0			
14	Ditto for singing	100	0	0			
15	Collection of amber and other minerals	100	0	0			
16	Polish seminary	50	0	0			
17	Medical-polyclinic institution	200	0	0			
18	Cabinet of ancient coins	50	0	0			
19	Academic collection of arts	112	0	0			
20	Midwife-assistant establishment	220	0	0			
	(@ 6 Ry. 25 sgr., L.2670. 11. 9d.)				18,249	0	0
	(At the exchange of 6 Ry. 25 sgr, L.22,962. 6s. 6d				Ry.156,912	0	8

There are also, unconnected with the universities, theological academies for the Catholics, Lutherans, and Moravians, where they receive the instruction necessary to qualify them for the duties of their functions. Besides these, there are useful establishments for pupils in medicine, surgery, midwifery, the veterinary and military professions, rural economy, and for teaching the deaf and dumb, and the blind.

The collections of natural history, the philosophical and astronomical apparatus, and the public libraries, are upon a very liberal footing, and at the service of any individual who wishes to avail himself of their assistance. The libraries of Berlin thus open to general use contain more than 300,000 volumes, those of Breslau more than 100,000, that of Halle more than 50,000, and in the other cities large collections are generally to be found.

The freedom of the press has of late been somewhat restrained, particularly as relates to fugitive and periodical publications of the smaller class. All books must undergo censorship previous to publication; but works of science are allowed to pass with scarcely any inspection, and there is no restriction on bringing into Prussia any works published in any of the other states of Germany. The universities have an unlimited right of printing without a previous inspection. In the year 1819 the newspapers were, sixty-two government weekly papers, which contained little but domestic intelligence and advertisements; fifteen political papers written by individuals, but with much reserve; and one literary journal.

A savings bank was established in Berlin in 1818. It allows four and a half per cent. on every deposit from a crown upwards. Its capital has increased rapidly, and in 1824 amounted to 685,742 crowns.

The practice of insuring against fire has now become very general, and the property insured in the province of Brandenburg alone in 1824 amounted to 37,854,875 crowns.

Currency.

The currency of Prussia consists of metallic and paper money, but the former is so much greater in amount, that the latter suffers no depreciation. The metallic money is estimated to amount to 30,000,000 reichs-thalern. The paper money, including that issued by a privileged company, does not amount to more than 5,000,000, and, by means of a sinking fund, is gradually diminishing, and will soon be extinct. The money is coined in Berlin, Breslau, and Dusseldorf. The gold coins are double, single, and half Frederick William d'ors, valued at 10 d., 5 d. and $2\frac{1}{2}$ d. reichs-thalern. The silver coins are the thaler, the half thaler, and the third, sixth, and twelfth of the thaler. The copper and mixed metal coins are groschen, sechser, drier, and pfenninge. In the old provinces accounts are kept in dollars (thalern), groschen, and pfenningen. Twelve pfenningen make a grosch, and twenty-four groschen a dollar. The value of the dollar in exchange with London varies from three shillings to three shillings and twopence. In the provinces the accounts are kept in various denominations of money, but they are easily reduced into florins or gulden, three of which are equal to two dollars, and the value of which in exchange with London is about two shillings.

The legal long measure of Prussia is the Berlin ell of two feet, which contains $25\frac{3}{8}$ths Rhenish inches, or 296 French lines. In the distant provinces a local measure of length prevails, which differs in each. The Prussian mile is 23,685 feet, or nearly the same as the German geographical mile, or one fifteenth of a degree of latitude, being somewhat less than four and a half English miles. The land measure is the Magdeburg morgen of 100 roods, each rood of twelve feet; and the foot is about one seventh longer than the English; thus the morgen is nearly two thirds of an English acre. The dry measure is the Berlin scheffel of $2758\frac{20}{21}$ Parisian cubic inches, or nearly one bushel, one peck, and one gallon, English measure. The liquid measures are more various than any other, and differ in every province; but as they are all legally reducible to Berlin measure, we give that only, viz. an oxhoft is six eimer, an eimer two ankers, an anker thirty-two quarts, the quart two nöseln. The quart contains fifty-eight Parisian cubic inches, or nearly one ninth less than the English quart. The weights of commerce are the shipslast, containing twelve shipspounds; the shipspound contains 280 common pounds; the centner, of 110 pounds, is divided into light and heavy stones, having ten of the former and five of the latter; the pound is divided into two marks, the mark into sixteen loth, the loth into four quentchen, and the quentchen into four pfenningen.

PRUYM, a city of Prussia, of the province of the Lower Rhine, and government of Trêves. It is the capital of a circle of the same name, which extends over 398 square miles, and comprehends three towns and 156 villages, with 23,500 inhabitants. It was once the capital of a principality, now mediatized, and contains 380 houses, with 2080 inhabitants.

PRYNNE, William, an English lawyer, distinguished in the civil commotions under Charles I., was born at Swainswick, in Somersetshire, in 1600. His *Histriomastix*, written against stage-plays in 1632, contained some reflections which offended the court, and he was in consequence sentenced by the Star-chamber to pay a fine of L.5000, to stand in the pillory, to lose his ears, and to suffer perpetual imprisonment. During his confinement he wrote several more books, particularly one entitled News from Ipswich, in 1637, which, reflecting severely on the bishops, subjected him to another sentence by the Star-chamber, which adjudged him to pay another fine of L.5000, to lose the remainder of his ears in the pillory, to be branded on both cheeks with S. L. for seditious libeller, and to be perpetually imprisoned in Caernarvon Castle. But nothing except cutting off his hands could have prevented Prynne from writing. He continued his favourite employment still; and being set at liberty by the House of Commons in 1640, he entered London in a kind of triumph, was elected member of parliament for Newport in Cornwall, opposed the bishops with great vigour, and was the chief manager of Archbishop Laud's trial. In the long parliament he was zealous in the Presbyterian cause; but when the Independents gained the ascendency he opposed them warmly, and promoted an agreement with the king. When the army expurgated the house and refused him entrance, he became a bitter enemy to them and their leader Cromwell, whom he attacked with so much severity that he was again imprisoned; but he pleaded the liberty of the subject so successfully that he was enlarged, and began to write more controversial books. Being restored to his seat with the other secluded members after Cromwell's death, he assisted in promoting the Restoration, and was appointed keeper of the Records of the Tower; a place excellently well calculated for him, and where he rendered himself very useful by the collections he published from them. He presented forty volumes of his works, in folio and quarto, to Lincoln's-Inn library, of which society he was a member. His principal works are, Records of the Tower, in three volumes folio; and his Parliamentary Writs, in four volumes quarto. The former is one of the rarest works in the whole department of English history. He died in the year 1669, and was buried under the chapel of Lincoln's-Inn.

PRYTANES, in Grecian antiquity, were the presidents of the senate, whose authority consisted chiefly in assembling the senate, which, for the most part, was done once every day. The senate consisted of five hundred, fifty senators being elected out of each tribe; after which, lots were cast to determine in what order the senators of each tribe should preside, which they did by turns, and during their presidentship were called *prytanes*. However, all the fifty prytanes of the tribes did not govern at once, but one at a time, namely, for seven days; and after thirty-five days another tribe came into play, and presided for other five weeks; and so of the rest.

PRZRMYSL, a city of the Austrian kingdom of Galicia, the capital of a circle of the same name, which extends over 2178 square miles. It comprehends five cities, twelve market-towns, and 232 villages, with 238,500 inhabitants, of whom about 16,000 are Jews. The city is fortified, and defended by a lofty castle. It is the see of a bishop, and has a cathedral and fourteen other churches, 760 houses, and 6980 inhabitants, none of them very wealthy. Long. 22. 39. E. Lat. 49. 46. 30. N.

PSALM, a divine song or hymn, but chiefly appropriated to the Psalms of David, a canonical book of the Old Testament. Most of the psalms have a particular title, signifying either the name of the author, the person who was to set it to music or sing it, the instrument which was to be employed, or the subject and occasion of the canticle. Some have imagined that David was the sole author of the Book of Psalms; but the titles of many of them prove the contrary, as Psalm xc., which appears to have been written by Moses. Many of the psalms are inscribed with the names Korah, Jeduthun, and others, from the persons who were to sing them.

PSALMANAZAR, George, the fictitious name of a pretended Formosan, a person of learning and ingenuity. Born in France, he was educated in a free school, and afterwards in a college of Jesuits, in an archiepiscopal city, the name of which, as likewise those of his birth-place and his parents, are unknown. Upon leaving the college he was recommended as a tutor to a young gentleman, but soon fell into a mean and rambling life, which involved him in disappointments and misfortunes. His first pretence was that of being a sufferer for religion. He procured a certificate that he was of Irish extraction, that he had left that country for the sake of the Catholic faith, and was going on a pilgrimage to Rome. But being unable to purchase a pilgrim's garb, and observing one in a chapel, dedicated to a miraculous saint, which had been set up as a monument of gratitude by some wandering pilgrims, he contrived to take away both the staff and the cloak; and, thus accoutred, he begged his way in fluent Latin, accosting only clergymen or persons of figure, whom he found so generous and credulous that, before he had gone twenty miles, he might easily have saved money, and put himself in a much better dress. As soon as he had got what he thought sufficient, however, he begged no more, but viewed everything worth seeing, and then retired to some inn, where he spent his money as freely as he had obtained it. Having heard the Jesuits speak much of China and Japan, he started the wild scheme, when he was in Germany, of passing for a native of the island of Formosa; and what he wanted in knowledge he supplied by a pregnant invention. He formed a new character and language on grammatical principles, which, like other oriental languages, he wrote from right to left with great readiness; and he planned a new religion, and a division of the year into twenty months, with other novelties, in order to give credit to his pretensions. He now assumed the character of a Japanese convert to Christianity, travelling for instruction, with an appearance of greater wretchedness than even that of common beggars. He then entered as a soldier in the Dutch service; but, being still desirous of passing for a Japanese, he altered his plan to that of being an unconverted heathen; and at Sluys, Brigadier Lauder, a Scotch colonel, introduced him to the chaplain, who, with the view of recommending himself to the bishop of London, resolved to carry him over to England. At Rotterdam, some persons having put shrewd questions to him, that carried an air of scepticism, he took one more whimsical step, which was to live upon raw flesh, roots, and herbs, thinking that such strange food would remove all scruples. The bishop of London patronized him with credulous humanity; and Psalmanazar found a large circle of friends, who extolled him as a prodigy. Yet there were some who entertained a just opinion of him, particularly Dr Halley, Dr Mead, and Dr Woodward; but their endeavours to expose him as a cheat only made others think the better of him, especially as these gentlemen were supposed to be unfriendly to revelation. In this instance at least, easiness of belief was no great evidence of penetration. He was employed to translate the church catechism into the Formosan language, which was examined, approved, and laid up as a valuable manuscript; and the author, after writing his well-known History of Formosa, was rewarded and sent to Oxford to study what he liked, whilst his patrons and opponents were learnedly disputing at London on the merits of his work. The learned members of the university were no better agreed in their opinions than the savans of London; but at length the sceptics triumphed. Some absurdities were discovered in his history, of such a nature as to discredit the whole narration, and saved him the trouble of an open declaration of his imposture, which, however, he owned at length to his private friends. For the remainder of his life, his learning and ingenuity enabled him to procure a comfortable support by his pen; and he was concerned in several works of credit, particularly The Universal History. He lived irreproachably for many years, and died some time in 1763.

PSALMIST, in the church of Rome, is one of the lesser ecclesiastical orders, being the same with what amongst us is called *clerk*, *precentor*, or *singer*.

PSALMODY, from the Greek, ψαλμος, the art or act of singing psalms. (See PSALM.) The earliest music of the Psalms is not now known. The modern Jewish psalmody is by no means the same in all their synagogues in different countries. Psalms were sung by the primitive Christians, but there are no data to show the precise nature of the melodies. St Augustin (lib. x. Confess. cap. 33) says, "De Alexandrino Episcopo Athanasio sæpe mihi dictum commemini, qui tum modico flexu vocis faciebat sonare lectorem psalmi, ut pronuncianti vicinior esset quam canenti." St Athanasius was made bishop of Alexandria in 326. Of the Ambrosian and Gregorian chants of the fourth and sixth centuries, time and change seem to have spared little more than the tonalities. In Roman Catholic church services the psalmody varies according to the particular occasion; and so also in some Protestant churches. Many of the psalm-tunes now in general use in Protestant churches were composed in the time of Luther, or not long afterwards, for the Protestant congregations which then began to spread over the European continent. Others of these tunes are the productions of various Protestant musicians in later times. Amongst the authors of these more recent tunes, we find the names of some of the Bachs, of Handel, and several other eminent German composers. Psalm-tunes are for voices only, or for voices accompanied by the organ, or for voices accompanied by different instruments; others for a single voice alone, or accompanied, and so on.

PSALTER, the same with the book of Psalms. Amongst the religious in the Catholic countries, the term *psalter* is also given to a large chaplet or rosary, consisting of a hundred and fifty beads, according to the number of psalms in the psalter.

PSALTERIUM, Greek ψαλτηριον, formerly called *magadis*, according to Athenæus, an ancient musical instrument, which some writers assert to have been the same as the ancient Hebrew *nebel*. The more modern psaltery being no longer in use, it is unnecessary to describe it.

PSAMMETICUS, or PSAMMITICHUS, a renowned conqueror, who, having subdued eleven petty kings of Egypt, became the founder of the kingdom of Egypt, about 670 before Christ. He is memorable, likewise, for taking the city of Azot, after a siege of twenty-nine years, and for discovering the sources of the river Nile.

PSATYRIANS, a sect of Arians, who, in the council of Antioch, held in the year 360, maintained that the Son was not like the Father as to will; that he was taken from nothing, or made out of nothing; and that in God, generation was not to be distinguished from creation.

PSELLUS, MICHAEL, a learned Christian of the eleventh century, was, by birth, a Constantinopolitan of consular rank, and flourished under the Emperor Constantine Monomachus. His genius and industry raised him far above the level of his contemporaries; and the celebrated historian, Anna Comnena, speaks of him as one who had been more indebted for his attainments to his own excellent talents than to the instructions of his preceptors; adding, that having made himself master of all the wisdom of the Greeks and the Chaldæans, he was justly esteemed the most learned man of the age. Thus furnished, he became the chief instructor of the Constantinopolitan youth. He was at the same time the companion and the preceptor of the emperor, who became so captivated by the studies and amusements in which Psellus engaged him, that, according to Zonaras, he neglected the concerns of the empire. The Byzantine historians complain, that the emperor, deluded by the head of the philosophers, the title with which Psellus was honoured, lost the world. Towards the close of his life, Psellus, meeting with some disappointment, retired into a monastery, and soon afterwards died; but the time of his death is uncertain. His works, which have been much celebrated, are, Commentaries upon Aristotle's Logic and Physics; a Compendium of Questions and Answers; and an explanation of the Chaldaic Oracles. The two latter works prove him to have been conversant, not only with Grecian, but with oriental philosophy.

PSEUDO, from ψευδος, a Greek term, used in the composition of many works to denote *false* or *spurious*.

PSEUDONYMOUS, amongst critics, is an author who publishes a book under a false or feigned name; as *cryp-*

tonymous is given to him who publishes one under a disguised name, and *anonymous* to him who publishes without any name at all.

PSYLLI, a people in the south of Cyrenaica, so called from Psyllus, their king, and who were almost all overwhelmed by sand. They had something in their bodies fatal to serpents, and their very savour proved a charm against them.

PTOLEMAIS, in *Ancient Geography*, the port of Arsinoë, situated on the western bank of the Nile, which concurs to form the island called *Nomos Heracleotes*, to the south of the vertex of the Delta.

Ptolemais, the largest and most considerable town of the Thebais, or Upper Egypt, and nothing short of Memphis. It was situated on the western side of the Nile, almost opposite to Coptos. This town was built by Ptolemy Philadelphus.

PTOLMEY Soter, or *Lagus*, king of Egypt, a renowned warrior and an excellent prince. He established an academy at Alexandria, and was himself a man of letters. He died at the age of ninety-two, 284 years before Christ.

Ptolemy *Philadelphus*, his second son, succeeded him, to the exclusion of Ptolemy Ceraunus. He was renowned as a conqueror, but more revered for his great virtues and political abilities. He established and augmented the famous library of Alexandria, which had been begun by his father. He also greatly increased the commerce of Egypt, and granted considerable privileges to the Jews, from whom he obtained a copy of the Old Testament, which he caused to be translated into Greek, and deposited in his library. This is supposed to have been the version denominated that of the *Septuagint.* He died at the age of sixty-four, 246 years before Christ.

Ptolmey *Ceraunus*, the elder brother of the preceding, fled to Seleucus king of Macedonia, who received him hospitably; in return for which Ceraunus assassinated him, and usurped his crown. He then invited Arsinoë, the widow and the sister of the murdered king, to share with him the government; but as soon as he got her in his power, he put her and her children to death. He was at length defeated, killed, and torn limb from limb, by the Gauls, 279 years before Christ.

Ptolmey, *Claudius*, a celebrated mathematician and astrologer, was born at Pelusium in Egypt. He flourished at Alexandria in the second century, under the reigns of Hadrian and Marcus Aurelius, about the 138th year of the Christian era. There are still extant his Geography, and several learned works on astronomy, the principal of which are, 1. The Almagest; 2. *De Judiciis Astrologicis;* 3. *Planisphærium.* His system of the world was for many years adopted by philosophers and astronomers; but the learned have long rejected it for the system of Copernicus.

PTYALISM, in *Medicine*, a salivation, or frequent and copious discharge of saliva. The word is Greek, being formed from the verb *πτυω, to spit.*

PUBERTY denotes the age at which the person is capable of procreating or begetting children.

Puberty, in *Law*, is fixed at the age of twelve in females and fourteen in males; after which they are reckoned fit for marriage. But as to crimes and punishments, the age of puberty is fixed at fourteen in both sexes.

PUBLIUS Syrus, a celebrated writer of mimes, that is, farces in the language of the common people, flourished at Rome about B. C. 42. He was of Syrian extraction, as his name implies, and was brought to Rome as a slave; but his talents having excited the admiration of his master, he received his freedom. His farces were much admired, and Julius Cæsar is said to have considered them as superior even to those of Laberius. He interspersed them with moral sentences, many of which have been preserved by later writers. St Jerome states that a collection of these moral sentences was made, and that the Romans employed them as a school-book. They have been again collected from various sources, and published several times, along with Seneca or Phædrus; and they have also been published separately. The best edition is that of J. C. Orelli, Leipzig, 1822, or that of C. Zell, Stuttgard, 1829.

PUBNA, a town of Hindustan, in the province of Bengal, sixty-three miles east from Moorshedabad. Long. 89. 12. E. Lat. 24. N.

PUCHMARY, a town of Northern Hindustan, in the province of Kemaon, situated at the top of a very steep pass in the mountain, in the neighbourhood of which is a cave containing an image of Maha Deo, and his wife Bowanee, to which pilgrims pay their devotions. A perpendicular cliff is also pointed out here, from which the Hindus precipitate themselves as an offering to their idols. Lat. not ascertained.

PUCKHOLI, the capital of a mountainous district of Hindustan, thought to be the Peucelaotis of the Greeks. It was besieged by the army of Alexander, and now belongs to an Afghan chief. Long. 72. 8. E. Lat. 33. 46. N. The district is mountainous, and is situated on the eastern side of the river Indus, about the thirty-fourth degree of north latitude. The climate here is cold, with frequent falls of snow, even in the plains; and it produces all the grains and fruits of Europe. The inhabitants are a rude and savage race, amongst whom there is no security for either life or property.

PUCQULOE, a town of Hindustan, in the province of Bengal, and district of Dacca. Long. 89. 55. E. Lat. 24. 8. N.

PUDDAR, a river of Hindustan, which rises in the province of Ajmeer, and empties itself into the Gulf of Cutch, thirty miles south-west of Janagur.

PUDUCOTTA, a town of Hindustan, in the Southern Carnatic, and district of Tanjore. It was formerly the capital of Tondiman, the hereditary polygar or landholder of a considerable district. It is thirty-two miles south-southwest from Tanjore. Long. 78. 50. E. Lat. 10. 20. N.

PUEGOS, or Siquior, one of the Philippine Islands. It is small, but abounds in inhabitants, who are brave and warlike. It is 50 miles north from the western part of Mindanao.

PUDSEY, a township of the west riding of Yorkshire, in the wapentake of Morley and parish of Calverly, 197 miles from London. It has an establishment settled in 1748, by a colony of Moravians from Germany, who built a village called Fulneck, from the name of the place whence they had emigrated. The large building appropriated to their use has a chapel, a dining-room, and separate divisions for the two sexes till marriage, which is said to be determined by lot. They pursue various manufacturing branches of industry. The population of the township amounted in in 1811 to 4697, in 1821 to 6229, and in 1831 to 7460.

PUERTO-REAL, a city of Spain, in Andalusia, in the province or portedo of Cadiz. It stands on the bay which takes its name from that city, and has a canal communicating with it. It is near the mouth of the river Guadalete, and is defended towards the water by some powerful batteries. It has a tolerable haven, in which there are establishments for building ships. The streets are wide and clean, and many of the houses magnificent. It contains five churches, three monasteries, a naval hospital, 1050 houses, and between 10,000 and 11,000 inhabitants. Near to it are these great masses of salt which are produced by natural evaporation from sea-water, and with which hundreds of ships are yearly loaded to all parts of the world.

PUFFENDORF, Samuel de, a very distinguished jurist and historian, was born in 1631, at Fleh, a little village in Misnia, a province in Upper Saxony, being the son of Elias Puffendorf, minister of that place. After having made great progress in the sciences at Leipzig, he turned his thoughts to the study of public law; which in Germany consists of the knowledge of the rights of the empire over the princes and states of which it is composed, and those of the princes and states with respect to each other. But though he used his utmost efforts to distinguish himself, he despised those pompous titles which are so much sought after at universities, and never would take the degree of doctor. He accepted the place of governor to the son of Coyet, a Swedish nobleman, who was then ambassador from Sweden to the court of Denmark. For this purpose he went to Copenhagen, but did not continue long at his ease there; for the war being some time afterwards renewed between Denmark and Sweden, he was seized, along with the whole family of the ambassador. During his confinement, which lasted eight months, as he had no books, and was not allowed to see any person, he amused himself by meditating on what he had read in the treatise of Grotius, *De Jure Belli et Pacis*, and the political writings of Hobbes. Out of these he drew up a short system, to which he added some thoughts of his own, and published it at the Hague in 1660, under the title of *Elementa Jurisprudentiæ Universalis*. This recommended him to the elector palatine, who invited him to the university of Heidelberg, where he founded in his favour a professorship of the law of nature and nations, which was the first chair of the kind established in Germany. Puffendorf remained at Heidelberg till 1673, when Charles XI. of Sweden gave him an invitation to become professor of the law of nature and nations at Lunden; a place which the elector palatine reluctantly allowed him to accept. He went thither the same year; and after that time his reputation greatly increased. Some years afterwards, the king of Sweden sent for him to Stockholm, and appointed him historiographer and one of his counsellors. In 1688, the elector of Brandenburg obtained the consent of his Swedish majesty that Puffendorf should come to Berlin in order to write the history of the elector William the Great; and in the year 1694 the elector made him a baron. But he died the same year, of an inflammation in his feet, occasioned by cutting his nails, having already attained his grand climacteric. Of his works, which are numerous, the following are the principal, viz. 1. A Treatise on the Law of Nature and Nations, written in German, of which there is an English translation with Barbeyrac's Notes; 2. An Introduction to the History of the Principal States which at present subsist in Europe, written in German, but also translated into English; 3. The History of Sweden, from Gustavus Adolphus's Expedition into Germany to the Abdication of Queen Christina; 4. The History of Charles Gustavus, in two vols. folio.

PULARIM, or POLAROON, one of the Banda Isles, and the smallest of the whole. The possession of this island was contested between the English East India Company and the Dutch. The English obtained possession of it in 1617, but were repeatedly expelled by the Dutch. In 1665 it was formally delivered up to the English, but in so desolated a state, the whole of the spice-trees having been destroyed, that it was rendered useless for eight years. In 1666 it was re-occupied by the Dutch. Long. 129. 45. E. Lat. 5. 35. N.

PULAWY, a city of Poland, in the province of Lublin, and the circle of that name. It stands on the right bank of the Vistula, over which is a ferry where the roads on both sides are concentrated. It is in a beautiful situation, rising above and overlooking the river. It contains 430 houses, with 3200 inhabitants, who carry on some woollen and other manufactures. It is distinguished by the magnificent palace adjoining to it, belonging, as well as the city and the surrounding district, to the celebrated family of Prince Czartoryski. It is a building of noble construction, having an extensive park laid out in the English style, with elegant drives and walks, and many beautiful trees. In the park is a museum of curiosities, and in the castle a curious and valuable library of 60,000 volumes, and many manuscripts illustrative of the ancient history of Poland. Long. 21. 41. E. Lat. 51. 25. N.

PULLICAT, a town of Hindustan, on the sea-coast of the Carnatic, situated on the borders of a salt-water lake, thirty-three miles in length by eleven in breadth, containing several islands, and communicating with the sea. This lake owes its existence to the sea breaking through a low sandy beach, and overflowing the lands within. The Dutch first settled here in 1609, which, after the loss of Negapatam, became the seat of their government on the Coromandel coast. The inhabitants are principally manufacturers and fishermen, who manufactured the handkerchiefs that took their name from this town. In 1795, when war commenced between Great Britain and Holland, the East India Company's troops took possession of this place, which is now comprehended in the northern division of the Arcot collectorship. It is twenty-five miles north of Madras. Long. 80. 25. E. Lat. 13. 26. N.

PULMARY, a town of Hindustan, in the nizam's dominions, in the province of Aurungabad. It is thirty miles west of Jalnapoor. Long. 76. 3. E. Lat. 19. 59. N.

PULO, in the Eastern languages, means *small*, and this epithet is accordingly applied to numerous islands in the Eastern Seas, the chief of which are comprised in the following list.

PULO AKAT, a small island in the Eastern Seas, near the north-east coast of Ceram, in long. 131. 3. E. lat. 3. 6. S. Pulo Ampal, Pulo Anam, two small islands near the western coast of Sumatra, the first in long. 99. 29. E. lat. 0. 44. S., the second in long. 99. 27. E. lat. 0. 40. S. Pulo Anna, a small island in the Pacific Ocean, in long. 131. 46. E. lat. 4. 38. N. Pulo Aru, in the Straits of Malacca, in long. 100. 24. E. lat. 2. 57. N. Pulo Ay, a small island in the Eastern Seas, to the westward of the Great Banda. It is rich in the production of spices, the soil being particularly favourable to the growth of the nutmeg tree. Pulo Ayer, near the west coast of Sumatra. Long. 100. 12. E. Lat. 1. 11. S. Pulo Babee, in the Straits of Sunda. Long. 106. 10. E. Lat. 5. 45. S. Pulo Babi, near the north coast of the island of Nias, where there is abundance of buffaloes and hogs. Pulo Bally, divided from the island of Bachian by a channel five miles wide. It is about two miles round, and has abundance of wood and fresh water. Pulo Baniack, about twenty-five miles in circumference, off the west coast of Sumatra, between the second and third degrees of north latitude. Pulo Batu, an island about forty miles off the western coast of Sumatra, forty miles long and twelve broad. Long. 97. 56. E. Lat. 0. 20. N. Pulo Bava, near the south coast of Nias. Long. 97. 18. E. Lat. 0. 52. N. Pulo Bicie, an elevated island in the Straits of Sunda. Pulo Bintango, near the west coast of Sumatra. Long. 99. 47. E. Lat. 0. 58. S. Pulo Brasse, of a triangular form, about ten miles in circumference, near the north-west coast of Sumatra. Long. 95. 30. E. Lat. 5. 39. N. Pulo Bringen, near the west coast of Sumatra. Long. 100. 21. E. Lat. 1. 58. S. Pulo Cannibaz, on the southern coast of Java, from which it is separated by a narrow strait. It is twenty miles in length by six in average breadth. Long. 109. 25. E. Lat. 7. 50. S. Pulo Casse, in the Eastern Seas, near the west coast of Sumatra. Long. 99. 28. E. Lat. 0. 20. S. Pulo Condore Isles, a cluster of small islands in the Eastern Seas, situated off the south coast of Cambodia. The principal island is twelve miles in length and three in breadth. The inhabitants are mostly refugees from Cochin China, and can supply ships that touch here, with some refreshments. Their flat faces and long and small eyes denote a Chinese origin. The English had a settlement here in 1704. Pulo Dammer, in the Eastern Seas, about thirty miles in circumference, near the south coast of Gilolo. Long. 128. 22. E. Lat. 0. 58. S. Pulo Datte, in the Eastern Seas, near the west coast of Borneo. Long. 108. 59. E. Lat. 0. 8. N. Pulo Doa, near the west coast of Sumatra. Long. 97. 33. E. Lat. 1. 18. N. Pulo Docan, Long. 105. 39. E. Lat. 1. 2. S. Pulo Dua, near the west coast of Sumatra. Long. 97. E. Lat. 2. 46. N. Pulo Een, on the north coast of Waygiou. Long. 130. 37. E. Lat. 0. 12. N. Pulo Ely, near the west coast of Sumatra. Long. 98. 11. E. Lat. 1. 6. N. Pulo Gasseb, near the south-east coast of the island of Ceram. Long. 131. 13. E. Lat. 3. 29. S. Pulo Gasses, near the east coast of the island of Oby. Long. 128. 20. E. Lat. 1. 37. S. Pulo Goere, near the north coast of Sumatra. Long. 97. 42. E. Lat. 4, 42. N. Pulo Gontei, near the coast of Sumatra. Long. 95. 23. E. Lat. 5. 15. N. Pulo Gunton, in the Straits of Malacca. Long. 101. 38. E. Lat. 1. 22. N. Pulo Jarejah, in the Straits of Malacca, three miles long, with abundance of wood and water. Pulo Kaka, off the south-west of the island of Celebes, about fifteen miles long. Pulo Kapini, or Iron Wood Island, between the west coast of Sumatra and Pulo Batu. Pulo Lalang, in the Straits of Malacca, about fifty miles in circumference. Long. 100. 9. E. Lat. 2. 25. N. Pulo Laut, situated at the south entrance of the Straits of Macassar, near the south-east coast of the island of Borneo, about a hundred miles in circumference. It is but thinly inhabited, and produces chiefly rice. The channel which separates it from Borneo is about two miles wide and eight fathoms deep all the way, and is a good harbour for shipping. Long. 116. 24. E. Lat. 3. 45. S. Pulo Laut, Little, a group of small islands, eighteen miles south of Pulo Laut. Long. 115. 55. E. Lat. 4. 54. S. Pulo Lawn, Long. 128. 48. E. Lat. 1. 33. S. Pulo Leat, Long. 107. 5. E. Lat. 2. 51. S. Pulo Majo, near the north coast of Cumbava. Long. 117. 20. E. Lat. 8. 11. S. Pulo Malora, near the north coast of Sumatra. Long. 95. 39. E. Lat. 5. 24. N. Pulo Mariore, in the Pacific Ocean. Long. 131. 57. E. Lat. 4. 17. N. Pulo Marra, near the west coast of Sumatra. Long. 99. 48. E. Lat. 1. 2. S. Pulo Mega, a small uninhabited island surrounded by a coral reef. Latitude not ascertained. Pulo Moar, near the east coast of Gilolo. Long. 128. 58. E. Lat. 0. 6. N. Pulo Nako-Nako, a cluster of small islands near the western coast of the island of Nias. Large quantities of cocoa-nut oil are exported. Pulo Nancy, near the north coast of Sumatra, about twenty miles in circumference. Long. 95. 21. E. Lat. 5. 18. N. Pulo Niamo, near the west coast of Sumatra. Long. 99. 45. E. Lat. 1. 8. S. Pulo Nye, near the west coast of the island of Poggy. Long. 99. 32. E. Lat. 2. 48. S. Pulo Pahang, near the coast of Malacca, about five miles from the town of Pahang. Pulo Panca, near the west coast of Sumatra. Long. 98. 35. E. Lat. 0. 18. N. Pulo Panjang, in the Eastern Seas, on the north coast of the island of Java, in the bay of Bantam. Long. 104. 55. E. Lat. 1. 3. S. Pulo Penneu, near the west coast of Sumatra. Long. 100. 2. E. Lat. 1. 28. S. Pulo Pinang, see PRINCE OF WALES ISLAND. Pulo Pisang, Long. 128. 49. E. Lat. 1. 22. S. Another of this name, one of the Banda Islands, two miles north-east of Banda Neira. Pulo Prampton, one of the Banda Islands. Long. 130. 38. E. Lat. 4. 2. S. Pulo Ron, near the south-east coast of Gilolo. Long. 128. 30. E. Lat. 0. 48. S. Pulo Rondo, a cluster of small islands to the north of Sumatra. Long. 95. 22. E. Lat. 4. 45. N. Pulo Roopat, an island in the Straits of Malacca, 120 miles in circumference, separated by a narrow channel from the island of Sumatra. Long. 101. 9. E. Lat. 1. 58. N. Pulo Rou, near the coast of Malacca. Long. 102. 12. E. Lat. 7. N. Pulo Sabadda, near the west coast of Sumatra. Long. 99. 53. E. Lat. 1. 3. S. Pulo Sabuda, about thirty miles west from New Guinea. Long. 131. 48. E. Lat. 2. 35. S. Pulo Salanama, in the Straits of Malacca, near the north coast of the island of Sumatra. Long. 98. 51. E. Lat. 3. 27. N. Pulo Sallier, in the Eastern Seas. Long. 105. 56. E. Lat. 5. 50. S. Pulo Sambolong, a cluster of islands at the entrance of the river Pera, on the coast of Malacca. Pulo Sanding or Sandiang, two small islands near the south-eastern extremity of the Nassau or Poggy Isles, in which group they are sometimes included. Pulo See Booro, near the north coast of the island of Pera. Long. 99. 9. E. Lat. 1. 52. S. Pulo See Geere, near the north coast of the island of Pera. Long. 99. 10. E. Lat. 1. 55. S. Pulo Seyer, a cluster of small islands. Long. 97. 15. E. Lat. 8. 40. N. Pulo Sonaro, near the west coast of Sumatra. Long. 99. 42. E. Lat. 0. 53. S. Pulo Suanjee, one of the Banda Islands. Long. 130. 20. E. Lat. 4. 6. S. Pulo Tamong, near the west coast of Sumatra. Long. 98. 24. E. Lat. 0. 27. N. Pulo Taya, Long. 104. 57. E. Lat. 0. 42. S. Pulo Teega, near the west coast of Sumatra. Long. 99. 40. E. Lat. 0. 52. S. Pulo Tellore, near the west coast of Sumatra. Long. 100. 15. E. Lat. 1. 42. S. Pulo Timoan, a mountainous and woody island, inhabited by Malays. It produces in abundance rice, and the cabbage and the cocoa-nut trees. Long. 104. 25. E. Lat. 3. N. Pulo Timpalis, in the Straits of Malacca, near the north-east coast of Sumatra. Long. 94. 45. E. Lat. 4. 27. N. Pulo Toti, between the islands of Borneo and Sumatra, in lat. 0. 53. S. Pulo Troosan, near the west coast of Sumatra. Long. 99. 58. E. Lat. 1. 6. S. Pulo Tullong, in the Straits of Malacca. Long. 100. 33. E. Lat. 4. 27. N. Pulo Varella, in the Straits of Malacca, about twenty miles off the north-east coast of Sumatra. Long. 99. 36. E. Lat. 3. 47. N. Pulo Way, one of the Spice Islands, in the Eastern Seas, about nine miles west of Gorong Apee. Long. 130. 26. E. Lat. 4. 9. S. Pulo Way, an island about thirty miles in circumference, near the north coast of Sumatra. Long. 95. 33. E. Lat. 5. 33. N.

PULPIT, an elevated place in a church, from which sermons are delivered. The French give the same name to a reading desk.

PULPITUM, in the Grecian and Roman theatres, was a place where the players performed their parts. It was lower than the scena, and higher than the orchestra, nearly answering to what we call the stage, as distinguished from the pit and the galleries. *Pulpitum* was also a moveable desk or pulpit, from which disputants pronounced their dissertations, and authors recited their works.

PULSE, in the animal economy, denotes the beating or throbbing of the heart and arteries.

No doctrine has been involved in greater difficulties than that of pulses, since, in giving a physiological account of them, physicians have espoused quite opposite sentiments; whilst some doubt whether the pulse is owing to the systole or diastole, as also, whether the motion of the heart and arteries be one and the same for a given instant of time.

With regard to motion, the pulses are reckoned only four; the great and little, the quick and slow. When quickness and greatness are joined together, it becomes violent; and when it is little and slow it is called a weak pulse. Pulses are also said to be frequent and rare, equal and unequal; but these are not the essential affections of motion. Frequency and quickness are often confounded with each other. A pulse is said to be hard or soft, with regard to the artery, according as it is tense, renitent, and hard, or flaccid, soft, and lax; for as the disposition of the arteries contributes greatly to the change of the pulse, it sometimes happens that the pulse in both arms is not alike, which is very common in hemiplexy. To these may be added a convulsive pulse, which does not proceed from the blood, but from the state of the artery, and is known by a tremulous subsultory motion, whilst the artery seems to be drawn upwards. This, in acute fevers, is the sign of death, and is said to be the pulse in dying persons, which is likewise generally unequal and intermitting. A great pulse shows a more copious afflux of the blood to the heart, and thence into the arteries; a little pulse indicates the contrary.

The pulses of persons differ according to the largeness of the heart and vessels, the quantity and temperies of the blood, the elastic force of the canals, and also with regard to the sex, age, season, air, motion, food, sleep, watchings, and passions of the mind. The pulse is larger and quicker in men than in women; in the bilious and sanguineo-bilious, than in the phlegmatic and melancholic. Those who are lean, with tense fibres and large vessels, have a greater and a stronger pulse than those who are fat, with lax fibres and small vessels; and hence they are much more healthy, robust, and apt for labour. In children the pulse is quick and soft, in adults greater and more violent. In the old it is commonly great, hard, and slow. Labour, motion, and exercise of the body, increase the circulation of the blood, the excretions, and particularly respiration; rest renders the circulation slow and weak. Animated speaking increases the circulation, and consequently renders the pulse large and quick. In watching, the pulse is more evident; in sleep, slower and more languid. After drinking hot things, such as coffee and tea, or hot-bath waters, as well as after meals, the pulse vibrates more quickly. But nothing produces a greater change in the pulse than the affections of the mind. In terror it is unequal, small, and contracted; in joy, frequent and great; in anger, quick and hard; in sadness, slow, small, deep, and weak; and in intense study, languid and weak. With regard to the atmosphere, when, after the predominance of a west or south wind, it comes round to north or east, the pulse is stronger and larger; and also when the quicksilver rises in the barometer. But when the atmosphere is dense, humid, and rainy, with a long south wind, and also where the life is sedentary, the sleep long, and the season autumnal, the pulse is languid and small, and the perspiration decreased. In May it is great, and sometimes violent; in the middle of summer, quick but weak; in the autumn, slow, soft, and weak; in the winter, hard and great. A drastic purge and an emetic render the pulse hard, quick, and weak, with loss of strength; chalybeates and bark render it great and robust, and the complexion lively; volatiles amplify and increase the pulse; acids and nitrous remedies refrigerate the body and appease the pulse; opiates and the like render it small and weak, and decrease the elasticity of the solids; and poisons render it small, contracted, and hard. When the quantity of the blood is too great, bleeding raises the pulse.

PULTAWA, a government of the Russian empire, extending in north latitude from 48. 48. to 51. 4. and in east longitude from 30. 20. to 35. 55., and comprehending 16,236 square miles. It is bounded on the north-west by Tchernigow and a part of Kursk, on the north-east by Slobodsk-Ukraine, on the south-east by Ykaterinoslav, on the south-west by Cherson, and on the west by Kiew. It contains twenty-two cities and towns, and 983 parishes, with 1,933,000 inhabitants. It is generally a plain, with scarcely any elevations, and is drained by the river Dnieper, which passes on its western sides, receives the waters of all the smaller streams, and is navigable to the sea. It is perhaps the best cultivated and the most productive of all the Russian provinces, yielding very good crops of corn, chiefly rye, and also affording more of wheat, barley, oats, and buckwheat, than the domestic consumption requires. The produce of flax, hemp, and tobacco, as well as beans and pease, is abundant. Wine is raised, but not copiously, because, there being no hills to protect the vines from the sharp northerly and easterly winds, they are injured by frost. The steppes cover a part of the province, but they produce excellent grass, and fatten numerous herds of black cattle. There are no mines in the province; but some chalk, limestone, and saltpetre are obtained. There are some manufactures of woollen and of linen cloth of the coarser kinds, and some excellent leather is prepared. The chief manufactured article for exportation is corn brandy, to which purpose the greater portion of the surplus grain is applied. Though the river Dnieper is always navigable, yet the small streams are not so, except for a short time in the spring; and as the roads are heavy, this obstacle opposes the export of the productions, and limits the trade to very narrow bounds.

PULTAWA, a city of Russia, the capital of the government of the same name, as well as of the circle. It is situated on the river Borskla, where the Pultawka falls into that stream. It is the see of a bishop of an extensive diocese, is surrounded with earthen walls, has a cathedral and nine other churches, 1200 houses, and 10,000 inhabitants. It has been rendered celebrated as the place of refuge of Charles XII. of Sweden, after his defeat in 1709. It is 948 miles from St Petersburg. Long. 34. 35. E. Lat. 43. 33. N.

PULTENEY, WILLIAM, the famous opponent of Sir Robert Walpole in parliament, and afterwards Earl of Bath, was descended from one of the most ancient families in the kingdom, and born in the year 1682. Possessing an affluent fortune, he early procured a seat in the House of Commons, and distinguished himself as a warm partisan against Queen Anne's ministry, whose errors he had the sagacity to detect and the eloquence to expose. When George I. came to the throne, Mr Pulteney was made secretary at war, and soon afterwards cofferer to the king's household; but the good understanding between this gentleman and Sir Robert Walpole, who then acted as prime minister, was interrupted in 1725, on a suspicion that Walpole was desirous of extending the limits of prerogative, and of promoting the interests of Hanover, to the prejudice of those of Britain. His opposition to Sir Robert was indeed carried to such indiscriminate lengths, that some persons have been of opinion he often acted against measures beneficial to the public, merely from personal motives. It would be impracticable here to trace his parliamentary conduct. It may suffice to observe in general, that he became so obnoxious to the crown, that in 1731 the king called for the council-book, and with his own hand struck out his name from the list of privy-councillors; a proceeding which only served to inflame his resentment and increase his popularity. He still continued to attack the minister with a severity of eloquence and sarcasm that worsted every antagonist; and Sir Robert was heard to declare, that he dreaded that man's tongue more than another man's sword. At length, in 1741, when Walpole found the place of prime minister no longer tenable, and resigned, amongst other promotions Mr Pulteney resumed his place in the privy-council, and was created Earl of Bath; a title purchased at the expense of that popularity which he afterwards naturally enough affected to contemn. In 1760, towards the close of the war, he published A Letter to two Great Men, recommending proper articles to be insisted on in a treaty of peace; a production which, though the writer was then unknown, was greatly applauded, and went through several impressions. He died in 1764; and, as his only son had died before him, the title became extinct.

PULVERIZATION, the art of pulverizing, or reducing a dry body into a fine powder. This is performed in friable bodies by pounding or beating them in a mortar; but to pulverize malleable ones, other methods must be taken. To pulverize lead or tin, the method is this: Rub a round wooden box all over the inside with chalk; pour a little of the melted metal nimbly into the box; then shut the lid, and shake the box briskly, when the metal will be reduced to powder.

PUMICE-STONE RIVER, a river on the east coast of New Holland, entered by Captain Flinders in 1799, and so called from the quantity of pumice-stone found on its shores. It falls into Glass-house Bay.

PUMP.

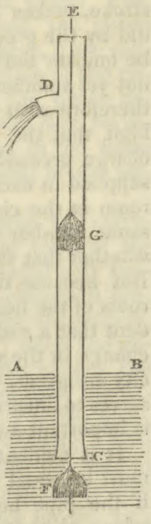
Pump, an hydraulic machine for raising water by means of the pressure of the atmosphere.

Of the invention of pumps.

It would be interesting to learn the progressive steps by which the ingenuity of man has invented the various methods of raising water. A pump must be considered as the last step of this progress. Common as it is, it is a very abstruse and refined invention. Nothing like it has been found in any of the rude nations, either in the new continent of America, or the islands of the Pacific Ocean. Nay, it was unknown in China at the time of our arrival there by sea, and it is still a rarity everywhere in Asia, in places unfrequented by Europeans. It does not appear to have been known to the Greeks and Romans in early times; and perhaps it came from Alexandria, where physical and mathematical science was much cultivated by the Greek school under the protection of the Ptolemies. The performances of Ctesibius and Hero are spoken of by Pliny and Vitruvius as curious novelties.[1] It is perhaps not difficult to trace the steps by which those mechanicians were led to the invention. The Egyptian wheel was a common machine all over Asia, and is still in use in the remotest parts, and was brought by the Saracens into Spain, where it is still very common under its ancient name *noria*. The Danish missionaries found in a remote village in the kingdom of Siam the immediate offspring of the noria (*Lettres Edifiantes et Curieuses*). It was a wheel turned by an ass, and carrying round, not a string of earthen pots, but a string of wisps of hay, which it drew through a wooden trunk. This rude chain-pump was in frequent use for watering the rice fields. It is highly probable that it is of great antiquity, although we do not recollect its being mentioned by any of the Greek or Roman writers. The Arabs and Indians were nothing less than innovators; and we may suppose with great safety, that what arts we now find among them they possessed in very remote periods. Now the step from this to the pump is but short, though it is nice and refined; and the forcing pump of Ctesibius is the easiest and most natural.

Ctesibius's pumps.

Fig. 1.



Let AB (fig. 1) be the surface of the water in the well, and D the height where it is to be delivered. Let DC be a long wooden trunk, reaching as deep under water as possible. Let the rope EF be fitted with its knot of hay F. When it is drawn up through the trunk, it will bring up along with it all the water lying between C and A, which will begin to run out by the spout D as soon as the knot gets to G, as far below D as C is below A. All this is very obvious; and it required but little reflection to be assured, that if F was let down again, or pushed down, by a rod instead of a rope, it would again perform the same office. Here is a very simple pump. And if it was ever put in practice, it behoved to show the supporting power of the atmosphere, because the water would not only be lifted by the knot, but would even follow it. The imperfection of this pump behoved to appear at first sight, and to suggest its remedy. By pushing down the knot F, which we shall henceforth call the *piston*, all the force expended in lifting up the water between A and G is thrown away, because it is again let down. A valve G at the bottom would prevent this. But then there must be a passage made for the water by a lateral tube KBD (fig. 2). And if this be also furnished with a valve H, to prevent its losing the water, we have the pump of Ctesibius, as sketched in fig. 2. The valve is the great refinement; but perhaps even this had made its appearance before in the noria. For, in the more perfect kinds of these machines, the pots have a stop or valve in their bottom, which hangs open while the pot descends with its mouth downwards, and then allows it to fill readily in the cistern; whereas, without the valve, it would occasion a double load to the wheel. If we suppose that the valve had made its appearance so early, it is not improbable that the common pump sketched in fig. 3 was as old as that of Ctesibius. In this place we shall first give a short description of the chief varieties of these engines, considering them in their simplest form; and we shall explain, in very general terms, their mode of operation. We shall then give a concise and popular theory of their operation, furnishing principles to direct us in their construction; and we shall conclude with the description of a few peculiarities which may contribute to their improvement or perfection.

There are but two sorts of pumps which essentially differ; and all the varieties that we see are only modifications of these. One of these original pumps has a solid piston; the other has a piston with a perforation and a valve. We usually call the first a *forcing pump*, and the second a *lifting* or *sucking pump*.

Forcing pump described.

Fig. 2.

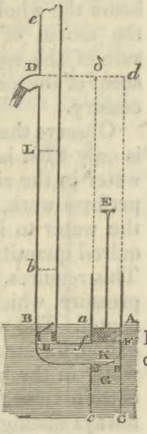


Fig. 2 is a sketch of the forcing pump in its most simple form and situation. It consists of a hollow cylinder AC *ca*, called the *working barrel*, open at both ends, and having a valve G at the bottom opening upwards. This cylinder is filled by a solid piston EF, covered externally with leather or tow, by which means it fits the box of the cylinder exactly, and allows no water to escape by its sides. There is a pipe KHD, which communicates laterally with this cylinder, and has a valve at some convenient place H, as near as possible to its junction with the cylinder. This valve also opens upwards. This pipe, usually called the *rising pipe* or *main*, terminates at the place D, where the water must be delivered.

Its mode of operation.

Now suppose this apparatus set into the water, so that the upper end of the cylinder may be under or even with the surface of the water AB; the water will open the valve G, and after filling the barrel and lateral pipe, will also open the valve H, and at last stand at an equal height within and without. Now let the piston be put in at the top of the working barrel, and thrust down to K. It will push the water before it. This will shut the valve G, and the water will make its way through the valve H, and fill a part B*b* of the rising pipe, equal to the internal capacity of the working barrel. When this downward motion of the piston ceases, the valve H will fall down by its own weight and shut this passage. Now let the piston be drawn up again. The valve H hinders the water in the rising pipe from returning into the working barrel. But now the valve G is opened by the pressure of the external water, and the water enters and fills the cylinder as the piston rises. When the piston has got to the top, let it be thrust down again. The valve G will again be shut, and the water will be forced through the passage at H, and rise along the main, pushing before it the water already there, and will now have its surface at L. Repeating this operation, the water must at last arrive at D, however remote; and the next stroke would raise it to *e*; so that during the next rise of the piston the water in *e*D will be running off by the spout.

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[1] In the early Greek writings, it does not appear that the words ἀντλος, ἀντλειν, ἀντλια, &c. were used to express any thing like what we call a pump. In all the passages where these words occur, they either express generally the drawing of water, or, more particularly, the drawing it with a bucket or something similar. Ἀντλος, which is the primitive, is a drain, sink, or receptacle for collecting water, either for use or to get rid of it; hence it came to signify the sink or well of a ship; and ἀντλειν was synonymous with our

The effect is the same whatever be the position of the working barrel, provided only that it be under water. It may lie horizontally or sloping, or it may be with its mouth and piston rod undermost. It is still the same forcing pump, and operates in the same manner and by the same means, viz. the pressure of the surrounding water.

The external force which must be applied to produce this effect is opposed by the pressure exerted by the water on the opposite face of the piston. It is evident, from the common laws of hydrostatics, that this opposing pressure is equal to the weight of a pillar of water having the face of the piston for its base, and the perpendicular height *d*A of the place of delivery above the surface of the water AB in the cistern for its height. The form and dimensions of the rising pipe are indifferent in this respect, because heavy fluids press only in the proportion of their perpendicular height. Observe that it is not *d*F, but *d*A, which measures this pressure, which the moving force must balance and surmount. The whole pressure on the under surface F*f* of the piston is indeed equal to the weight of the pillar *d*F*f*δ; but part of this is balanced by the water AF*f*α. If, indeed, the water does not get into the upper part of the working barrel, this compensation does not obtain. While we draw up the piston, this pressure is removed, because all communication is cut off by the valve H, which now bears the whole pressure of the water in the main. Nay, the ascent of the piston is even assisted by the pressure of the surrounding water. It is only during the descent of the piston, therefore, that the external force is necessary.

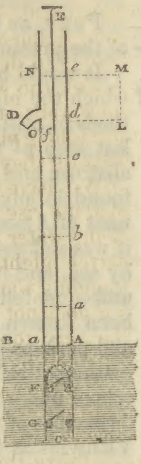
Observe that the measure now given of the external force is only what is necessary for *balancing* the pressure of the water in the rising pipe. But in order that the pump may perform work, it must *surmount* this pressure, and cause the water to issue at D with such a velocity that the required quantity of water may be delivered in a given time. This requires force, even although there were no opposing pressure, which would be the case if the main were horizontal. The water fills it, but it is at rest. In order that a gallon, for instance, may be delivered in a second, the whole water in the horizontal main must be put in motion with a certain velocity. This requires force. We must therefore always distinguish between the state of equilibrium and the state of actual working. It is the equilibrium only that we consider at present; and no more is necessary for understanding the operation of the different species of pumps. The other force is of much more intricate investigation, and will be considered by itself.

Lifting pump.

The simplest form and situation of the lifting pump is represented by the sketch fig. 3. The pump is immersed in the cistern till both the valve G and piston F are under the surface AB of the surrounding water. By this means the water enters the pump, opening both valves, and finally stands on a level within and without.

Its mode operating

Fig. 3.



Now draw up the piston to the surface A. It must lift up the water which is above it (because the valve in the piston remains shut by its own weight); so that its surface will now be at *a*, A*a* being made equal to *a*F. In the mean time, the pressure of the surrounding water forces it into the working barrel, through the valve G; and the barrel is now filled with water. Now, let the piston be pushed down again; the valve G immediately shuts by its own weight, and in opposition to the endeavours which the water in the barrel makes to escape this way. This attempt to compress the water in the barrel causes it to open the valve F in the piston; or rather this valve yields to our endeavour to push the piston down through the water in the working barrel. By this means we get the piston to the bottom of the barrel; and it has now above it the whole pillar of water reaching to the height *a*. Drawing up the piston to the surface A a second time must lift this double column along with it, and its surface will now be at *b*. The piston may again be thrust down through the water in the barrel, and again drawn up to the surface, which will raise the water to *c*. Another repetition will raise it to *d*; and it will now show itself at the intended place of delivery. Another repetition will raise it to *e*; and while the piston is now descending to make another stroke, the water in *e d* will be running off through the spout D; and thus a stream will be produced, in some degree continual, but very unequal. This is inconvenient in many cases: thus, in a pump for domestic uses, such a hobbling stream would make it very troublesome to fill a bucket. It is therefore usual to terminate the main by a cistern LMNO, and to make the spout small. By this means the water brought up by the successive strokes of the piston rises to such a height in this cistern as to produce an efflux by the spout nearly equable. The smaller we make the spout D the more equable will be the stream; for when the piston brings up more water than can be discharged during its descent, some of it remains in the cistern. This, added to the supply of next stroke, makes the water rise higher in the cistern than it did by the preceding stroke. This will cause the efflux to be quicker during the descent of the piston, but perhaps not yet sufficiently quick to discharge the whole supply. It therefore rises higher next stroke; and at last it rises so high that the increased velocity of efflux makes the discharge precisely balance the supply. Now, the quantity supplied in each stroke is the same, and occupies the same room in the cistern at top: and the surface will sink the same number of inches during the descent of the piston, whether that surface has been high or low at the beginning. But because the velocities of the efflux are as the square roots of the heights of the water above the spout, it is evident that a sink of two or three inches will make a smaller change in the velocity of efflux when this height and velocity are great. This seems but a trifling observation; but it serves to illustrate a thing to be considered afterwards, which is important and abstruse, but perfectly similar to this.

It is evident that the force necessary for this operation must be equal to the weight of the pillar of water *d* A *a* D, if the pipe be perpendicular. If the pump be standing aslope, the pressure which is to be balanced is still equal to

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expression "to bale the boat." (*Odyssey*, O. 476, M. 411; Euripides, *Hecuba*, 1025.) 'Αντλιον is the *vessel* or *bucket* with which water is drawn. 'Αντλια is the service, which was generally a punishment, of drawing water. 'Αντλειν means to draw water with a bucket; hence the force of Aristotle's expression (*Œcon.* i.) τῳ γαρ ἠθμῳ ἀντλειν τουτ' ἐστι. The authority of the New Testament (John, ii. 8; iv. 7, 11) is to the same effect. Here ἀντλημα is evidently something which the woman brought along with her, probably a bucket and rope.

the weight of a pillar of water of this perpendicular height, and having the surface of the piston for its base.

Such is the simplest, and, we may add, by far the best, form of the forcing and lifting pumps; but it is not the most usual. Circumstances of convenience, economy, and more frequently of fancy and habit, have caused the pump-makers to deviate greatly from this form. It is not usual to have the working barrel in the water; this, especially in deep wells, makes it of difficult access for repairs, and requires long piston-rods. This would not do in a forcing pump, because they would bend.

Effect of riving the istou a onger troke.

We have supposed, in our account of the lifting pump, that the rise of the piston always terminated at the surface of the water in the cistern. This we did in order that the barrel might always be filled by the pressure of the surrounding water. But let us suppose that the rise of the piston does not end here, and that it is gradually drawn up to the very top: it is plain that the pressure of the atmosphere is by this means taken off from the water in the pipe (see PNEUMATICS), while it remains pressing on the water of the cistern. It will therefore cause the water to follow the piston as it rises through the pipe, and it will raise it in this way thirty-three feet at a medium. If, therefore, the spout D is not more than thirty-three feet above the surface of the water in the cistern, the pipe will be full of water when the piston is at D. Let it be pushed down to the bottom; the water will remain in the pipe, because the valve G will shut: and thus we may give the piston a stroke of any length not exceeding thirty-three feet. If we raise it higher than this the water will not follow; but it will remain in the pipe, to be lifted by the piston, after it has been pushed down through it to the bottom.

But it is not necessary, and would be very inconvenient, to give the piston so long a stroke. The great use of a pump is to render effectual the reciprocation of a short stroke which we can command, while such a long stroke is generally out of our power. Suppose that the piston is pushed down only to *b*; it will then have a column *b*O incumbent on it, and it will lift this column when again drawn up. And this operation may be repeated like the former, when the piston was always under water; for the pressure of the atmosphere will always cause the water to follow the piston to the height of thirty-three feet.

Nor is it necessary that the fixed valve G be placed at the lower orifice of the pipe, nor even under water. For, while things are in the state now described, the piston drawn up to O, and the whole pipe full of water, if we suppose another valve placed at *b* above the surface of the cistern, this valve can do no harm. Now let the piston descend, both valves G and *b* will shut. G may now be removed, and the water will remain supported in the space *b*G by the air; and now the alternate motions of the piston will produce the same effect as before.

Effect of he weight f the wa- er and ressure of he atmo- phere.

We found in the former case that the piston was carrying a load equal to the weight of a pillar of water of the height A*d*, because the surrounding water could only support it at its own level. Let us see what change is produced by the assistance of the pressure of the atmosphere. Let the under surface of the piston be at *b*; when the water was at *f*, 33 feet above the surface of the cistern, the water was raised to that height by the pressure of the atmosphere. Suppose a partition made at *b* by a thin plate, and all the water above it taken away. Now pierce a hole in this plate. The pressure of the atmosphere was able to carry the whole column O*a*. Part of this column is now removed, and the remainder is not a balance for the air's pressure. This will therefore cause the water to spout up through this hole and rise to O. Therefore the under surface of this plate is pressed up by the contiguous water with a force equal to the weight of that pillar of water which it formerly supported; that is, with a force equal to the weight of the pillar O*b*. Now the under surface of the piston, when at *b*, is in the same situation. It is pressed upwards by the water below it, with a force equal to the weight of the column O*b*; but it is pressed downwards by the whole pressure of the atmosphere, which presses on all bodies, that is, with the weight of the pillar O*b*. On the whole, therefore, it is pressed downwards by a force equal to the difference of the weights of the pillars O*a* and O*b*; that is, by a force equal to the weight of the pillar *ba*.

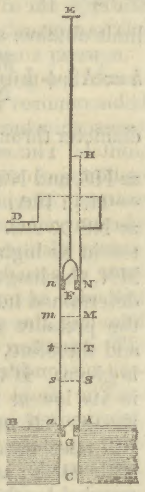
It may be conceived better perhaps in this way. When the piston was under the surface of the water in the cistern, it was equally pressed on both sides, both by the water and the atmosphere. The atmosphere exerted its pressure on it by the intervention of the water, which being to all sense a perfect fluid, propagates every external pressure undiminished. When the piston is drawn up above the surface of the pit-water, the atmosphere continues to press on its upper surface with its whole weight, through the intervention of the water which lies above it; and its pressure must therefore be added to that of the incumbent water. It also continues to press on the under surface of the piston by the intervention of the water; that is, it presses this water to the piston. But, in doing this, it carries the weight of this water which it is pressing on the piston. The pressure on the piston therefore is only the excess of the whole pressure of the atmosphere above the weight of the column of water which it is supporting. Therefore the difference of atmospherical pressure on the upper and under surfaces of the piston is precisely equal to the weight of the column of water supported in the pipe by the air. It is not, however, the individual weight of this column that loads the piston; it is the part of the pressure of the atmosphere on its upper surface, which is not balanced by its pressure on the under surface.

In attempting, therefore, to draw up the piston, we have to surmount this unbalanced part of the pressure of the atmosphere, and also the weight of the water which lies above the piston, and must be lifted by it; and thus the whole opposing pressure is the same as before, namely, the weight of the whole vertical pillar reaching from the surface of the water in the cistern to the place of delivery. Part of this weight is immediately carried by the pressure of the atmosphere; but, in lieu of it, there is an equal part of this pressure of the atmosphere abstracted from the under surface of the piston, whilst its upper surface sustains its whole pressure.

Other circumstances to be attended to.

So far, then, these two states of the pump agree. But they differ exceedingly in their mode of operation; and there are some circumstances not very obvious which must be attended to, in order that the pump may deliver any water at the spout D. This requires, therefore, a serious examination.

Fig. 4.



Let the fixed valve G (fig. 4) be supposed at the surface of the cistern water. Let M*m* be the lowest and N*n* the highest positions of the piston, and let HA = *h* be the height of a column of water equiponderant with the atmosphere.

When the pump is filled, not with water, but with air, and the piston is in its lowest position, and all in equilibrio, the internal air has the same density and elasticity with the external. The space MA*am*, therefore, contains air of the common density and elasticity. These may be measured by *h*, or the weight of a column of water whose height is *h*. Now, let the piston be drawn up to N*n*. The air which occupied the space MA*am* now occupies the space NA*an*, and its density is now $\frac{\text{MA}am}{\text{NA}an}$. Its elasticity is now diminished, being proportionable to its density (see PNEUMATICS), and no longer balances the pressure of the atmosphere. The valve G will therefore be forced up by the water, which will rise to some height SA. Now let the piston again descend to M*m*. It cannot do this with its valve shut; for when it comes down so far as to reduce the air again to its common density, it is not yet at M, because the space below it has been diminished by the water which got into the pipe, and is retained there by the valve G. The piston-valve, therefore, opens by the air which we thus attempt to compress, and the superfluous air escapes. When the piston has got to M, the air is again of the common density, and occupies the space MS*sm*. Now draw the piston up to N. The air will expand into the space NS*sn*, and its density will be reduced to $\frac{\mathrm{MS}sm}{\mathrm{NS}sn}$, and its elasticity will no longer balance the pressure of the atmosphere, and more water will enter, and it will rise higher. But it may happen that the water will never rise so high as to reach the piston, even though not thirty-three feet above the water in the cistern: for the successive diminutions of density and elasticity are a series of quantities that decrease geometrically, and therefore will have a limit. Let us see what determines this limit.

When the piston descends, its valve, as we have already seen, is opened by the force arising from the compression of the air below it. Now if this force should at length become equal to the pressure of the atmosphere above the valve, it is clear that the valve could not open. Supposing the water to be at S, and the piston at N; then, if, from the peculiar construction of the pump, it should so happen that the air which has been compressed into the space MS*sm*, by the descent of the piston, regains an elastic force merely equal to the pressure of the external air, the valve in the piston would remain closed, and consequently no more air could escape. Were the working of the piston, in such circumstances, to be continued, the air below it would alternately fill the spaces MS*sm* and NS*sn*, the water meanwhile rising no higher than S.

At whatever height the water stands in the lower part of the pipe, the weight of the column of water SA*as*, together with the remaining elasticity of the air above it, exactly balances the pressure of the atmosphere. (See PNEUMATICS.) Now the elasticity of the air in the space NS*sn* is equal to $h \times \frac{\mathrm{MS}sm}{\mathrm{NS}sn}$. Therefore, in the case where the limit obtains, and the water rises no farther, we must have $h = \mathrm{AS} + h\,\frac{\mathrm{MS}sm}{\mathrm{NS}sn}$, or, because the column is of the same diameter throughout, $h = \mathrm{AS} + h\,\frac{\mathrm{MS}}{\mathrm{NS}}$, and $\frac{\mathrm{MS}}{\mathrm{NS}}\,h = h - \mathrm{AS}$, $= \mathrm{HS}$, and $\mathrm{NS} : \mathrm{MS} = \mathrm{HA} : \mathrm{HS}$, and $\mathrm{NS} - \mathrm{MS} : \mathrm{NS} = \mathrm{HA} - \mathrm{HS} : \mathrm{HA}$, or $\mathrm{MN} : \mathrm{NS} = \mathrm{AS} : \mathrm{AH}$, and $\mathrm{MN} \times \mathrm{AH} = \mathrm{NS} \times \mathrm{AS}$. Therefore, if AN, the distance of the piston in its highest position from the water in the cistern, and MN, the length of its stroke, be given, there is a certain determined height AS to which the water can be raised by the pressure of the air: for AH is a constant quantity; and therefore, when MN is given, the rectangle AS × SN is given. If this height AS be less than that of the piston in its lowest position, the pump will raise no water, although AN may be less than AH. Yet the same pump will raise water very effectually, if it be first of all filled with water; and we have seen professional engineers much puzzled by this capricious failure of their pumps. A little knowledge of the principles would have prevented their disappointment.

Delivery of water.

To insure the delivery of water by the pump, the stroke must be such that the rectangle MN × AH may be greater than any rectangle that can be made of the parts of AN, that is, greater than the square of half AN. Or, if the length of the stroke be already fixed by other circumstances, which is a common case, we must make AN so short that the square of its half, measured in feet, shall be less than thirty-three times the stroke of the piston.

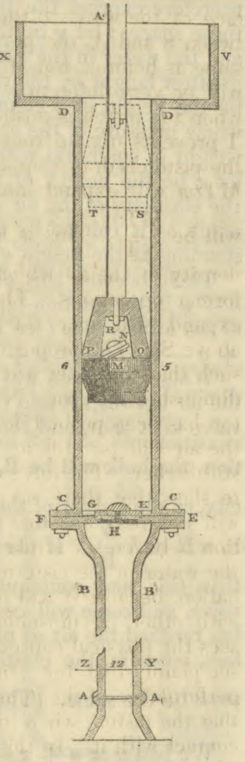
Suppose that the fixed valve, instead of being at the surface of the water in the cistern, is at S, or anywhere between S and A, the performance of the pump will be the same as before; but if it be placed anywhere above S, it will be very different. Let it be at T. It is plain that when the piston is pushed down from N to M, the valve at T prevents any air from getting down; and therefore, when the piston is drawn up again, the air contained in the space MT*tm* will expand into the space NT*tn*, and its density will be $\frac{\mathrm{MT}}{\mathrm{NT}}$. This is less than $\frac{\mathrm{MS}}{\mathrm{NS}}$, which expresses the density of the air which was left in the space TS*st* by the former operations. The air, therefore, in TS*st* will also expand, will open the valve, and now the water will rise above S. The proportion of NS to NT may be evidently such that the water will even get above the valve T. This diminishes the space NT*tn*; and therefore, when the piston has been pushed down to M, and again drawn up to N, the air will be still more rarefied, and the water will rise still higher. The foregoing reasoning, however, is sufficient to show that there may still be a height which the water will not pass, and that this height depends on the proportion between the stroke of the piston and its distance from the water in the cistern. We need not give the determination, because it will come in afterwards in combination with other circumstances. It is enough that the reader sees the physical causes of this limitation; and, lastly, we see plainly that the utmost security will be given for the performance of the pump, when the fixed valve is so placed that the piston, when in its lowest position, shall come into contact with it. In this case, the rarefaction of the air will be the completest possible; and if there were no space left between the piston and valve, and all were perfectly air-tight, the rarefaction would be complete, and the valve might be anything less than thirty-three feet from the surface of the water in the cistern.

Valves no easily kep air-tight.

But this perfect contact and tightness is unattainable; and though the pump may be full of water, its continual downward pressure causes it to filtrate slowly through every crevice, and the air enters through every pore, and even disengages itself from the water, with which a considerable portion had been chemically combined. The pump by this means loses water, and it requires several strokes of brisk working to fill it again; and if the leathers have become dry, so much admission may be given to the air, that the pump will not fill itself with water by *any working*. It is then necessary to pour water into it, which shuts up these passages, and soon sets all to rights again. For these reasons, it is always prudent to place the fixed valve as low as other circumstances will permit, and to make the piston-rod of such a length, that when it is at the bottom of its stroke it shall be almost in contact with the valve. When we are not limited by other circumstances, it is evident that the best possible form is to have both the piston and the fixed valve under the surface of the water of the cistern. In this situation they are always wet and air-tight. The chief objection is, that by this disposition they are not easily come at when needing repair. This is a material objection in deep mines. In such situations, therefore, we must make the best compensation of different circumstances that we can. It is usual to place the fixed valve at a moderate distance from the surface of the water, and to have a hole in the side of the pipe, by which it may be got out. This is carefully shut up by a plate firmly screwed on, with leather or cement between the parts. This is called the *clack-door*.

It would, in every case, be very proper to have a fixed valve in the lower end of the pipe. This would combine all advantages. Being always tight, the pipe would retain the water, and it would leave to the valve above it its full effect of increasing the rarefaction.

Fig. 5.



A similar hole is made in the working barrel, a little above the highest position of the piston. When this needs repair, it can be got at through this hole, without the immense trouble of drawing up the whole rods.

Thus we have conducted the reader, step by step, from the simplest form of the pump to that which long experience has at last selected as the most generally convenient. This we shall now describe in some detail.

Description of the sucking pump.

The *sucking pump* consists of two pipes DCCD, BAAB (fig. 5); of which the former is called the *barrel*, or the *working barrel*, and the other is called the *suction-pipe*, and is commonly of a smaller diameter. These are joined by means of flanches E, F, pierced with holes to receive screwed bolts. A ring of leather, or of lead, covered with a proper cement, is put between them; which, being strongly compressed by the screw-bolts, renders the joint perfectly air-tight. The lower end A of the suction-pipe is commonly spread out a little to facilitate the entry of the water, and frequently has a grating across at AA to keep out filth or gravel. This is immersed in the standing water YZ. The working barrel is cylindrical, as evenly and smoothly bored as possible, that the piston may fill it exactly through its whole length, and move along it with as little friction as may be consistent with air-tightness.

Air-tightness not properly attended to.

The piston is a sort of truncated cone OPKL, generally made of wood not made to slip, such as elm or beech. The small end of it is cut off at the sides, so as to form a sort of arch OQP, by which it is fastened to the iron rod or spear. It is exhibited in different positions in figures 6, 7, which will give a more distinct notion of it than any description. The two ends of the conical part may be hooped with brass. This cone has its larger end surrounded with a ring or band of strong leather fastened with nails, or by a copper hoop, which is driven on it at the smaller end. This band should reach to some distance beyond the base of the cone; the farther the better; and the whole must be of uniform thickness all round, so as to suffer equal compression between the cone and the working barrel. The seam or joint of the two ends of this band must be made very close, but not sewed or stitched together. This would occasion bumps or inequalities, which would spoil its tightness; and no harm can result from the want of it, because the two edges will be squeezed close together by the compression in the barrel. It is by no means necessary that this compression be great. This is a very detrimental error of the pump-makers. It occasions enormous friction, and destroys the very purpose which they have in view, viz. rendering the piston air-tight; for it causes the leather to wear through very soon at the edge of the cone, and it also wears the working barrel. This very soon becomes wide in that part which is continually passed over by the piston, while the mouth remains of its original diameter, and it becomes impossible to thrust in a piston which shall completely fill the worn part.

Fig. 6.

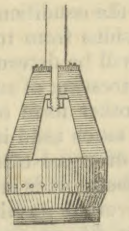
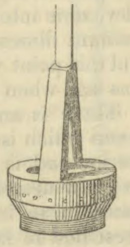


Fig. 7.



An easy mode of rendering pumps tight.

Now, a very moderate pressure is sufficient for rendering the pump perfectly tight, and a piece of glove-leather would be sufficient for this purpose, if loose or detached from the solid cone; for suppose such a loose and flexible, but impervious, band of leather put round the piston, and put into the barrel; and let it even be supposed that the cone does not compress it in the smallest degree to its internal surface. Pour a little water carefully into the inside of this sort of cup or dish; it will cause it to swell out a little, and apply itself close to the barrel all round, and even adjust itself to all its inequalities. Let us suppose it to touch the barrel in a ring of an inch broad all round. We can easily compute the force with which it is pressed. It is half the weight of a ring of water an inch deep and an inch broad. This is a trifle, and the friction occasioned by it not worth regarding; yet this trifling pressure is sufficient to make the passage perfectly impervious, even by the most enormous pressure of a high column of incumbent water; for let this pressure be ever so great, the pressure by which the leather adheres to the barrel always exceeds it, because the incumbent fluid has no *preponderating* power by which it can force its way between them, and it must insinuate itself precisely so far that its pressure on the inside of the leather shall still exceed, and only exceed, the pressure by which it endeavours to insinuate itself; and thus the piston becomes perfectly tight with the smallest possible friction. This reasoning is perhaps too refined for the uninstructed artist, and probably will not persuade him. To such we would recommend an examination of the pistons and valves contrived and executed by that artist whose skill far surpasses our highest conceptions, the All-wise Creator of this world. The valves which shut up the passages of the veins, and this in places where an extravasation would be followed by instant death, are cups of thin membrane, which adhere to the sides of the channel about half way round, and are detached in the rest of their circumference. When the blood comes in the opposite direction, it pushes the membrane aside, and has a passage perfectly free. But a stagnation of motion allows the tone of the muscular (perhaps) membrane, to restore it to its natural shape, and the least *motion* in the opposite direction causes it instantly to clap close to the sides of the vein, and then no pressure whatever can force a passage.

Best form of a piston recommended.

What we have said is enough for supporting our directions for constructing a tight piston. But we recommended thick and strong leather, while our present reasoning seems to render thin leather preferable. If the leather be thin, and the solid piston in any part does not press it gently to the barrel, there will be in this part an unbalanced pressure of the incumbent column of water, which would instantly burst even a strong leather bag; but when the solid piston, covered with leather, exactly fills the barrel, and is even pressed a little to it, there is no such risk; and now that part of the leather band which reaches beyond the solid piston performs its office in the completest manner. We do not hesitate, therefore, to recommend this form of a piston, which is the most common and simple of all, as preferable, when well executed, to any of those more artificial, and frequently very ingenious, constructions, which we have met with in the works of the first engineers. To proceed, then, with our description of the sucking pump.

Further description of the sucking pump.

At the joining of the working barrel with the suction-pipe there is a hole H, covered with a valve opening upwards. This hole H is either made in a plate which makes a part of the suction-pipe, being cast along with it, or it is made in a separate plate. This last is the most convenient, being easily removed and replaced. Different views are given of this valve in figs. 8, 9, 10. The diameter EF (fig. 10) of this plate is the same with that of the flanches, and it has holes corresponding to them, through which their bolts pass, which keep all together. A ring of thick leather NKL is applied to this plate, having a part cut out between N and L, to make room for another piece of strong leather NR (fig. 9), which composes the valve. The circular part of this valve is broader than the hole in the middle of fig. 10, but not quite so broad as to fill up the inside of the ring of leather OQP of this figure, which is the same with GKI of fig. 10. The middle of this leather valve is strengthened by two brass (not iron) plates, the uppermost of which is seen at R of fig. 9; the one on its under side is a little smaller than the hole in the valve-plate, that it may go freely in; and the upper plate R is larger than this hole, that it may compress the leather to its brim all round. It is evident that when this plate with its leathers is put between the joint-flanches, and all is screwed together, the tail of leather N of fig. 9 will be compressed between the plates, and form a hinge, on which the valve can turn, rising and falling. There is a similar valve fastened to the upper side, or broadest base of the piston. This description serves for both valves, and in general for most valves which are to be found in any parts of a pump.

Fig. 8.

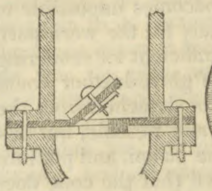


Fig. 9.

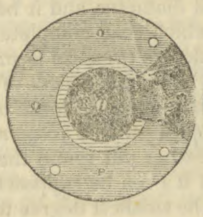
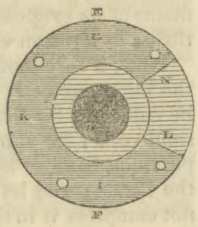


Fig. 10.



Its mode of operation.

The reader will now understand, without any repetition, the process of the whole operation of a sucking pump. The piston rarefies the air in the working barrel, and that in the suction-pipe expands through the valve into the barrel; and, being no longer a balance for the atmospheric pressure, the water rises into the suction-pipe; another stroke of the piston produces a similar effect, and the water rises farther, but by a smaller step than by the preceding stroke; by repeating the strokes of the piston the water gets into the barrel; and when the piston is now pushed down through it, it gets above the piston, and may now be lifted up to any height. The suction-pipe is commonly of smaller size than the working barrel, for the sake of economy. It is not necessary that it be so wide; but it may be, and often is, made too small. It should be of such a size that the pressure of the atmosphere may be able to fill the barrel with water as fast as the piston rises. If a void is left below the piston, it is evident that the piston must be carrying the whole weight of the atmosphere, besides the water which is lying above it. Nay, if the pipe be only so wide that the barrels shall fill precisely as fast as the piston rises, it must sustain all this pressure. The suction-pipe should be wider than this, that all the pressure of the atmosphere which exceeds the weight of the pillar in the suction-pipe may be employed in pressing it on the under surface of the piston, and thus diminish the load. It cannot be made too wide; and too strict an economy in this respect may very sensibly diminish the performance of the pump, and more than defeat its own purpose. This is most likely when the suction-pipe is long, because there the length of the pillar of water nearly balances the air's pressure, and leaves very little accelerating force; so that water will rise but slowly even in the widest pipe. All these things will be made the subjects of computation afterwards.

It is plain that there will be limitations to the rise of the water in the suction-pipe, similar to what we found when the whole pump was an uniform cylinder. Let a be the height of the fixed valve above the water in the cistern; let B and b be the spaces in cubic measure between this valve and the piston in its highest and lowest positions, and therefore express the bulks of the air which may occupy these spaces; let y be the distance between the fixed valve and the water in the suction-pipe, when it has attained its greatest height by the rarefaction of the air above it; let h be the height of a column of water in equilibrio with the whole pressure of the atmosphere, and therefore having its weight in equilibrio with the elasticity of common air; and let x be the height of the column whose weight balances the elasticity of the air in the suction-pipe, when rarefied as much as it can be by the action of the piston, the water standing at the height $a-y$.

Then, because this elasticity, together with the column $a-y$ in the suction-pipe, must balance the whole pressure of the atmosphere (see PNEUMATICS), we must have $h=x+a-y$, and $y=a+x-h$.

When the piston was in its lowest position, the bulk of the air between it and the fixed valve was b. Suppose the valve kept shut, and the piston raised to its highest position, the bulk will be B, and its density $\frac{b}{\text{B}}$, and its elasticity, or the height of the column whose weight will balance it, will be $h\frac{b}{\text{B}}$. If the air in the suction-pipe be denser than this, and consequently more elastic, it will lift the valve, and some will come in; therefore, when the pump has rarefied the air as much as it can, so that none does, in fact, come in, the elasticity of the air in the suction-pipe *must* be the same. Therefore $x=h\frac{b}{\text{B}}$.

We had $y=a+x-h$. Therefore $y=a+h\frac{b}{\text{B}}-h$,

$$=a+\frac{b-\text{B}}{\text{B}}h, =a-\frac{\text{B}-b}{\text{B}}h.$$

Therefore, when $\frac{b-\text{B}}{\text{B}}h$ is less than a, the water will stop before it reaches the fixed valve. But when a is less than $\frac{\text{B}-b}{\text{B}}h$, the water will get above the fixed valve, y becoming negative.

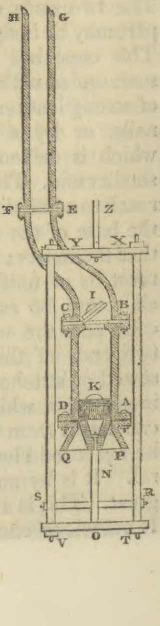
But it does not follow that the water will reach the piston, that is, will rise so high that the piston will pass through it in its descent. Things now come into the condition of a pump of uniform dimensions from top to bottom; and this point will be determined by what was said when treating of such a pump.

The same pump is used in an inverted position.

There is another form of the sucking pump which is much used in great water-works, and is of equal efficacy with the one now described. It is indeed the same pump in an inverted position. It is represented in fig. 11, where ABCD is the working barrel, immersed, with its mouth downwards, in the water of the cistern. It is joined by means of flanches to the rising pipe or *main*.

This usually consists of two parts. The first, BEFC, is bent to one side, that it may give room for the iron frame TXYV, which carries the rod NO of the piston M, attached to the traverses RS, TOV of this frame. The other part, EGHF, is usually of a less diameter, and is continued

Fig. 11.



to the place of delivery. The piston-frame XTVY hangs by the rod Z, at the end of a lever or working beam, not brought into the figure. The piston is perforated like the former, and is surrounded, like it, with a band of leather in form of a taper-dish. It has a valve K on its broad or upper base, opening when pressed from below. The upper end of the working barrel is pierced with a hole, covered with a valve I, also opening upwards.

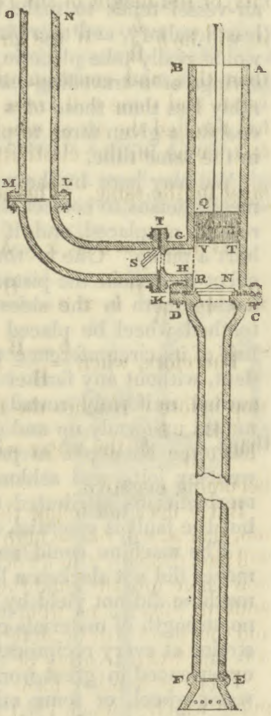
Now suppose this working apparatus immersed into the cistern, and the piston drawn up till it touch the end of the barrel. When the piston is allowed to descend by its own weight, the water rises up through its valve K, and fills the barrel. If the piston be now drawn up by the moving power of the machinery with which it is connected, the valve K shuts, and the piston pushes the water before it through the valve I into the main pipe EFGH. When the piston is again let down, the valve I shuts by its own weight and the water incumbent on it, and the barrel is again filled by the water of the cistern. Drawing up the piston pushes this water into the main pipe, &c. and then the water is at length delivered at the place required.

This pump is usually called the *lifting pump;* perhaps the simplest of all in its principles and operation. It needs no farther explanation: and we proceed to describe

Forcing pump described.

The *forcing pump*, represented in fig. 12. It consists of a working barrel ABCD, a suction-pipe CDEF, and a main or rising pipe. This last is usually in three joints. The first, GHKI, may be considered as making part of the working barrel, and is commonly cast in one piece with it. The second, IKLM, is joined to it by flanches, and forms the elbow which this pipe must generally have. The third, LNOM, is properly the beginning of the main, and is continued to the place of delivery. At the joint IK there is a hanging valve or clack S; and there is a valve R on the top of the suction-pipe.

Fig. 12.



The piston PQTV is solid, and is fastened to a stout iron rod, which goes through it, and is fixed by a key drawn through its end. The body of the piston is a sort of double cone, widening from the middle to each end, and is covered with two bands of very strong leather, fitted to it in the manner already described.

Its mode of operation.

The operation of this pump is abundantly simple. When the piston is thrust into the pump, it pushes the air before it through the valve S, for the valve R remains shut by its own weight. When it has reached near the bottom, and is drawn up again, the air which filled the small space between the piston and the valve S now expands into the barrel; for as soon as the air begins to expand, it ceases to balance the pressure of the atmosphere, which therefore shuts the valve S. By the expansion of the air in the barrel the equilibrium at the valve R is destroyed, and the air in the suction-pipe lifts the valve, and expands into the barrel; consequently it ceases to be a balance for the pressure of the atmosphere, and the water is forced into the suction-pipe. Pushing the piston down again forces the air in the barrel through the valve S, the valve R in the mean time shutting. When the piston is again drawn up, S shuts, R opens, the air in the suction-pipe dilates anew, and the water rises higher in it. Repeating these operations, the water gets at last into the working barrel, and is forced into the main by pushing down the piston, and is pushed along to the place of delivery.

The operation of this pump is therefore twofold, sucking and forcing. In the first operation, the same force must be employed as in the sucking pump, namely, a force equal to the weight of a column of water having the section of the piston for its base, and the height of the piston above the water in the cistern for its height. It is for the sake of this part of the operation that the upper cone is added to the piston. The air and water would pass by the sides of the lower cone whilst the piston is drawn up; but the leather of the upper cone applies to the surface of the barrel, and prevents this. The space contained between the barrel and the valve S is a great obstruction to this part of the operation, because this air cannot be rarefied to a very great degree. For this reason, the suction-pipe of a forcing pump must not be made long. It is not indeed necessary; for, by placing the pump a few feet lower, the water will rise into it without difficulty, and the labour of suction is as much diminished as that of impulsion is increased. However, an intelligent artist will always endeavour to make this space between the valve S and the lowest place of the piston as small as possible.

The power employed in forcing must evidently surmount the pressure of the whole water in the rising pipe, and (independent of what is necessary for giving the water the required velocity, so that the proper quantity per hour may be delivered) the piston has to withstand a force equal to the weight of a column of water having the section of the piston for its base, and the perpendicular altitude of the place of delivery above the lower surface of the piston for its height. It is quite indifferent in this respect what is the diameter of the rising pipe; because the pressure on the piston depends on the altitude of the water only, independent of its quantity. We shall even see that a small rising pipe will require a greater force to convey the water along it to any given height or distance.

When we would employ a pump to raise water in a crooked pipe, or in any pipe of moderate dimensions, this form of pump, or something equivalent, must be used. In bringing up great quantities of water from mines, the common sucking pump is generally employed, as really the best of them all; but it is the most expensive, because it requires the pipe to be perpendicular, straight, and of great dimensions, that it may contain the piston-rods. But this is impracticable when the pipe is crooked.

If the forcing pump, constructed in the manner now described, be employed, we cannot use forcers with long rods. These would bend when pushed down by their further extremity. In this case it is usual to employ only a short and stiff rod, and to hang it by a chain, and load it with a weight superior to the weight of water to be raised by it. The machinery therefore is employed, not in forcing the water along the rising pipe, but in raising the weight which is to produce this effect by its subsequent descent.

In this case it would be much better to employ the lifting pump of fig. 11; for as the load on the forcers must be greater than the resistances which it must surmount, the force exerted by the machine must in like manner be greater than this load. This double excess would be avoided by using the lifting pump.

Quantity of water delivered by any pump.

It will readily occur to the reader that the quantity of water delivered by any pump will be in the joint proportion of the surface or base of the piston and its velocity; for this measures the capacity of that part of the working barrel which the piston passes over. The velocity of the water in the conduit-pipe, and in its passage through every valve, will be greater or less than the velocity of the piston, in the same proportion that the area of the piston or working barrel is greater or less than the area of the conduit or valve. For whatever quantity of water passes through any section of the working barrel in a second, the same quantity must go through any one of these passages. This enables us to modify the velocity of the water as we please: we can increase it to any degree at the place of delivery by diminishing the aperture through which it passes, provided we apply sufficient force to the piston.

The operation of pumps not equable.

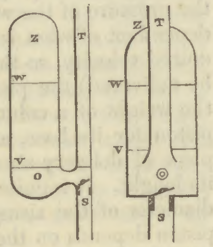
It is evident that the operation of a pump is by starts, and that the water in the main remains at rest, pressing on the valve during the time that the piston is withdrawn from the bottom of the working barrel. It is in most cases desirable to have this motion equable, and in some cases it is absolutely necessary. Thus, in the engine for extinguishing fires, the spout of water going by jerks could never be directed with a certain aim, and half of the water would be lost by the way; because a body at rest cannot in an instant be put in rapid motion, and the first portion of every jerk of water would have but a small velocity.

The mode of making them so.

A very ingenious contrivance has been fallen upon for obviating this inconvenience, and procuring a stream nearly equable. We have not been able to discover the author. At any convenient part of the rising pipe beyond the valve S there is annexed a capacious vessel VZ (fig. 13, No. 1 and 2) close a-top, and of great strength. When the water is forced along this pipe, part of it gets into this vessel, keeping the air confined above it; and it fills it to such a height V that the elasticity of the confined air balances a column reaching to T, we shall suppose, in the rising pipe. The next stroke of the piston sends forward more water, which would fill the rising pipe to some height above T. But the pressure of this additional column causes some more of it to go into the air-vessel, and compress its air so much more that its elasticity now balances a longer column. Every succeeding stroke of the piston produces a like effect. The water rises higher in the main pipe, but some more of it goes into the air-vessel. At last the water *appears* at the place of delivery; and the air in the air-vessel is now so much compressed that its elasticity balances the pressure of the whole column. The next stroke of the piston sends forward some more water. If the diameter of the orifice of the main be sufficient to let the water flow out with a velocity equal to that of the piston, it will so flow out, rising no higher, and producing no sensible addition to the compression in the air-vessel. But if the orifice of the main be contracted to half its dimensions, the water sent forward by the piston cannot flow out in the time of the stroke without a greater velocity, and therefore a greater force. Part of it, therefore, goes into the air-vessel, and increases the compression. When the piston has ended its stroke, and no more water comes forward, the compression of the air in the air-vessel, being greater than what was sufficient to balance the pressure of the water in the main pipe, now forces out some of the water which is lying below it. This cannot return towards the pump, because the valve S is now shut. It therefore goes forward along the main, and produces an efflux during the time of the piston's rising in order to make another stroke. In order that this efflux may be very equable, the air-vessel must be very large. If it be small, the quantity of water that is discharged by it during the return of the piston makes so great a portion of its capacity, that the elasticity of the confined air is too much diminished by this enlargement of its bulk, and the rate of efflux must diminish accordingly. The capacity of the air-vessel should be so great that the change of bulk of the compressed air during the inaction of the piston may be inconsiderable. It must therefore be very strong.

Fig. 13.

No. 1. No. 2.



It is pretty indifferent in what way this air-vessel is connected with the rising pipe. It may join it laterally, as in fig. 13, No. 1, and the main pipe go on without interruption; or it may be made to *surround* an interruption of the main pipe, as in fig. 13, No. 2. It may also be in any part of the main pipe. If the sole effect intended by it is to produce an equable jet, as in ornamental water-works, it may be near the end of the main. This will require much less strength, because there remains but a short column of water to compress the air in it. But it is, on the whole, more advantageous to place it as near the pump as possible, that it may produce an equable motion in the whole main pipe. This is of considerable advantage. When a column of water several hundred feet long is at rest in the main pipe, and the piston at one end of it is put at once into motion, even with a moderate velocity, the strain on the pipe must be very great. Indeed if it were possible to put the piston instantaneously into motion with a finite velocity, the strain on the pipe, tending to burst it, would be next to infinite.

The desultory motion of the pistons.

But this seems impossible in nature; all changes of motion *which we observe* are gradual, because all impelling bodies have some elasticity or softness, by which they yield to compression. And, in the way in which pistons are commonly moved, viz. by cranks, or something analogous to them, the motion is *very sensibly* gradual. But still the air-vessel tends to make the motion along the main pipe less desultory, and therefore diminishes those strains which would really take place in the main pipe. It acts like the springs of a travelling-carriage, whose jolts are incomparably less than those of a cart; and by this means really enables a given force to propel a greater quantity of water in the same time.

We may here by the way observe, that the attempts of mechanicians to correct this unequal motion of the piston-rod are misplaced, and, if it could be done, would greatly hurt a pump. One of the best methods of producing this effect is to make the piston-rod consist of two parallel bars, having teeth in the sides which front each other. Let a toothed wheel be placed between them, having only the half of its circumference furnished with teeth. It is evident, without any farther description, that if this wheel be turned uniformly round its axis, the piston-rod will be moved uniformly up and down without intermission. This has often been put in practice; but the machine always went by jolts, and seldom lasted a few days. Unskilled mechanicians attributed this to defect in the execution; but the fault is essential, and lies in the principle.

The machine could not perform one stroke if the first mover did not slacken a little, or the different parts of the machine did not yield by bending or by compression; and no strength of materials could withstand the violence of the strains at every reciprocation of the motion. This is chiefly experienced in great works which are put in motion by a water-wheel, or some other equal power exerted on the mass of matter of which the machine consists. The water-wheel being of great weight, moves with considerable steadiness or uniformity; and when an additional resistance is opposed to it by the beginning of a new stroke of the piston, its great quantity of motion is but little affected by this addition, and it proceeds very little retarded; and the machine must either yield a little by bending and compression, or go to pieces, which is the common event. Cranks are free from this inconvenience, because they accelerate the piston gradually, and bring it gradually to rest, while the water-wheel moves round with almost perfect uniformity. The only inconvenience (and it may be considerable) attending this slow motion of the piston at the beginning of its stroke is, that the valves do not shut with rapidity, so that some water gets back through them. But when they are properly formed and loaded, this is but trifling.

Equable pumps deliver very little more water than the others.

We must not imagine, that because the stream produced by the assistance of an air-barrel is almost perfectly equable, and because as much water runs out during the returning of the piston as during its active stroke, it therefore doubles the quantity of water. No more water can run out than what is sent forward by the piston during its effective stroke. The continued stream is produced only by preventing the whole of this water from being discharged during this time, and by providing a propelling force to act during the piston's return. Nor does it enable the moving force of the piston to produce a double effect; for the compression which is produced in the air-vessel, more than what is necessary for merely balancing the quiescent column of water, re-acts on the piston, resisting its compression just as much as the column of water would do which produces a velocity equal to that of the efflux. Thus if the water is made to spout with the velocity of eight feet per second, this would require an additional column of one foot high, and this would just balance the compression in the air-vessel, which maintains this velocity during the non-action of the piston. It is, however, a matter of fact, that a pump furnished with an air-vessel delivers a little more water than it would do without it. But the difference depends on the combination of many very dissimilar circumstances, which it is extremely difficult to bring into calculation. Some of these will be mentioned afterwards.

To describe, or even to enumerate, the immense variety of combinations of these three simple pumps, would fill a volume. We shall select a few, which are more deserving of notice.

1. *Sucking Pump converted into a Lifting Pump.*

The sucking pump converted into a lifting pump.

The common sucking pump may, by a small addition, be converted into a lifting pump, fitted for propelling the water to any distance, and with any velocity.

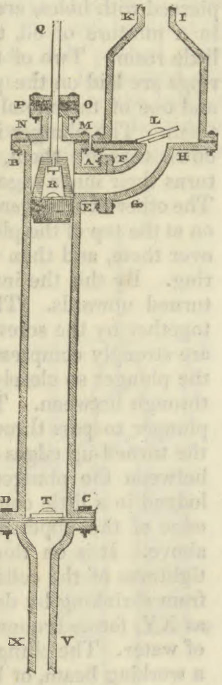


Fig. 14.

Fig. 14 is a sucking pump, whose working barrel ACDB has a lateral pipe AEGHF connected with it close to the top. This terminates in a *main* or rising pipe IK, furnished or not with a valve L. The top of the barrel is shut up by a strong plate MN, having a hollow neck terminating in a small flanch. The piston-rod QR passes through this neck, and is nicely turned and polished. A number of rings of leather are put over the rod, and strongly compressed round it by another flanch and several screwed bolts, as is represented at OP. By this contrivance the rod is closely grasped by the leathers, but may be easily drawn up and down, while all passage of air or water is effectually prevented.

The piston R is perforated, and furnished with a valve opening upwards. There is also a valve T on the top of the suction-pipe VX; and it will be of advantage, though not absolutely necessary, to put a valve L at the bottom of the rising pipe. Now, suppose the piston at the bottom of the working barrel. When it is drawn up, it tends to compress the air above it, because the valve in the piston remains shut by its own weight. The air therefore is driven through the valve L into the rising pipe, and escapes. In the mean time, the air which occupied the small space between the piston and the valve T expands into the upper part of the working barrel; and its elasticity is so much diminished thereby, that the atmosphere presses the water of the cistern into the suction-pipe, where it will rise till an equilibrium is again produced. The next downward stroke of the piston allows the air, which had come from the suction-pipe into the barrel during the ascent of the piston, to get through its valve. Upon drawing up the piston, this air is also drawn off through the rising pipe. Repeating this process brings the water at last into the working barrel, and it is then driven along the rising pipe by the piston.

Advantages of this conversion.

This is one of the best forms of a pump. The rarefaction may be very perfect, because the piston can be brought so near to the bottom of the working barrel; and, for forcing water in opposition to great pressures, it appears preferable to the common forcing pump. because in that the piston-rods are compressed and exposed to bending, which greatly hurts the pump by wearing the piston and barrel on one side. This soon renders it less tight, and much water squirts out by the sides of the piston. But in this pump the piston-rod is always drawn or pulled, which keeps it straight; and rods exert a much greater force in opposition to a pull than in opposition to compression. The collar of leather round the piston-rods is found by experience to need very little repairs, and is very impervious to water. The whole is very accessible for repairs; and in this respect much preferable to the common pump in deep mines, where every fault of the piston obliges us to draw up some hundred feet of piston-rods. By this addition, too, any common pump for the service of a house is converted into an engine for extinguishing fire, or may be made to convey the water to every part of the house; and this without hurting or obstructing its common uses. All that is necessary is to have a large cock on the upper part of the working barrel, opposite to the lateral pipe in this figure. This cock serves for a spout when the pump is used for common purposes; and the merely shutting this cock converts the whole into an engine for extinguishing fire or for supplying distant places with water. It is scarcely necessary to add, that for these services it will be proper to connect an air-vessel with some convenient part of the rising pipe, in order that the current of the water may be continual.

Equable streams produced in great works by combinations.

We have frequently spoken of the advantages of a continued current in the main pipe. In all great works a considerable degree of uniformity is produced by the manner of disposing the actions of the different pumps; for it is very rarely that a machine works but one pump. In order to maintain some uniformity in the resistance, that it may not all be opposed at once to the moving power, with intervals of total inaction, which would produce a very hobbling motion, it is usual to distribute the work into portions, which succeed alternately; and thus both diminish the strain, and give greater uniformity of action, and frequently enable a natural power which we can command, to perform a piece of work which would be impossible if the whole resistance were opposed at once. In all pump machines, therefore, we are obviously directed to construct them so that they may give motion to at least two pumps, which work alternately. By this means a much greater uniformity of current is produced in the main pipe. It will be rendered still more uniform if four are employed, succeeding each other at the interval of one quarter of the time of a complete stroke.

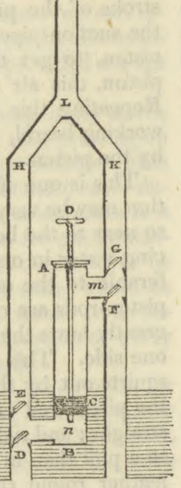
A single pump for this purpose described.

But ingenious men have attempted the same thing with a single pump, and many different constructions for this purpose have been proposed and executed, The thing is not of much importance, or of great research. We shall content ourselves, therefore, with the description of one that appears to us the most perfect, both in respect of simplicity and effect.

2. *Description of a Pump with a continued current.*

It consists of a working barrel AB (fig. 15) close at both ends. The piston C is solid, and the rod O passes through a collar of leathers in the plate, which closes the upper end of the working barrel. This barrel communicates laterally with two pipes H, K; the communications *m* and *n* being as near to the top and bottom of the barrel as possible. Adjoining to the passage *m* are two valves F and G opening upwards. Similar valves accompany the passage *n*. The two pipes H and K unite in a larger rising pipe L. They are all represented as in the same plane; but the upper ends must be bent backwards, to give room for the motion of the piston-rod O.

Fig. 15.



Suppose the piston close to the entry of the lateral pipe *n*, and that it is drawn up; it compresses the air above it, and drives it through the valve G, where it escapes along the rising pipe; at the same time it rarefies the air in the space below it. Therefore the weight of the atmosphere shuts the valve E, and causes the water of the cistern to rise through the valve D, and fill the lower part of the pump. When the piston is pushed down again, this water is first driven through the valve E, because D immediately shuts; and then most of the air which was in this part of the pump at the beginning goes up through it, some of the water coming back in its stead. In the mean time, the air which remained in the upper part of the pump, after the ascent of the piston, is rarefied by its descent; because the valve G shuts as soon as the piston begins to descend, the valve F opens, the air in this suction-pipe F expands into the barrel, and the water rises into the pipes by the pressure of the atmosphere. The next rise of the piston must bring more water into the lower part of the barrel, and must drive a little more air through the valve G, namely, part of that which had come out of the suction-pipe F; and the next descent of the piston must drive more water into the rising pipe H, and along with it most if not all of the air which remained below the piston, and must rarefy still more the air remaining above the piston; and more water will come in through the pipe F, and get into the barrel. It is evident that a few repetitions will at last fill the barrel on both sides of the piston with water. When this is accomplished, there is no difficulty in perceiving how, at every rise of the piston, the water of the cistern will come in by the valve D, and the water in the upper part of the barrel will be driven through the valve G; and, in every descent of the piston, the water of the cistern will come into the barrel by the valve F, and the water below the piston will be driven through the valve E; and thus there will be a continual influx into the barrel through the valves D and F, and a continual discharge along the rising pipe L through the valves E and G.

It is equivalent to two forcing pumps.

This machine is, to be sure, equivalent to two forcing pumps, although it has but one barrel and one piston; but it has no sort of superiority. It is not even more economical in most cases; because we apprehend that the additional workmanship will fully compensate for the barrel and piston that is saved. There is indeed a saving in the rest of the machinery, because one lever produces both motions. We cannot, therefore, say that it is inferior to two pumps; and we acknowledge that there is some ingenuity in the contrivance.

Authors recommended.

We recommend to our readers the perusal of Belidor's *Architecture Hydraulique*, where is to be found a great variety of combinations and forms of the simple pumps; but we must caution them with respect to his theories, which in this article are extremely defective. Also in Leupold's *Theatrum Machinarum Hydraulicarum* there is a prodigious variety of all kinds of pumps, many of them very singular and ingenious, and many which have particular advantages, which may suit local circumstances, and give them a preference. But it would be improper to swell a work of this kind with so many peculiarities; and a person who makes himself master of the principles delivered here, in sufficient detail, can be at no loss to suit a pump to his particular views, or to judge of the merit of such as may be proposed to him.

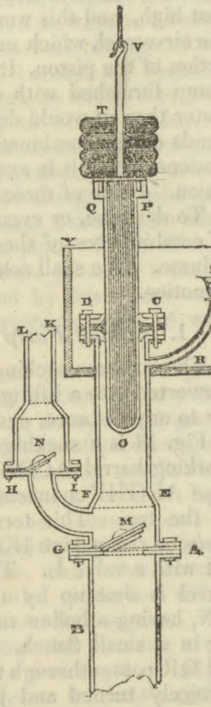
We must now take notice of some very considerable and important varieties in the form and contrivance of the essential parts of a pump.

3. *Description of an improved Forcing Pump.*

The forcing pump differently constructed.

The forcing pump is sometimes of a very different form from that already described. Instead of a piston, which applies itself to the inside of the barrel, and slides up and down in it, there is a long cylinder POQ (fig. 16) nicely turned and polished on the outside, and of a diameter somewhat less than the inside of the barrel. This cylinder (called a PLUNGER) slides through a collar of leathers on the top of the working barrel, and is constructed as follows. The top of the barrel terminates in a flanch *ab*, pierced with four holes for receiving screw-bolts. There are two rings of metal, of the same diameter, and having holes corresponding to those in the flanch. Four rings of soft leather, of the same size, and similarly pierced with holes, are well soaked in a mixture of oil, tallow, and a little rosin. Two of these leather rings are laid on the pump flanch, and one of the metal rings above them. The plunger is then thrust down through them, by which it turns their inner edges downwards. The other two rings are then slipped on at the top of the plunger, and the second metal ring is put over them, and then the whole are slid down to the metal ring. By this the inner edges of the last leather rings are turned upwards. The three metal rings are now forced together by the screwed bolts; and thus the leathern rings are strongly compressed between them, and made to grasp the plunger so closely that no pressure can force the water through between. The upper metal ring just allows the plunger to pass through it, but without any play; so that the turned-up edges of the leathern rings do not come up between the plunger and the upper metal ring, but are lodged in a little conical taper, which is given to the inner edge of the upper plate, its hole being wider below than above. It is on this trifling circumstance that the great tightness of the collar depends. To prevent the leathers from shrinking by drought, there is usually a little cistern, as XY, formed round the head of the pump, and kept full of water. The plunger is either forced down by a rod from a working beam, or by a set of metal weights laid on it, as is represented in the figure.

Fig. 16.



Its mode of operation.

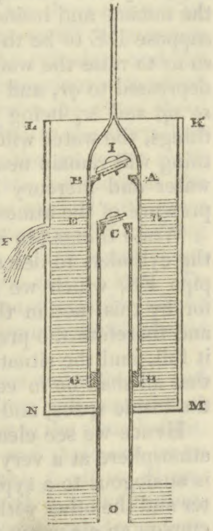
It is hardly necessary to be particular in explaining the operation of this pump. When the plunger is at the bottom of the barrel, touching the fixed valve M with its lower extremity, it almost completely fills it. That it may do it completely, there is sometimes a small pipe RSZ branching out from the top of the barrel, and fitted with a cock at S. Water is admitted till the barrel is completely filled, and the cock is then shut. Now when the plunger is drawn up, the valve N in the rising pipe must remain shut by the pressure of the atmosphere, and a void must be made in the barrel. Therefore the valve M on the top of the suction-pipe must be opened by the elasticity of the air in this pipe, and the air must expand into the barrel; and being no longer a balance for the atmosphere, the water in the cistern must be forced into the suction-pipe, and rise in it to a certain height. When the plunger descends, it must drive the water through the valve N (for the valve M will immediately shut), and along with it most of the air which had come into the barrel. And as this air occupied the upper part of the barrel, part of it will remain when the plunger has reached the bottom; but a stroke or two will expel it all, and then every succeeding stroke of the descending piston will drive the water along the rising pipe, and every ascent of the plunger will be followed by the water from the cistern.

The advantage proposed by this form of piston is, that it may be more accurately made and polished than the inside of a working barrel, and it is of much easier repair. Yet we do not find that it is much used, although an invention of the seventeenth century (we think by Sir Samuel Morland), and much praised by the writers on these subjects.

Sucking pump similarly varied.

It is easy to see that the sucking pump may be varied in the same way. Suppose this plunger to be open both at top and bottom, but the bottom filled with a valve opening upward. When this is pushed to the bottom of the barrel, the air which it tends to compress lifts the valve (the lateral pipe being taken away and the passage shut up), and escapes through the plunger. When it is drawn up, it makes the same rarefaction as the solid plunger, because the valve at O shuts, and the water will come up from the cistern as in the former case. If the plunger be now thrust down again, the valve M shuts, the valve O is forced open, and the plunger is filled with water. This will be lifted by it during its next ascent; and when it is pushed down again, the water which filled it must now be pushed out, and will flow over its sides into the cistern at the head of the barrel. Instead of making the valve at the bottom of the piston, it may be made at the top; but this disposition is much inferior, because it cannot rarefy the air in the barrel one half. This is evident; for the capacity of the barrel and plunger together cannot be twice the capacity of the barrel.

Fig. 17.



4. *Description of another form of the Forcing Pump.*

Another form of the sucking pump, and its mode of operation.

It may be made after a still different form, as represented in fig. 17. Here the suction-pipe CO comes up through a cistern KMNL deeper or longer than the intended stroke of the piston, and has a valve C at top. The piston, or what acts in lieu of it, is a tube AHGB, open at both ends, and of a diameter somewhat larger than that of the suction-pipe. The interval between them is filled up at HG by a ring or belt of soft leather, which is fastened to the *outer* tube, and moves up and down with it, sliding along the smoothly polished surface of the suction-pipe with very little friction. There is a valve I on the top of this piston, opening upwards. Water is poured into the outer cistern.

The outer cylinder or piston being drawn up from the bottom, there is a great rarefaction of the air which was between them, and the atmosphere presses the water up through the suction-pipe to a certain height; for the valve I keeps shut by the pressure of the atmosphere and its own weight. Pushing down the piston causes the air, which had expanded from the suction-pipe into the piston, to escape through the valve I; drawing it up a second time allows the atmosphere to press more water into the suction-pipe, to fill it, and also part of the piston. When this is pushed down again, the water which had come through the valve C is now forced out through the valve I into the cistern KMNL, and now the whole is full of water. When, therefore, the piston is drawn up, the water follows, and fills it, if not thirty-three feet above the water in the cistern; and when it is pushed down again, the water which filled the piston is all thrown out into the cistern; and after this it delivers its full contents of water at every stroke. The water in the cistern KMNL effectually prevents the entry of any air between the two pipes; so that a very moderate compression of the belt of soft leather at the mouth of the piston-cylinder is sufficient to make all perfectly tight.

The piston-cylinder differently formed.

It might be made differently. The ring of leather might be fastened round the top of the inner cylinder at DE, and slide on the inside of the piston cylinder; but the first form is easily executed. Muschenbroeck has given a figure of this pump in his large system of natural philosophy, and speaks very highly of its performance. But we do not see any advantage which it possesses over the common sucking pump. He indeed says that it is without friction, and makes no mention of the ring of leather between the two cylinders. Such a pump will raise water extremely well to a small height, and it seems to have been a model only which he had examined. But if the suction-pipe is long, it will by no means do without the leather; for on drawing up the piston, the water of the upper cistern will rise between the pipes and fill the piston, and none will come up through the suction pipe.

Pumps without friction not of important use.

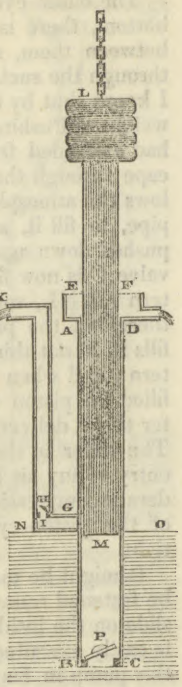
We may take this opportunity of observing, that the many ingenious contrivances of pumps without friction are of little importance in great works; because the friction which is completely sufficient to prevent all escape of water in a well-constructed pump, is but a very trifling part of the whole force. In the great pumps which are used in mines, and are worked by a steam-engine, it is very usual to make the pistons and valves without any leather whatever. The working barrel is bored truly cylindrical, and the piston is made of metal of a size that will just pass along it without sticking. When this is drawn up with the velocity competent to a properly loaded machine, the quantity of water which escapes round the piston is insignificant. The piston is made without leathers, not to avoid friction, which is also insignificant in such works; but to avoid the necessity of frequently drawing it up for repairs through such a length of pipes.

5. *Description of a Pump without Friction.*

Example of a pump without friction.

If a pump absolutely without friction be wanted, the following seems preferable for simplicity and performance to any we have seen, when made use of in proper situations. Let NO (fig. 18) be the surface of the water in the pit, and K the place of delivery. The pit must be as deep in water as from K to NO. ABCD is a wooden trunk, round or square, open at both ends, and having a valve P at the bottom. The top of this trunk must be on a level with K, and has a small cistern EADF. It also communicates laterally with a rising pipe GHK, furnished with a valve at H opening upwards. LM is a beam of timber so fitted to the trunk as to fill it without sticking, and is of at least equal length. It hangs by a chain from a working beam, and is loaded on the top with weights exceeding that of the column of water which it displaces. Now suppose this beam allowed to descend from the position in which it is drawn in the figure; the water must rise all around it, in the crevice which is between it and the trunk, and also in the rising pipe, because the valve P shuts, and H opens; so that when the plunger has got to the bottom, the water will stand at the level of K. When the plunger is again drawn up to the top by the action of the moving power, the water sinks again in the trunk, but not in the rising pipe, because it is stopped by the valve H. Then allowing the plunger to descend again, the water must again rise in the trunk to the level of K, and it must now flow out at K; and the quantity discharged will be equal to the part of the beam below the surface of the pit-water, deducting the quantity which fills the small space between the beam and the trunk. This quantity may be reduced almost to nothing; for if the inside of the trunk and the outside of the beam be made tapering, the beam may be let down till they exactly fit; and as this may be done in square work, a good workman can make it exceedingly accurate. But in this case the lower half of the beam and trunk must not taper; and this part of the trunk must be of sufficient width round the beam to allow free passage into the rising pipe; or, which is better, the rising pipe must branch off from the bottom of the trunk. A discharge may be made from the cistern EADF, so that as little water as possible may descend along the trunk when the piston is raised.

Fig. 18.



Its excellencies are considerable, but it is limited.

One great excellence of this pump is, that it is perfectly free from all the deficiencies which in common pumps result from want of being air-tight. Another is, that the quantity of water raised is precisely equal to the power expended; for any want of accuracy in the work, while it occasions a diminution of the quantity of water discharged, makes an equal diminution in the weight which is necessary for pushing down the plunger. We have seen a machine consisting of two such pumps suspended from the arms of a long beam, the upper side of which was formed into a walk with a rail on each side. A man stood on one end till it got to the bottom, and then walked soberly up to the other end, the inclination being about twenty-five degrees at first, but gradually diminished as he went along, and changed the load of the beam. By this means he made the other end go to the bottom, and so on alternately, with the easiest of all exertions, and what we are most fitted for by our structure. With this machine, a very feeble old man, weighing 110 pounds, raised seven cubic feet of water eleven and a half feet high in a minute, and continued working eight or ten hours every day. A stout young man, weighing nearly 135 pounds, raised eight and a third to the same height; and when he carried thirty pounds conveniently slung about him, he raised nine and a fourth feet to this height, working ten hours a day without fatiguing himself. This exceeds Desagulier's maximum of a hogshead of water ten feet high in a minute, in the proportion of nine to seven nearly. It is limited to very moderate heights; but in such situations it is very effectual. It was the contrivance of an untaught labouring man, of uncommon mechanical genius.

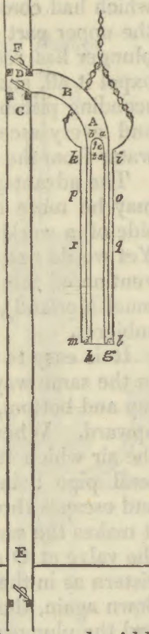
6. *Description of Haskins's Quicksilver Pump.*

Haskins's pump described.

The most ingenious contrivance of a pump without friction is that of Mr Haskins, described by Desaguliers, and called by him the *Quicksilver Pump.* Its construction and mode of operation are pretty complicated; but the following preliminary observations will, we hope, render it abundantly plain.

Let *ilmk* (fig. 19) be a cylindrical iron pipe, about six feet long, open at top. Let *eghf* be another cylinder, connected with it at the bottom, and of smaller diameter. It may either be solid, or, if hollow, it must be close at top. Let *acdb* be a third iron cylinder, of an intermediate diameter, so that it may move up and down between the other two, without touching either, but with as little interval as possible. Let this middle cylinder communicate, by means of the pipe AB, with the upright pipe FE, having valves C and D (both opening upwards) adjoining to the pipe of communication. Suppose the outer cylinder suspended by chains from the end of a working beam, and let mercury be poured into the interval between the three cylinders till it fills the space to *op*, about three fourths of their height. Also suppose that the lower end of the pipe FE is immersed into a cistern of water, and that the valve D is less than thirty-three feet above the surface of this water.

Fig. 19.



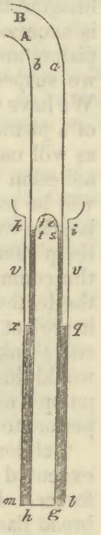
Its mode of operation.

Now suppose a perforation made somewhere in the pipe AB, and a communication made with an air-pump. When the air-pump is worked, the air contained in CE, in AB, and in the space between the inner and middle cylinders, is rarefied, and is abstracted by the air-pump; for the valve D immediately shuts. The pressure of the atmosphere will cause the water to rise in the pipe CE, and will cause the mercury to rise between the inner and middle cylinders, and sink between the outer and middle cylinders. Let us suppose mercury twelve times heavier than water: then for every foot that the water rises in EC, the level between the outside and inside mercury will vary an inch; and if we suppose DE to be thirty feet, then, if we can rarefy the air so as to raise the water to D, the outside mercury will be depressed to *qr*, and the inside mercury will have risen to *st*, *sq*, and *tr*, being about thirty inches. In this state of things, the water will run over by the pipe BA, and everything will remain nearly in this position. The columns of water and mercury balance each other, and balance the pressure of the atmosphere.

While things are in this state of equilibrium, if we allow the cylinders to descend a little, the water will rise in the pipe FE, which we may now consider as a suction-pipe; for by this motion the capacity of the whole is enlarged, and therefore the pressure of the atmosphere will still keep it full, and the situation of the mercury will again be such that all shall be in equilibrio. It will be a little lower in the inside space, and higher in the outside.

Hence we see clearly how the water is supported by the atmosphere at a very considerable height. The apparatus is analogous to a syphon which has one leg filled with water and the other with mercury. But it was not necessary to employ an air-pump to fill it. Suppose it again empty, and all the valves shut by their own weight. Let the cylinders descend a little. The capacity of the spaces below the valve D is enlarged, and therefore the included air is rarefied, and some of the air in the pipe CE must diffuse itself into the space quitted by the inner cylinder. Therefore the atmosphere will press some water up the pipe FE, and some mercury into the inner space between the cylinders. When the cylinders are raised again, the air which came from the pipe CE would return into it again, but is prevented by the valve C. Raising the cylinders to their former height would compress this air; it therefore lifts the valve D, and escapes. Another depression of the cylinders will have a similar effect. The water will rise higher in FC, and the mercury in the inner space; and then, after repeated strokes, the water will pass the valve C, and fill the whole apparatus, as the air-pump had caused it to do before. The position of the cylinders, when things are in this situation, is represented in fig. 20, the outer and inner cylinders in their lowest position having descended about thirty inches. The mercury in the outer space stands at *qr*, a little above the middle of the cylinders, and the mercury in the inner space is near the top *ts* of the inner cylinder. Now let the cylinders be drawn up. The water above the mercury cannot get back again through the valve C, which shuts by its own weight. We therefore attempt to compress it; but the mercury yields, and descends in the inner space and rises in the outer, till both are quickly on a level, about the height *vv*. If we continue to raise the cylinders, the compression forces out more mercury, and it now stands lower in the inner than in the outer space. But that there may be something to balance this inequality of the mercurial columns, the water goes through the valve D, and the equilibrium is restored when the height of the water in the pipe ED above the surface of the internal mercury is twelve times the difference of the mercurial columns (on the former supposition of specific gravity). If the quantity of water is such as to rise two feet in the pipe ED, the mercury in the outer space will be two inches higher than that in the inner space. Another depression of the cylinders will again enlarge the space within the apparatus, the mercury will take the position of fig. 19, and more water will come in. Raising the cylinders will send this water four feet up the pipe ED, and the mercury will be four inches higher in the inner than in the outer space. Repeating this operation, the water will be raised still higher in DE; and this will go on till the mercury in the outer space reaches the top of the cylinder; and this is the limit of the performance. The dimensions with which we set out will enable the machine to raise the water about thirty feet in the pipe ED, which, added to the thirty feet of CF, makes the whole height above the pit-water sixty feet. By making the cylinders longer, we increase the height of FD. This machine must be worked with great attention, and but slowly; for at the beginning of the forcing stroke the mercury very rapidly sinks in the inner space and rises in the outer, and will dash out and be lost. To prevent this as much as possible, the outer cylinder terminates in a sort of cup or dish, and the inner cylinder should be tapered a-top.

Fig. 20.



ngenuity
the con-
ivance.

The machine is exceedingly ingenious and refined; and there is no doubt but that its performance will exceed that of any other pump which raises the water to the same height, because friction is completely avoided, and there can be no want of tightness of the piston. But this is all its advantage; and, from what has been observed, it is but trifling. The expense would be enormous; for, with whatever care the cylinders are made, the interval between the inner and outer cylinders must contain a very great quantity of mercury. The middle cylinder must be made of iron plate, and must be without a seam, for the mercury would dissolve every solder. For such reasons, it has never come into general use. But it would have been unpardonable to have omitted the description of an invention which is so original and ingenious; and there are some occasions where it may be of great use, as, in nice experiments for illustrating the theory of hydraulics, it would give the finest pistons for measuring the pressures of water in pipes, &c. It is on precisely the same principle that the cylinder bellows, described in the article Pneumatics, are constructed.

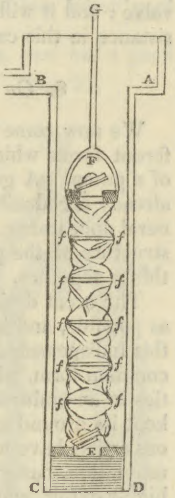
7. *Simple Pump without Friction.*

Description of another pump without friction.

We beg leave to conclude this part of the subject with the description of a pump without friction, which may be constructed in a variety of ways by any common carpenter, without the assistance of the pump-maker or plumber, and will be very effective for raising a great quantity of water to small heights, as in draining marshes, marl-pits, quarries, &c. or even for the service of a house.

ABCD (fig 21) is a square trunk of carpenter's work, open at both ends, and having a little cistern and spout at top. Near the bottom there is a partition made of board, perforated with a hole E, and covered with a clack. *ffff* represents a long cylindrical bag or pudding, made of leather, or of double canvass with a fold of thin leather such as sheep-skin between the canvass bags. This is firmly nailed to the board E, with soft leather between. The upper end of this bag is fixed on a round board, having a hole and valve F. This board may be turned in the lathe with a groove round its edge, and the bag fastened to it by a cord bound tight round it. The fork of the piston-rod FG is firmly fixed into this board; the bag is kept distended by a number of wooden hoops or rings of strong wire *ff*, *ff*, *ff*, &c. put into it at a few inches distance from each other. It will be proper to connect these hoops before putting them in, by three or four cords from top to bottom, which will keep them at their proper distances. Thus will the bag have the form of a barber's bellows powder-puff. The distance between the hoops should be about twice the breadth of the rim of the wooden ring to which the upper valve and piston-rod are fixed.

Fig. 21.



Its mode of operation.

Now let this trunk be immersed in the water. It is evident, that if the bag be stretched from the compressed form which its own weight will give it, by drawing up the piston-rod, its capacity will be enlarged, the valve F will be shut by its own weight, the air in the bag will be rarefied, and the atmosphere will press the water into the bag. When the rod is thrust down again, this water will come out by the valve F, and fill part of the trunk. A repetition of the operation will have a similar effect; the trunk will be filled, and the water will at last be discharged by the spout.

Here is a pump without friction, and perfectly tight, for the leather between the folds of canvass renders the bag impervious both to air and water; and the canvass has very considerable strength. We know from experience that a bag of six inches diameter, made of sail-cloth No. 3, with a sheep-skin between, will bear a column of fifteen feet of water, and stand six hours work per day for a month without failure; and that the pump is considerably superior in effect to a common pump of the same dimensions. We must only observe, that the length of the bag must be three times the intended length of the stroke; so that when the piston-rod is in its highest position, the angles or ridges of the bag may be pretty acute. If the bag be more stretched than this, the force which must be exerted by the labourer becomes much greater than the weight of the column of water which he is raising. If the pump be laid aslope, which is very usual in these occasional and hasty drawings, it is necessary to make a guide for the piston-rod within the trunk, that the bag may play up and down without rubbing on the sides, which would quickly wear it out.

The experienced reader will see that this pump is very like that of Gosset and De la Deuille, described by Belidor, vol. ii. p. 120, and most writers on hydraulics. It would be still more like it if the bag were on the under side of the partition E, and a valve placed farther down the trunk. But we think that our form is greatly preferable in point of strength. When in the other situation, the column of water lifted by the piston tends to burst the bag, and this with a great force, as the intelligent reader well knows. But in the form recommended here, the bag is *compressed*, and the strain on each part may be made much less than that which tends to burst a bag of six inches diameter. The nearer the rings are placed to each other the smaller will the strain be.

The same bag-piston may be employed for a forcing pump, by placing it below the partition, and inverting the valve; and it will then be equally strong, because the resistance in this case too will act by compression.

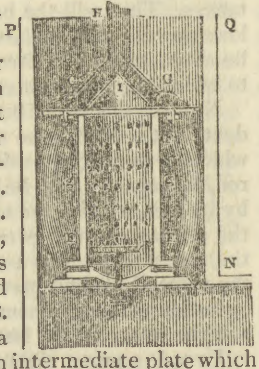
8. *On the different Forms of Pistons.*

We now come naturally to the consideration of the different forms which may be given to the pistons and valves of a pump. A good deal of what we have been describing already is reducible to this head; but, having a more general appearance, changing as it were the whole form and structure of the pump, it was not improper to keep these things together.

Pistons should have little friction.

The great desideratum in a piston is, that it be as tight as possible, and have as little friction as is consistent with this indispensable quality. We have already said that the common form, when carefully executed, has these properties in an eminent degree. And accordingly this form has kept its ground amidst all the improvements which ingenious artists have made. Mr Belidor, an author of the first reputation, has given the description of a piston which he highly extols, and is undoubtedly a very good one, constructed from principle, and extremely well composed.

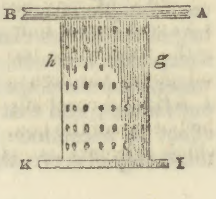
Fig. 22.



Improved one by Belidor.

It consists of a hollow cylinder of metal *g h* (fig. 23) pierced with a number of holes, and having at top a flanch AB, whose diameter is nearly equal to that of the working barrel of the pump PQ (fig. 22). This flanch has a groove round it. There is another flanch IK below, by which this hollow cylinder is fastened with bolts to the lower end of the piston, represented in fig. 23. This consists of a plate with a grooved edge similar to AB, and an intermediate plate which forms the seat of the valve. The composition of this part is better understood by inspecting the figure than by any description. The piston-rod HL is fixed to the upper plate by bolts through its different branches at G, G. This metal body is then covered with a cylindrical bag of leather fastened on it by cords bound round it, filling up the grooves in the upper and lower plates. The operation of the piston is as follows.

Fig. 23.



Its defects.

A little water is poured into the pump, which gets past the sides of the piston, and lodges below in the fixed valve. The piston being pushed down, dips into this water, and it gets into it by the valve. But as the piston in descending compresses the air below it, this compressed air also gets into the inside of the piston, swells out the bag which surrounds it, and compresses it to the sides of the working barrel. When the piston is drawn up again, it must remain tight, because the valve will shut and keep in the air in its most compressed state; therefore the piston must perform well during the suction. It must act equally well when pushed down again, and acting as a forcer; for, however great the resistance may be, it will affect the air within the piston to the same degree, and keep the leather close applied to the barrel. There can be no doubt, therefore, of the piston's performing both its offices completely; but we imagine that the adhesion to the barrel will be greater than is necessary: it will extend over the whole surface of the piston, and be equally great in every part of its surface, and we suspect that the friction will therefore be very great. We have very high authority for supposing that the adhesion of a piston of the common form, carefully made, will be such as will make it perfectly tight; and it is evident that the adhesion of Belidor's piston will be much greater, and it will be productive of worse consequences. If the leather bag be worn through in any one place, the air escapes, and the piston ceases to be compressed altogether; whereas in the common piston there will very little harm result from the leather being worn through in one place, especially if it project a good way beyond the base of the cone. We still think the common piston preferable. Belidor's piston would do much better inverted as the piston of a sucking pump; and in this situation it would be equal, but not superior, to the common.

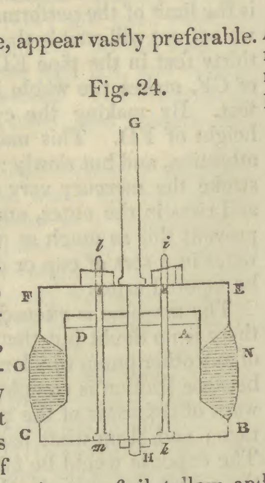
Another by the same author, objectionable.

Belidor describes another forcing piston, which he had executed with success, and prefers to the common wooden forcer. It consists of a metal cylinder or cone, having a broad flanch united to it at one end, and a similar flanch which is screwed on the other end. Between these two plates are a number of rings of leather strongly compressed by the two flanches, and then turned in a lathe like a block of wood, till the whole fits tight, when dry, into the barrel. It will swell, says he, and soften with the water, and withstand the greatest pressures. We cannot help thinking this but an indifferent piston. When it wears, there is nothing to squeeze it to the barrel. It may indeed be taken out and another ring or two of leather put in, or the flanches may be more strongly screwed together; but all this may be done with any kind of piston, and this has therefore no peculiar merit.

Another recommended as preferable.

The following will, we presume, appear vastly preferable. ABCD (fig. 24) is the solid wooden or metal block of the piston; EF is a metal plate, which is turned hollow or dish-like below, so as to receive within it the solid block. The piston-rod goes through the whole, and has a shoulder above the plate EF, and a nut H below. Four screw-bolts, such as *i k*, *l m*, also go through the whole, have their heads *k*, *m* sunk into the block, and nuts above at *i*, *l*. The packing, or stuffing as it is termed by the workmen, is represented at NO. This is made as solid as possible, and generally consists of soft hempen twine well soaked in a mixture of oil, tallow, and

Fig. 24.



rosin. The plate EF is gently screwed down, and the whole is then put into the barrel, fitting it as tight as may be thought proper. When it wears loose, it may be tightened at any time by screwing down the nuts *i*, *l*, which cause the edges of the dish to squeeze out the packing, and compress it against the barrel to any degree.

Difficulties in constructing pistons.

The greatest difficulty in the construction of a piston is to give a sufficient passage through it for the water, and yet allow a firm support for the valve, and fixture for the piston-rod. We shall see presently that it occasions a considerable expense of the moving power to force a piston with a narrow perforation through the water lodged in the working barrel. When we are raising water to a small height, such as ten or twenty feet, the power so expended amounts to a fourth part of the whole, if the water-way in the piston is less than one half of the section of the barrel, and the velocity of the piston two feet per second, which is very moderate. There can be no doubt, therefore, that metal pistons are preferable, because their greater strength allows much wider apertures.

These considerably removed in one described by Belidor.

The following piston, described and recommended by Belidor, seems as perfect in these respects as the nature of things will allow. We shall therefore describe it in the author's own words as a model, which may be adopted with confidence in the greatest works.

“ The body of the piston is a truncated metal cone (fig. 25), having a small fillet at the greater end. Fig. 26 shows the profile, and fig. 27 the plan of its upper base, where appears a cross-bar DD, pierced with an oblong mortise E for receiving the tail of the piston-rod. A band of thick and uniform leather AA (figs. 26 and 28) is put round this cone, and secured by a brass hoop BB firmly driven on its smaller end, where it is previously made thinner to give room for the hoop.

Fig. 25.

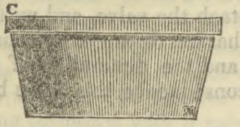


Fig. 26.

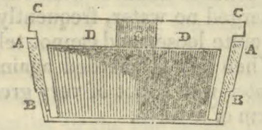


Fig. 27.

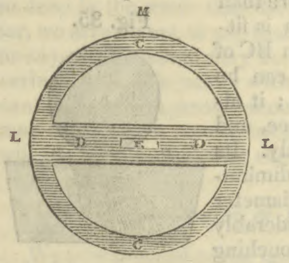
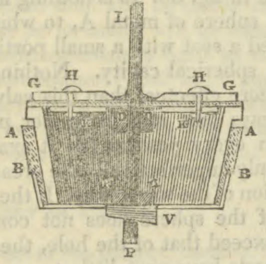


Fig. 28.



“ This piston is covered with a leather valve fortified with metal plates GG (fig. 29). These plates are wider than the hole of the piston, so as to rest on its rim. There are similar plates below the leather, of a smaller size, that they may go into the hollow of the piston; and the leather is firmly held between the metal plates by screws H, H, which go through all. This is represented by the dotted circle IK. Thus the pressure of the incumbent column of water is supported by the plates GG, whose circular edges rest on the brim of the water-way, and their straight edges rest on the cross bar DD of figs. 26 and 27. This valve is laid on the top of the conical box, in such a manner that its middle FF rests on the cross bar. To bind all together, the end of the piston-rod is formed like a cross, and the arms MN (fig. 30) are made to rest on the diameter FF of the valve, the tail EP going through the hole E in the middle of the leather, and through the mortise E of the cross bar of the box, and also through another bar QR (figs. 28 and 30) which is notched into the lower brim of the box. A key V is then driven into the hole T in the piston-rod, and this wedges all fast. The bar QR is made strong; and its extremities project a little, so as to support the brass hoop BB which binds the leather band to the piston-box. The adjoining scale gives the dimensions of all the parts, as they were executed for a steam-engine near Condé, where the piston gave complete satisfaction.”

Fig. 29.

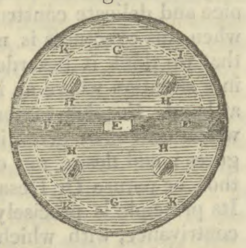
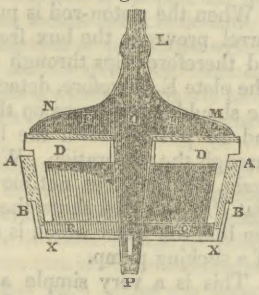


Fig. 30.



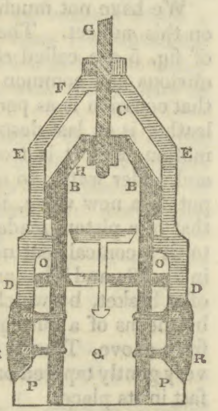
Advantage of this piston.

This piston has every advantage of strength, tightness, and large water-way. The form of the valve, which has given it the name of the *butterfly-valve*, is extremely favourable to the passage of the water; and as it has but half the motion of a complete circular valve, less water goes back while it is shutting.

Another ingenious and useful piston described.

The following piston is also ingenious, and has a good deal of merit. OPPO (fig. 31) is the box of the piston, having a perforation Q, covered above with a flat valve K, which rests in a metal plate that forms the top of the box. ABCBA is a stirrup of iron to which the box is fixed by screws *a*, *a*, *a*, *a*, whose heads are sunk in the wood. This stirrup is perforated at C, to receive the end of the piston-rod, and a nut H is screwed on below to keep it fast. DEFED is another stirrup, whose lower part at DD forms a hoop like the sole of a stirrup, which embraces a small part of the top of the wooden box. The lower end of the piston-rod is screwed; and before it is put into the holes of the two stirrups (through which holes it slides freely) a broad nut G is screwed on it. It is then put into the holes, and the nut H firmly screwed up. The packing RR is then wound about the piston as tight as possible, till it completely fills the working barrel of the pump. When long use has rendered it in any degree loose, it may be tightened again by screwing down the nut G. This causes the ring DD to compress the packing between it and the projecting shoulder of the box at PP; and thus causes it to swell out, and apply itself closely to the barrel.

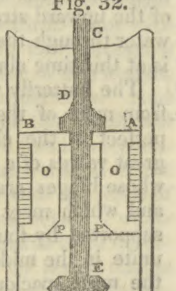
Fig. 31.



Another on a different principle.

We shall add only another form of a perforated piston; which being on a principle different from all the preceding, will suggest many others, each of which will have its peculiar advantages. OO in fig. 32 represents the box of this piston, fitted to the working barrel in any of the preceding ways, as may be thought best. AB is a cross bar of four arms, which is fixed to the top of the box. CF is the piston-rod going through a hole in the middle of AB, and reaching a little way beyond the bottom of the box. It has a shoulder D, which prevents its going too far through.

Fig. 32.



On the lower end there is a thick metal plate, turned conical on its upper side, so as to fit a conical seat PP in the bottom of the piston-box.

When the piston-rod is pushed down, the friction on the barrel prevents the box from immediately yielding. The rod therefore slips through the hole of the cross-bar AB. The plate E, therefore, detaches itself from the box. When the shoulder D presses on the bar AB, the box must yield, and be pushed down the barrel, and the water gets up through the perforation. When the piston-rod is drawn up again, the box does not move till the plate E lodge in the seat PP, and thus shuts the water-way; and then the piston lifts the water which is above it, and acts as the piston of a sucking pump.

Advantages of this.

This is a very simple and effective construction, and makes a very tight valve. It has been much recommended by engineers of the first reputation, and is frequently used; and from its simplicity, and the great solidity of which it is capable, it seems very fit for great works. But it is evident that the water-way is limited to less than one half of the area of the working barrel. For if the perforation of the piston be one half of the area, the diameter of the plate or ball EF must be greater, and therefore less than half the area will be left for the passage of the water by its sides.

9. *Description of Valves.*

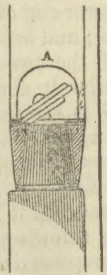
Valves.

The requisites of a valve are, that it shall be tight, of sufficient strength to resist the great pressures to which it is exposed, that it afford a sufficient pressure for the water, and that it do not allow much to go back while it is shutting.

Clack-valves.

We have not much to add to what has been said already on this subject. The valves which accompany the pump of fig. 5 are called *clack-valves*, and are of all the most obvious and common; and the construction described on that occasion is as perfect as any. We only add, that as the leather is at last destroyed at the hinge by such incessant motion, and it is troublesome, especially in deep mines, and under water, to undo the joint of the pump in order to put in a new valve, it is frequently annexed to a box like that of a piston, made a little conical on the outside, so as to fit a conical seat made for it in the pipe, as represented in fig. 33; and it has an iron handle A like that of a basket, by which it can be laid hold of by means of a long grappling-hook let down from above. Thus it is drawn up; and being very gently tapered on the sides, it sticks very fast in its place.

Fig. 33.



Defect in them.

The only defect of this valve is, that by opening very wide when pushed up by the stream of water, it allows a good deal to go back during its shutting again. In some great machines which are worked by a slow turning crank, the return of the piston is so very slow that a sensible loss is incurred by this; but it is nothing like what Dr Desaguliers says, one half of a cylinder whose height is equal to the diameter of the valve. For in such machines, the last part of the upward stroke is equally slow, and the velocity of the water through the valve exceedingly small, so that the valve is at this time almost shut.

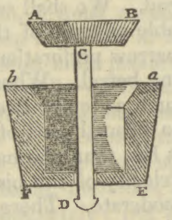
Utility of the butterfly-valve.

The butterfly valve, represented in fig. 29, &c. is free from most of these inconveniences, and seems the most perfect of the clack-valves. Some engineers make their great valves of a pyramidal form, consisting of four clacks, whose hinges are in the circumference of the water-way, and which meet with their points in the middle, and are supported by four ribs which rise up from the sides, and unite in the middle. This is an excellent form, affording the most spacious water-way, and shutting very readily. It seems to be the best possible for a piston. The rod of the piston is branched out on four sides, and the branches go through the piston-box, and are fastened below with screws. These branches form the support for the four clacks. We have seen a valve of this form in a pump of six feet diameter, which discharged twenty hogsheads of water at every stroke, and made twelve strokes in a minute, raising the water above twenty-two feet.

Button valves.

There is another form of valve, called the button or tail valve. It consists of a plate of metal AB (fig. 34) turned conical, so as exactly to fit the conical cavity *a b* of its box. A tail CD projects from the under side, which passes through a cross-bar EF in the bottom of the box, and has a little knob at the end, to hinder the valve from rising too high.

Fig. 34.



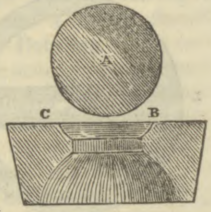
This valve, when nicely made, is unexceptionable. It has great strength, and is therefore proper for all severe strains, and it may be made perfectly tight by grinding. Accordingly it is used in all cases where this is of indispensable consequence. It is most durable, and the only kind that will do for passages where steam or hot water is to go through. Its only imperfection is a small water-way, which, from what has been said, cannot exceed, or indeed equal, one half of the area of the pipe.

If we endeavour to enlarge the water-way, by giving the cone very little taper, the valve frequently sticks so fast in the seat that no force can detach it. And this sometimes happens during the working of the machine; and the jolts and blows given to the machine in taking it to pieces, in order to discover what has been the reason that it has discharged no water, frequently detach the valve, and we find it quite loose, and cannot tell what has deranged the pump. When this is guarded against, and the diminution of the water-way is not of very great consequence, this is the best form of a valve.

A very simple valve described.

Analogous to this is the simplest of all valves, represented in fig. 35. It is nothing more than a sphere of metal A, to which is fitted a seat with a small portion BC of a spherical cavity. Nothing can be more effectual than this valve; it always falls into its proper place, and in every position fits it exactly. Its only imperfection is the great diminution of the water-way. If the diameter of the sphere does not considerably exceed that of the hole, the touching parts have very little taper, and it is very apt to stick fast. It opposes much less resistance to the passage of the water than the flat under surface of the button-valve. *N. B.* It would be an improvement of that valve to give it a taper shape below like a boy's top. The spherical valve must not be made too light, otherwise it will be hurried up by the water, and much may go back while it is returning to its place.

Fig. 35.



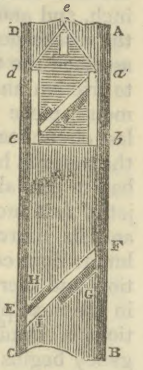
A valve by Belidor uniting every requisite.

Belidor describes with great minuteness (vol. ii. p. 221, &c.) a valve which unites every requisite. But it is of such nice and delicate construction, and its defects are so great when this exactness is not attained, or is impaired by use, that we think it hazardous to introduce it into a machine in a situation where an intelligent and accurate artist is not at hand. For this reason we have omitted the description, which cannot be given in few words, nor without many figures; and desire our curious readers to consult that author, or peruse Dr Desagulier's translation of this passage. Its principle is precisely the same with the following rude contrivance, with which we shall conclude the descriptive part of this article.

Suppose ABCD (fig. 36) to be a square wooden trunk. EF is a piece of oak board, exactly fitted to the trunk in nother alve on he same rinciple.

an oblique position, and supported by an iron pin which goes through it at I, one third of its length from its lower extremity E. The two ends of this board are bevelled, so as to apply exactly to the sides of the trunk. It is evident, that if a stream of water come in the direction BA, its pressure on the part IF of this board will be greater than that upon EI. It will therefore force it up and rush through, making it stand almost parallel to the sides of the trunk. To prevent its rising so far, a pin must be put in its way. When this current of water changes its direction, the pressure on the upper side of the board being again greatest on the portion IF, it is forced back again to its former situation; and its two extremities rising on the opposite sides of the trunk, the passage is completely stopped. This board therefore performs the office of a valve; and this valve is the most perfect that can be, because it offers the freest passage to the water, and it allows very little to get back while it is shutting; for the part IE brings up half as much water as IF allows to go down. It may be made extremely tight, by fixing two thin fillets H and G to the sides of the trunk, and covering those parts of the board with leather which applies to them; and in this state it perfectly resembles Belidor's fine valve.

Fig. 36.



escrip- on of an ccasional ump easi- y con- ructed.

And this construction of the valve suggests, by the way, a form of an occasional pump, which may be quickly set up by any common carpenter, and will be very effectual in small heights. Let *a b c d e* (fig. 36) be a square box made to slide along this wooden trunk without shake, having two of its sides projecting upwards, terminating like the gable-ends of a house. A piece of wood *e* is mortised into these two sides, and to this the piston-rod is fixed. This box being furnished with a valve similar to the one below, will perform the office of a piston. If this pump be immersed so deep in the water that the piston shall also be under water, we scruple not to say that its performance will be equal to any. The piston may be made abundantly tight by covering its outside neatly with soft leather. And as no pipe can be bored with greater accuracy than a very ordinary workman can make a square trunk, we presume that this pump will not be very deficient even for a considerable suction.

10. *Motion of Water in Pumps.*

he mo- on of wa- er in umps.

We now proceed to the last part of the subject, namely, to consider the motion of water in pumps, in reference to the force which must be employed. What we have hitherto said with respect to the force which must be applied to a piston, related only to the sustaining the water at a certain height: but in actual service we must not only do this, but we must discharge it at the place of delivery in a certain quantity; and this must require a force superadded to what is necessary for its mere support at this height.

he theory enominat- d *Hydro- ynamics.*

This is an extremely intricate and difficult subject, and very imperfectly understood even by professed engineers. The principles on which this knowledge must be founded are of a much more abstruse nature than the ordinary laws of hydrostatics; and all the genius of Newton was employed in laying the foundation of this part of physical science. It has been much cultivated in the course of this century by the first mathematicians of Europe. Daniel and John Bernoulli have written very elaborate treatises on the subject, under the very apposite name of *Hydrodynamics;* in which, although they have added little or nothing to the fundamental propositions established in some sort by Newton, and acquiesced in by them, yet they have greatly contributed to our progress in it by the methods which they have pursued in making application of those fundamental propositions to the most important cases. It must be acknowledged, however, that both these propositions, and the extensions given them by these authors, are supported by a train of argument that is by no means unexceptionable; and that they proceed on assumptions or postulates which are but nearly true in any case, and in many are inadmissible: and it remains to this hour a wonder or puzzle how these propositions and their results correspond with the phenomena which we observe.

But fortunately this correspondence does obtain to a certain extent. And it seems to be this correspondence chiefly which has given these authors, with Newton at their head, the confidence which they place in their respective principles and methods; for there are considerable differences among them in those respects, and each seems convinced that the others are in a mistake. MM. d'Alembert and Lagrange have greatly corrected the theories of their predecessors, and have proceeded on postulates which come much nearer to the real state of the case. But their investigations involve us in such an inextricable maze of analytical investigation, that, even when we are again conducted to the light of day by the clue which they have given us, we can make no use of what we there discovered.

But this theory, imperfect as it is, is of great service. It generalizes our observations and experiments, and enables us to compose a *practical doctrine* from a heap of facts which otherwise must have remained solitary and unconnected.

Fundamental proposition.

The fundamental proposition of this practical hydrodynamics is, that water or any fluid contained in an open vessel of indefinite magnitude, and impelled by its weight only, will flow through a small orifice with the velocity which a heavy body would acquire by falling from the horizontal surface of the fluid. Thus, if the orifice is 16 feet under the surface of the water, it will issue with the velocity of 32 feet in a second.

Its velocity corresponding to any other depth h of the orifice under the surface, will be had by this easy proportion: As the square root of 16 is to the square root of h, so is 32 feet to the velocity required: or, alternately,

$$\sqrt{16} : 32 = \sqrt{h} : v, \text{ and } v = \frac{32\sqrt{h}}{\sqrt{16}}, = \frac{32}{4}\sqrt{h}, = 8\sqrt{h};$$

that is, multiply the square root of the height in feet by 8, and the product is the required velocity.

On the other hand, it frequently occurs that we want to discover the depth under the surface which will produce a known velocity v. Therefore, $\sqrt{h} = \frac{v}{8}$, and $h = \frac{v^2}{64}$; that is, divide the square of the velocity by 64, and the quotient is the depth wanted in feet.

Its utility.

This proposition is sufficient for all our purposes. For, since water is nearly a perfect fluid, and propagates all impressions undiminished, we can, in place of any pressure of a piston or other cause, substitute a perpendicular column of water whose weight is equal to this pressure, and will therefore produce the same efflux. Thus, if the surface of a piston is half a square foot, and it be pressed down with the weight of 500 pounds, and we would wish to know with what velocity it would cause the water to flow through a small hole, we know that a column of water of this weight, and of half a foot base, would be sixteen feet high. And this proposition teaches us, that a vessel of this depth will have a velocity of efflux equal to thirty-two feet in a second.

If therefore our pressing power be of such a kind that it can continue to press forward the piston with the force of 500 pounds, the water will flow with this velocity, whatever be the size of the hole. All that remains is, to determine what change of actual pressure on the piston results from the motion on the piston itself, and to change the velocity of efflux in the subduplicate ratio of the change of actual pressure.

But before we can apply this knowledge to the circumstances which take place in the motion of water in pumps, we must take notice of an important modification of the fundamental proposition, which is but very obscurely pointed out by any good theory, but is established on the most regular and unexceptionable observation.

If the efflux is made through a hole in a thin plate, and the velocity is computed as above, we shall discover the quantity of water which issues in a second by observing, that it is a prism or cylinder of the length indicated by the velocity, and having its transverse section equal to that of the orifice. Thus, in the example already given, supposing the hole to be a square inch, the solid contents of this prism, or the quantity of water issuing in a second, is $1 \times 32 \times 12$ cubic inches, or 384 cubic inches. This we can easily measure by receiving it in a vessel of known dimensions. Taking this method, we uniformly find a deficiency of nearly thirty-eight parts in a hundred; that is, if we should obtain a hundred gallons in any number of seconds, we shall in fact get only sixty-two. This is a most regular fact, whether the velocities are great or small, and whatever be the size and form of the orifice. The deficiency increases indeed in a very minute degree with the velocities. If, for instance, the depth of the orifice be one foot, the discharge is $\frac{6213}{10000}$; if it be fifteen feet, the discharge is $\frac{6172}{10000}$.

This deficiency is not owing to a diminution of velocity; for the velocity may be easily and accurately measured by the distance to which the jet will go if directed horizontally. This is found to correspond very nearly with the proposition, making a very small allowance for friction at the border of the hole, and for the resistance of the air. Sir Isaac Newton ascribed the deficiency with great justice to this, that the lateral columns of water, surrounding the column which is incumbent on the orifice, press towards the orifice, and contribute to the expense equally with that column. These lateral filaments, therefore, issue obliquely, crossing the motion of the central stream, and produce a contraction of the jet; and the whole stream does not acquire a parallel motion and its ultimate velocity till it has got to some distance from the orifice. Careful observation showed him that this was really the case. But even his genius could not enable him to ascertain the motion of the lateral filaments by theory, and he was obliged to measure everything as he saw it. He found the diameter of the jet at the place of the greatest contraction to be precisely such as accounted for the deficiency. His explication has been unanimously acquiesced in; and experiments have been multiplied to ascertain all those circumstances which our theory cannot determine *a priori*. The most complete set of experiments are those of Michelotti, made at Turin at the expense of the prince of Piedmont. Here jets were made of one, two, three, and four inches diameter; and the water received into cisterns most accurately formed of brick, and lined with stucco. It is the result of these experiments which we have taken for a measure of the deficiency.

We may therefore consider the water as flowing through a hole of this contracted dimension, or substitute this for the real orifice in all calculations. For it is evident, that if a mouth-piece (so to call it) were made, the internal shape of which precisely tallied with the form which the jet assumes, and if this mouth-piece be applied to the orifice, the water will flow out without any obstruction. The vessel may therefore be considered as really having this mouth-piece.

Nay, from this we derive a very important observation, that if, instead of allowing the water to flow through a hole of an inch area made in a thin plate, we make it flow through a hole in a thick plank, so formed that the external orifice shall have an inch area, but be widened internally agreeably to the shape which nature forms, both the velocity and quantity will be that which the fundamental proposition determines. Michelotti measured with great care the form of the great jets of three and four inches diameter, and found that the bounding curve was an elongated trochoid. He then made a mouth-piece of this form for his jet of one inch, and another for his jet of two inches; and he found the discharges to be $\frac{979}{1000}$ and $\frac{987}{1000}$; and he, with justice, ascribed the trifling deficiency which still remained, partly to friction and partly to his not having exactly suited his mouth-piece to the natural form. We imagine that this last circumstance was the sole cause: For, in the first place, the water in his experiments, before getting at his jet-holes, had to pass along a tube of eight inches diameter. Now a jet of four inches bears too great a proportion to this pipe; and its narrowness undoubtedly hindered the lateral columns from contributing to the efflux in their due proportion, and therefore rendered the jet less convergent. And, in the next place, there can be no doubt (and the observations of Daniel Bernoulli confirm it), but that this convergency begins within the vessel, and perhaps at a very considerable distance from the orifice. And we imagine, that if accurate observations could be made on the motion of the remote lateral particles within the vessel, and an internal mouth-piece were shaped according to the curve which is described by the remotest particle that we can observe, the efflux of water would almost perfectly tally with the theory. But indeed the coincidence is already sufficiently near for giving us very valuable information. We learn that the quantity of water which flows through a hole, in consequence of its own weight, or by the action of any force, may be increased one half by properly shaping the passage to this hole; for we see that it may be increased from sixty-two to near ninety-nine.

But there is another modification of the efflux, which we confess our total incapacity to explain. If the water issues through a hole made in a plate whose thickness is about twice the diameter of the hole, or, to express it better, if it issues through a pipe whose length is about twice its diameter, the quantity discharged is nearly $\frac{82}{100}$ of what results from the proposition. If the pipe be longer than this, the quantity is diminished by friction, which increases as the length of the pipe increases. If the pipe be shorter, the water will not fill it, but detaches itself at the very entry of the pipe, and flows with a contracted jet. When the pipe is of this length, and the extremity is stopped with the finger, so that it begins to flow with a full mouth, no subsequent contraction is observed; but merely striking on the pipe with a key or the knuckle is generally sufficient to detach the water in an instant from the sides of the pipe, and reduce the efflux to $\frac{62}{100}$.

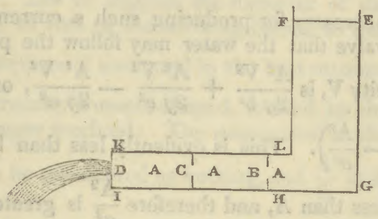
This effect is most unaccountable. It certainly arises from the mutual adhesion or attraction between the water and the sides of the pipe; but how this, acting at right angles to the motion, should produce an increase from sixty-two to eighty-two, nearly one third, we cannot explain. It shows, however, the prodigious force of this attraction, which in the space of two or three inches is able to communicate a great velocity to a very great body of water. Indeed the experiments on capillary tubes show that the mutual attraction of the parts of water is some thousands of times greater than their weight.

We have only further to add, that every increase of pipe beyond two diameters is accompanied with a diminution of the discharge; but in what ratio this is diminished it is very difficult to determine. We shall only observe at present, that the diminution is very great. A pipe of two inches diameter and thirty feet long has its discharge only $\frac{54}{100}$ of what it would be if only four inches long. If its length be sixty feet, its discharge will be no more than $\frac{39}{100}$. A pipe of one inch diameter would have a discharge of $\frac{44}{100}$ and $\frac{31}{100}$ in the same situation. Hence we may conclude that the discharge of a four-inch pipe of thirty feet long will not exceed two thirds of what it would be if only eight inches long.

Before we can proceed to apply this fundamental proposition to our purpose, we must anticipate a proposition of continual use in the construction of *water-works.*

Let water be supposed stagnant in a vessel EFGH (fig. 37), and let it be allowed to flow out by a cylindrical pipe HIKL, divided by any number of partitions B, C, D, &c. Whatever be the areas B, C, D, of these orifices, the velocity in the intermediate parts of the pipe will be the same; for as much passes through any one orifice in a second as passes through any other in the same time, or through any section of the intervening pipe. Let this velocity in the pipe be V, and let the area of the pipe be A. The velocity in the orifices B, C, D, must be $\frac{VA}{B}$, $\frac{VA}{C}$, $\frac{VA}{D}$, &c. Let g be the velocity acquired in a second by a heavy body. Then, by the general proposition, the height of water in the vessel which will produce the velocity $\frac{VA}{B}$ in the first orifice alone, is $\frac{V^2}{2g}\frac{A^2}{B^2}$. After this passage the velocity is again reduced to V in the middle of the space between the first and second orifices. In the second orifice this velocity is changed to $\frac{VA}{C}$. This alone would have required a height of water $\frac{V^2}{2g}\frac{A^2}{C^2}$. But the water is already moving with the velocity V, which would have resulted from a height of water in the vessel (which we shall, in the language of the art, call the *head of water*) equal to $\frac{V^2}{2g}$. Therefore there is only required a head of water $\frac{V^2}{2g}\frac{A^2}{C^2} - \frac{V^2}{2g}$, or $\frac{V^2}{2g} \times \overline{\frac{A^2}{C^2} - 1}$. Therefore the whole height necessary for producing the efflux through both orifices, so as still to preserve the velocity V in the intervening pipe, is $\frac{V^2}{2g} \times \overline{\frac{A^2}{B^2} + \frac{A^2}{C^2} - 1}$. In like manner, the third orifice D would alone require a head of water $\frac{V^2}{2g} \times \overline{\frac{A^2}{D^2} - 1}$; and all the three would require a head $\frac{V^2}{2g} \times \overline{\frac{A^2}{B^2} + \frac{A^2}{C^2} + \frac{A^2}{D^2} - 2}$. By this induction may easily be seen what head is necessary for producing the efflux through any number of orifices.

Fig. 37.



Let the expense or quantity of water discharged in an unit of time (suppose a second) be expressed by the symbol Q. This is measured by the product of the velocity and by the area of the orifice, and is therefore $= \text{VA}$, or $\frac{VA}{B} \times B$, or $\frac{VA}{C} \times C$, &c. and $V^2 = \frac{Q^2}{A^2}$. Therefore we may compute the head of water (which we shall express by H) in reference to the quantity of water discharged, because this is generally the interesting circumstance. In this view we have $H = \frac{Q^2}{2gA} \times \overline{\frac{A^2}{B^2} + \frac{A^2}{C^2} + \frac{A^2}{D^2} - 2}$; which shows that the head of water necessary for producing the discharge increases in the proportion of the square of the quantity of water which is discharged.

To determine the motion of water in the sucking pump.

These things being premised, it is an easy matter to determine the motion of water in a pump, and the quantity discharged, resulting from the action of any force on the piston, or the force which must be applied to the piston in order to produce any required motion or quantity discharged. We have only to suppose that the force employed is the pressure of a column of water of the diameter of the working barrel; and this is over and above the force which is necessary for merely supporting the water at the height of the place of delivery. The motion of the water will be the same in both cases.

Let us, first of all, consider a sucking pump. The motion here depends on the pressure of the air, and will be the same as if the pump were lying horizontally, and communicated with a reservoir in which is a head of water sufficient to overcome all the obstructions to the motion, and produce a velocity of efflux such as we desire. And here it must be noted that there is a limit. No velocity of the piston can make the water rise in the suction-pipe with a greater velocity than what would be produced by the pressure of a column of water thirty-three feet high; that is, about forty-six feet per second.

Let the velocity of the piston be V, and the area of the working barrel be A. Then, if the water fills the barrel as fast as the piston is drawn up, the discharge during the rise of the piston, or the number of cubic feet of water per second, must be $= V \times A$. This is always supposed, and we have already ascertained the circumstances which insure this to happen. If, therefore, the water arrived with perfect freedom to the piston, the force necessary for giving it this velocity, or for discharging the quantity $V \times A$ in a second, would be equal to the weight of the pillar of water whose height is $\frac{V^2}{2g}$, and base A.

It does not appear at first sight that the force necessary for producing this discharge has any thing to do with the obstructions to the ascent of the water into the pump, because this is produced by the pressure of the atmosphere; and it is the action of this pressure which is measured by the head of water necessary for producing the internal motion in the pump. But we must always recollect that the piston, before bringing up any water, and supporting it at a certain height, was pressed on both sides by the atmosphere. While the air supports the column below the piston, all the pressure expended in this support is abstracted from its pressure on the under part of the piston, while its upper part still supports the whole pressure. The atmosphere continues to press on the under surface of the piston, through the intermedium of the water in the suction-pipe, with the difference of these two forces. Now, while the piston is drawn up with the velocity V, more of the atmospheric pressure must be expended in causing the water to follow the piston; and it is only with the remainder of its whole pressure that it continues to press on the under surface of the piston. Therefore, in order that the piston may be raised with the velocity V, a force must be applied to it, over and above the force necessary for merely supporting the column of water, equal to that part of the atmospheric pressure thus employed; that is, equal to the weight of the head of water necessary for forcing the water up through the suction-pipe, and producing the velocity V in the working barrel.

Therefore let B be the area of the mouth of the suction-pipe, and C the area of the fixed valve, and let the suction-pipe be of equal diameter with the working barrel. The head necessary for producing the velocity V on the working barrel is $\frac{V^2}{2g}\left(\frac{A^2}{B^2}+\frac{A^2}{C^2}-1\right)$. If d express the density of water, that is, if d be the number of pounds in a cubic foot of water, then $dA\frac{V^2}{2g}$ will express the weight of a column whose base is A, and height $\frac{V^2}{2g}$, all being reckoned in feet. Therefore the force which must be applied, when estimated in pounds, will be $p=\frac{dAV^2}{2g}\left(\frac{A^2}{B^2}+\frac{A^2}{C^2}-1\right)$.

The first general observation to be made on what has been said is, that the power which must be employed to produce the necessary motion, in opposition to all the obstacles, is in the proportion of the square of the velocity which we would produce, or the square of the quantity of water we would discharge.

We have hitherto proceeded on the supposition that there is no contraction of the jet in passing through these two orifices. This we know would be very far from the truth. We must therefore accommodate things to these circumstances, by diminishing B and C in the ratio of the contraction, and calling the diminished areas b and c; then we have $p=\frac{AdV^2}{2g}\left(\frac{A^2}{b^2}+\frac{A^2}{c^2}-1\right)$.

What this diminution may be, depends on the form of the parts. If the fixed valve and the entry into the pump are simply holes in thin plates, then $b=\frac{62}{100}$ B, and $c=\frac{62}{100}$ C. The entry is commonly widened or trumpet-shaped, which diminishes greatly the contraction; but there are other obstacles in the way, arising from the strainer usually put round it to keep out filth. The valve may have its contraction greatly diminished also by its box being made bell-shaped internally; nay, even giving it a cylindrical box, in the manner of fig. 33, is better than no box at all, as in fig. 5; for such a cylindrical box will have the unaccountable effect of the short tube, and make $b=\frac{82}{100}$ B, instead of $\frac{62}{100}$ B. Thus we see that circumstances seemingly very trifling may produce great effects in the performance of a pump. We should have observed that the valve itself presents an obstacle which diminishes the motion, and requires an increase of power; and it would seem that in this respect the clack or butterfly valve is preferable to the button valve.

Example. Suppose the velocity of the piston to be 2 feet or 24 inches per second, and that the two contracted areas are each one fifth of the area of the pump, which is not much less than what obtains in ordinary pumps. We have $\frac{V^2}{2g}\left(\frac{A^2}{b^2}+\frac{A^2}{c^2}-1\right)=\frac{576}{768}(25+25-1)=36{\cdot}75$ inches, and the force which we must add to what will merely support the column is the weight of a pillar of water incumbent on the piston, and something more than three feet high. This would be a sensible portion of the whole force in raising water to small heights.

We have supposed the suction-pipe to be of the same diameter with the working barrel; but it is usual to make it of smaller diameter, generally equal to the water-way of the fixed valve. This makes a considerable change in the force necessary to be applied to the piston. Let a be the area of the suction-pipe, the area of the entry being still B, and the equivalent entry without contraction being still b; we have the velocity at the entrance $=\frac{AV}{b}$, and the producing head of water $=\frac{A^2V^2}{2g\,b^2}$. After this the velocity is changed to $\frac{AV}{a}$ in the suction-pipe, with which the water arrives at the valve, where it is again changed to $\frac{AV}{c}$, and requires for this change a head of water equal to $\frac{A^2V^2}{2g\,c^2}$. But the velocity retained in the suction-pipe is equivalent to the effect of a head of water $\frac{A^2V^2}{2g\,a^2}$. Therefore the head necessary for producing such a current through the fixed valve that the water may follow the piston with the velocity V, is $\frac{A^2V^2}{2g\,b^2}+\frac{A^2V^2}{2g\,c^2}-\frac{A^2V^2}{2g\,a^2}$, or $=\frac{V^2}{2g}\left(\frac{A^2}{2g}+\frac{A^2}{c^2}-\frac{A^2}{a^2}\right)$. This is evidently less than before, because a is less than A, and therefore $\frac{A^2}{a^2}$ is greater than unity, which was the last term of the former formula. There is some advantage, therefore, derived from making the diameter of the suction-pipe less than that of the working barrel; but this is only because the passage of the fixed valve is smaller, and the inspection of the formula plainly points out that the area of the suction-pipe should be equal to that of the fixed valve. When it is larger, the water must be accelerated in its passage through the valve; which is an useless expense of force, because this velocity is to be immediately reduced to V in the working barrel. If the foregoing example be computed with a equal to one fourth of A, we shall find the head H equal to 29 inches instead of 37.

But this advantage of a smaller suction-pipe is in all cases very moderate; and the pump is always inferior to one of uniform dimensions throughout, having the orifice at the fixed valve of the same area. And if these orifices are considerably diminished in any proportion, the head necessary for overcoming the obstacles, so that the required velocity V may still be produced in the working barrel, is greatly increased. If we suppose the area a one ninth of A, which is frequently done in house-pumps, where the diameter of the suction-pipe does seldom exceed one third of that of the working barrel; and suppose everything made in proportion to this, which is also usual, because the unskilled pump-makers study a symmetry which satisfies the eye; we shall find that the pump taken as an example will require a head of water equal to thirteen feet and upwards. Besides, it must be observed that the friction of the suction-pipe itself has not been taken into the account. This alone is greater, in most cases, than all the obstructions we have been speaking of; for if this pipe is three inches diameter, and that of the working barrel is six, which is reckoned a liberal allowance for a suction-pipe, and if the fixed valve is twenty-five feet above the surface of the pit-water, the friction of this pipe will amount to one third of the whole propelling force.

Thus we have enabled the reader to ascertain the force necessary for producing any required discharge of water from a pump of known dimensions; and the converse of this determination gives us the discharge which will be produced by any given force. For, making $\frac{A^2}{b^2}+\frac{A^2}{c^2}-\frac{A^2}{a^2}$ (which is a known quantity, resulting from the dimensions of the pump) $=$ M, we have $H=\frac{V^2}{2g}M$, and $V^2=\frac{2g\,H}{M}$, and $V=\sqrt{\frac{2g\,H}{M}}$. Now H is that part of the natural power which we have at command which exceeds what is necessary for merely supporting the column of water. Thus, if we have a pump whose piston has an area of one fourth of a square foot, its diameter being six and three-fourth inches; and we have to raise the water thirty-two feet, and can apply a power of five hundred and twenty-five pounds to the piston; we wish to know at what rate the piston will be moved, and the quantity of water discharged. Merely to support the column of water of this height and diameter, requires five hundred pounds. Therefore the remaining power, which is to produce the motion, is twenty-five pounds. This is the weight of a column one foot four inches high, and $H = 1333$ feet. Let us suppose the diameter of the suction-pipe one half of that of the working barrel, so that $\frac{A}{B} = 4$. We may suppose it executed in the best manner, having its lower extremity trumpet-shaped, formed by the revolution of the proper trochoid. The contraction at the entry may therefore be considered as nothing, and $\frac{A}{b} = 4$, and $\frac{A^2}{b^2} = 16$. We may also suppose the orifice of the fixed valve equal to the area of the suction-pipe, so that $\frac{A^2}{C^2}$ is also $= 16$; and there is no contraction here, and therefore $\frac{A^2}{c^2}$ is also 16; and, lastly, $\frac{A^2}{a^2}$ is also 16. Therefore $\frac{A^2}{b^2} + \frac{A^2}{c^2} - \frac{A^2}{a^2}$ or $M, = 16 + 16 - 16, = 16$. We have also $2g = 64$. Now $N = \sqrt{\frac{2g\,H}{M}}, = \sqrt{\frac{64 \times 1333}{16}}, = 2309$ feet, and the piston will move with the velocity of two feet four inches nearly. Its velocity will be less than this, on account both of the friction of the piston and the friction of the water in the suction-pipe. These two circumstances will probably reduce it to one foot eight inches; and it can hardly be less than this.

We have taken no notice of the friction of the water in the working barrel, or in the space above the piston; because it is in all cases quite insignificant. The longest pipes employed in our deep mines do not require more than a few inches of head to overcome it.

But there is another circumstance which must not be omitted. This is the resistance given to the piston in its descent. The pistons of an engine for drawing water from deep mines must descend again by their own weight in order to repeat their stroke. This must require a preponderance on that end of the working beam to which they are attached, and this must be overcome by the moving power during the effective stroke. It makes, therefore, part of the whole work to be done, and must be added to the weight of the column of water which must be raised.

This is very easily ascertained. Let the velocity of the piston in its descent be V, the area of the pump-barrel A, and the area of the piston-valve a. It is evident, that while the piston descends with the velocity V, the water which is displaced by the piston in a second is $(A - a)\,V$. This must pass through the hole of the piston, in order to occupy the space above, which is left by the piston. If there were no contraction the water would go through with the velocity $\frac{A-a}{a}V$; but as there will always be some contraction, let the diminished area of the hole (to be discovered by experiment) be b; the velocity therefore will be $V\frac{A-a}{b}$. This requires for its production a head of water $\frac{V^2}{2g}\left(\frac{A-a}{b}\right)^2$. This is the height of a column of water the base of which is not A, but $A - a$. Calling the density of water d, we have for the weight of this column, and the force p in $d \times \overline{A-a} + \left(\frac{A-a}{b}\right) \times \frac{V^2}{2g}, = \frac{dV^2(A-a)^3}{2gb^2}$. This, we see again, is proportional to the square of the velocity of the piston in its descent, and has no relation to the height to which the water is raised.

If the piston has a button-valve, its surface is at least equal to a; and therefore the pressure is exerted on the water by the whole surface of the piston. In this case we shall have $p = \frac{dV^2A^3}{2gb2}$, considerably greater than before. We cannot ascertain this value with great precision, because it is extremely difficult, if possible, to determine the resistance in so complicated a case. But the formula is exact if b can be given exactly; and we know within very moderate limits what it may amount to. In a pump of the very best construction. with a button-valve, b cannot exceed one half of A; and therefore $\frac{A^3}{b^2}$ cannot be less than 8. In this case, $\frac{V^2\,A^3}{2g\,b^2}$ will be $\frac{V^2}{8}$. In a good steam-engine pump, V is about three feet per second, and $\frac{V^2}{8}$ is about $1\frac{1}{8}$ feet, which is but a small matter.

Motion of water in the forcing pump.

We have hitherto been considering the sucking pump alone; but the forcing pump is of more importance, and apparently more difficult of investigation. Here we have to overcome the obstructions in long pipes, with many bends, contractions, and other obstructions. But the consideration of what relates merely to the pump is abundantly simple. In most cases we have only to force the water into an air-vessel, in opposition to the elasticity of the air compressed in it, and to send it thither with a certain velocity, regulated by the quantity of water discharged in a given time. The elasticity of the air in the air-vessel propels it along the main. We are not now speaking of the force necessary for counterbalancing this pressure of the air in the air-vessel, which is equivalent to all the subsequent obstructions, but only of the force necessary for propelling the water out of the pump with the proper velocity.

We have in a manner determined this already. The piston is solid, and the water which it forces has to pass through a valve in the lateral pipe, and then to move in the direction of the main. The change of direction requires an addition of force to what is necessary for merely impelling the water through the valve. Its quantity is not easily determined by any theory, and it varies according to the abruptness of the turn. It appears from experiment, that when a pipe is bent to a right angle, without any curvature or rounding, the velocity is diminished about $\frac{1}{18}$th. This would augment the head of water $\frac{1}{9}$th. This may be added to the contraction of the valve hole. Let c be its natural area, and, whatever is the contraction competent to its form, increase it $\frac{1}{18}$th, and call the contracted area c. Then this will require a head of water $= \frac{V^2\,A^2}{2g\,c^2}$. This must be added to the head $\frac{V^2}{2g}$, necessary for merely giving the velocity V to the water. Therefore the whole is $\frac{V^2}{2g}\left(\frac{A^2}{c^2} + 1\right)$; and the power p necessary for this purpose is $\frac{d\,AV^2}{2g}\left(\frac{A^2}{c^2} + 1\right)$.

It cannot escape the observation of the reader, that in all these formulæ, expressing the height of the column of water which would produce the velocity V in the working barrel of the pump, the quantity which multiplies the constant factor $\frac{d\,AV^2}{2g}$ depends on the contracted passages which are in different parts of the pump, and increases in the duplicate proportion of the sum of those contractions. It is therefore of the utmost consequence to avoid all such, and to make the main which leads from the forcing pump equal to the working barrel. If it be only of half the diameter, it has but one fourth of the area, the velocity in the main is four times greater than that of the piston, and the force necessary for discharging the same quantity of water is sixteen times greater.

Use of experiments.

It is not, however, possible to avoid these contractions altogether, without making the main pipe wider than the barrel. For if only so wide, with an entry of the same size, the valve makes a considerable obstruction. Unskilful engineers endeavour to obviate this by making an enlargement in that part of the main which contains the valve. This is seen in fig. 14, at the valve L. If this be not done with great judgment, it will increase the obstructions. For if this enlargement is full of water, the water must move in the direction of its axis with a diminished velocity; and when it comes into the main, it must again be accelerated. In short, any abrupt enlargement which is to be afterwards contracted does as much harm as a contraction, unless it be so short that the water in the axis keeps its velocity till it reaches the contraction. Nothing would do more service to an artist who is not well founded in the theory of hydrodynamics, than to make a few simple and cheap experiments with a vessel like that of fig. 37. Let the horizontal pipe be about three inches diameter, and made in joints which can be added to each other. Let the joints be about six inches long, and the holes from one fourth to a whole inch in diameter. Fill the vessel with water, and observe the time of its sinking three or four inches. Each joint should have a small hole in its upper side to let out the air; and when the water runs out by it, let it be stopped by a peg. He will see that the larger the pipe is in proportion to the orifices made in the partitions, the efflux is more diminished. We believe that no person would suspect this who has not considered the subject minutely.

All angular enlargements, all boxes into which the pipes from different working barrels unite their water before it goes into a main, must therefore be avoided by an artist who would execute a good machine; and the different contractions which are unavoidable at the seats of valves and the perforations of pistons, &c. should be diminished by giving the parts a trumpet-shape.

In the air-vessels represented in fig. 13, this is of very great consequence. The throat O, through which the water is forced by the expansion of the confined air, should always be formed in this manner. For it is this which produces the motion during the returning part of the stroke in the pump constructed like fig. 13, No. 1, and during the whole stroke in No. 2. Neglecting this seemingly trifling circumstance will diminish the performance at least one fifth. The construction of No. 1 is the best, for it is hardly possible to make the passage of the other so free from the effects of contraction. The motion of the water during the returning stroke is very much contorted.

Accelerated motion of water in pumps.

There is one circumstance that we have not taken any notice of, viz. the gradual acceleration of the motion of water in pumps. When a force is applied to the piston, it does not in an instant communicate all the velocity which it acquires. It acts as gravity acts on heavy bodies; and if the resistances remained the same, it would produce, like gravity, an uniformly accelerated motion. But we have seen that the resistances, which are always measured by the force that just overcomes them, increase as the square of the velocity increases. They therefore quickly balance the action of the moving power, and the motion becomes uniform in a time so short that we commit no error of any consequence by supposing it uniform from the beginning. It would have prodigiously embarrassed our investigations to introduce this circumstance; and it is a matter of mere speculative curiosity; for most of our moving powers are unequal in their exertions, and these exertions are regulated by other laws. The pressure on a piston moved by a crank is as variable as its velocity, and in most cases is nearly in the inverse proportion of its velocity, as any mechanician will readily discover. The only case in which we could consider this matter with any degree of comprehensibility is that of a steam-engine, or of a piston which forces by means of a weight lying on it. In both, the velocity becomes uniform in a very small fraction of a second.

Deficiency of elementary books on this subject.

We have been very minute on this subject. For although it is the only view of a pump which is of any importance, it is hardly ever understood even by professed engineers; and this is not peculiar to hydraulics, but is seen in all the branches of practical mechanics. The elementary knowledge to be met with in such books as are generally perused by them, goes no farther than to state the forces which are in equilibrio by the intervention of a machine, or the proportion of the parts of a machine which will set two known forces in equilibrio. But when this equilibrium is destroyed by the superiority of one of the forces, the machine must move; and the only interesting question is, what will be the motion? Till this is answered with some precision, we have learned nothing of any importance. Few engineers are able to answer this question even in the simplest cases; and they cannot, from any confident science, say what will be the performance of an untried machine. They guess at it with a success proportioned to the multiplicity of their experience and their own sagacity. Yet this part of mechanics is as susceptible of accurate computation as the cases of equilibrium. We therefore thought it our duty to point out the manner of proceeding so circumstantially that every step should be plain and easy, and that conviction should always accompany our progress. This we think it has been in our power to do, by the very simple method of substituting a column of water acting by its weight in lieu of any natural power which we may chance to employ.

To such as wish to prosecute the study of this important part of hydraulics in its most abstruse parts, we recommend the perusal of the Dissertations of M. Pitot and M. Bossut, in the Memoirs of the Academy of Paris; the Dissertations of the Chevalier de la Borda, 1766 and 1767; and the *Hydraulique* of the Chevalier de Buat.

PUN, an expression where a word has at once different meanings. The practice of punning is the refuge of those who wish to pass for wits, without having a grain of it in their composition. James I. of England delighted in punning; and the taste of the sovereign was studied by the courtiers, nay, even by the clergy. Hence the sermons of that age abound with this species of false wit. It continued to be more or less fashionable until the reign of Queen Anne, when Addison, Swift, Pope, and Arbuthnot, with the other real wits of that age, united their efforts to banish punning from polite composition. It is still admitted sparingly in conversation, and only from those who cannot furnish anything better.

PUNCH, an instrument of iron or steel, used in several arts, for piercing or stamping holes in plates of metals, and other purposes, being so contrived as not only to perforate, but to cut out and take away the piece. The punch is a principal instrument of the metal-button makers, shoemakers, and other craftsmen.

PUNCH is also a name for a sort of compound drink, much used in this country, and in many parts abroad, particularly in Jamaica, and several other parts of the West Indies.

PUNCHEON, PUNCHIN, or *Punchion*, a little block or piece of steel, on one end of which is some figure, letter, or mark, engraved either *en creux* or in relief, and impressions of which are taken on metal or some other matter, by striking it with a hammer on the end not engraved. There are various kinds of these puncheons used in the mechanical arts; such, for instance, are those of the goldsmiths, cutlers, pewterers, and others.

The puncheon, in coining, is a piece of iron steeled, on which the engraver has cut in relief the several figures, arms, effigy, inscription, or the like, that there are to be in the matrices wherewith the species are to be marked. Minters distinguish three kinds of puncheons, according to the three kinds of matrices to be made; that of the effigy, that of the cross or arms, and that of the legend or inscription. The first includes the whole portrait in relief; the second is small, containing only a piece of the cross or arms, as a fleur-de-lis, a harp, or a coronet, by the assemblage of all which the entire matrice is formed; the puncheons of the legend contain only one letter each, and serve equally for the legend on the effigy side and the cross side. (See the article COINAGE.)

PUNCHEON is also the name of several iron tools, of various sizes and figures, used by the engravers *en creux* on metals. Seal-engravers particularly use a great number for the several pieces of arms, and other devices to be engraven, and many stamp the whole seal from a single puncheon.

PUNCHEON is also a common name for all the iron instruments used by stone-cutters, sculptors, blacksmiths, and others, for the cutting, inciding, or piercing their several matters.

Those of sculptors and statuaries serve for the repairing of statues when taken out of the moulds. The locksmiths use the greatest variety of puncheons; some for piercing hot, others for piercing cold; some flat, others square; some round, others oval; each to pierce holes of its respective figure in the several parts of locks.

PUNCHEON, in *Carpentry*, is a piece of timber placed upright between two posts, the bearing of which is too great, and serving, together with them, to sustain some large weights.

PUNCHEON is also the name of a measure for liquids, containing about a hundred and thirty-three gallons.

PUNCTUATION, in *Grammar*, the art of pointing, or of dividing a discourse into periods, by points expressing the pauses to be made therein.

The points used are four; the period, colon, semicolon, and comma, which are too well known to require any particular explanation. We shall only observe, in general, therefore, that the comma is used to distinguish nouns from nouns, verbs from verbs, and such other parts of a period as are not necessarily joined together. The semicolon serves to suspend and sustain the period when too long; the colon to add some new or supernumerary reason or consequence to what is already said; and the period to close up the sense and construction, and release the voice.

It has been asserted, that punctuation is a modern art, and that the ancients were entirely unacquainted with the use of our commas and other points, and wrote not only without any distinction of numbers and periods, but also without distinction of words; a custom which, Lipsius observes, continued until the hundred and fourth Olympiad, during which time the sense alone divided the discourse.

What places this beyond dispute is the Alexandrian manuscript, in the British Museum. Whoever examines this codex will find that the whole is written *continuo ductu*, without distinction of words or sentences. How the ancients read their works written in this manner, it is not easy to conceive.

After the practice ceased of joining words together, notes of distinction were placed at the end of every word. In all the editions of the *Fasti Capitolini* these points occur. The same are to be seen on the *Columna Rostrata*. For want of them, we find much confusion in the *Chronicon Marmoreum*, and the covenant between the Smyrnæans and Magnesians, which are both at Oxford. In Salmasius's edition of *Dedicatio Statuæ Rigillæ Herodis*, the same confusion occurs, where we find ΔΕΥΡΙΤΕ and Δευρ ιτε.

Of these marks of distinction, the Walcote inscription found near Bath may serve as a specimen;

IVLIUSv VITALISv FABRI
CESISv LEGv XXVv Vv V
STIPENDIORUMv

After every word here, except at the end of a line, we see the mark v. There is an inscription in Montfaucon, which has a capital letter laid in an horizontal position, by way of interstitial mark, which makes one apt to think that this way of pointing was sometimes according to the fancy of the graver.

P. FERRARIVS HERMES
CAECINIAE ⊢ DIGNAE
CONIVGI ⊢ KARISSIMAE
NVMERIAE ⊢

Here we observe after the words a T laid horizontally, but not after each word, which proves this to be of a much later age than the former.

As the improvement of stops appears not to have taken place whilst manuscripts and monumental inscriptions were the only known methods of conveying knowledge, it is conjectured that it was introduced with the art of printing. The fourteenth century, to which we are supposed to be indebted for this invention, did not, however, bestow those appendages which we call *stops*. Whoever will be at the pains of examining the first printed books, will discover no stops of any kind; but arbitrary marks here and there, according to the humour of the printer. In the sixteenth century we observe their first appearance. From the books of this age, we find that they were not at all produced at the same time; those we meet with in use being only the comma, the parenthesis, the interrogation, and the full point. To prove this, we need but look into Bale's Acts of English Worthies, in black letter, printed in 1550. In the dedication of this book to Edward VI. we discover a colon, it is true; but as this is the only one of the kind throughout the work, it is plain that the colon was not established at that time, or, if it was, that it had not yet come into common use. Thirty years afterwards, in the sensible and judicious performance of Sir Thomas Elyot, entitled The Governour, imprinted in the year 1580, we see the colon as frequently introduced as any other stop; but the semicolon and the mark of admiration were still wanting, neither of these being visible in Sir Thomas's book. In Hackluyt's Voyages, printed in 1599, we meet with the semicolon; but, as if the editors did not fully apprehend the propriety of its general admission, it is sparingly introduced. It has been said, indeed, that the semicolon was brought into use at a much earlier period; but it appears that it was only for the purpose of an abbreviation, as in (*namq ;*) (*neq ;*) for *namque*, *neque*, and not in the sense in which it is now employed.

The semicolon, as well as all the ordinary points, is used in a work entitled *Imagines Deorum*, printed at Leyden in the year 1581, in Roman characters. We likewise meet with them in the translation of a book written in French by Philip de Mornay, lord of Plessis; in the Schoolmaster of Roger Ascham, printed in 1570, with the exception of the semicolon; and in the Trewnesse of the Christian Religion, by Sir Philip Sidney, published in 1587, in which we find the asterisk, brackets, the interrogation, the comma, and the semicolon, all as we now use them, the colon and period being square dots.

In an alchemical manuscript, of date 1572, the semicolon is said to be met with, as well as the other three points which are now in common use. The colon and period are abundant in a work entitled *Dionysius de Situ Orbis*, printed at Venice in 1498, but none of the other stops or points occur. The single point (.) appears to be the most ancient. Since the year 1485 the colon was introduced; the comma is first seen about the year 1521; and the more refined semicolon was brought into use about the year 1570.

The invention of the semicolon is most probably due to the English; for, from the Leyden edition of Pliny, 1553, it is evident that the Dutch printers were not then in the practice of using it; and if they were in 1570, Roger Ascham would probably have employed it, since the Dutch were the principal classical printers in his time. But we find that some English books were marked with it at that period.

The note of admiration was the last stop invented, and seems to have been added to the rest at a period not far distant from our own time.

Thus we see that these notes of distinction came into use as learning gradually advanced and improved; one invention, indeed, but enlarged by several additions. But notwithstanding what has been said relative to the use of stops as being a modern invention, we shall find reason to be satisfied that the ancients were not unacquainted with the method of making pauses in speaking and writing, if we attend to the following investigation of Warburton.

"Some species of pauses and divisions of sentences in speaking and writing must have been coeval with the knowledge of communicating ideas by sound or by symbols.

"Suidas says that the *period* and the *colon* were discovered and explained by Thrasymachus, about 380 years before the Christian era. Cicero says that Thrasymachus was the first who studied oratorical numbers, which entirely consisted in the artificial structure of periods and colons. It appears from a passage in Aristotle, that punctuation was known in his time. The learned Dr Edward Bernard refers the knowledge of pointing to the time of that philosopher, and says that it consisted in the different positions of one single point. At the bottom of a letter, thus (A.), it was equivalent to a comma; in the middle (A·) it was equal to a colon; at the top (A˙) it denoted a period, or the conclusion of a sentence.

"This mode was easily practised in Greek manuscripts, while they were written in capitals. But when the small letters were adopted, that is, about the ninth century, this distinction could not be observed; a change was therefore made in the scheme of punctuation. *Unciales literas hodierno usu dicimus eas in vetustis codicibus, quæ priscam formam servant, ac solutæ sunt, nec mutuo colligantur. Hujus modi literæ unciales observantur in libris omnibus ad nonum usque sæculum.* Montf. *Palæog. Recens.* p. xii.

"According to Cicero, the ancient Romans as well as the Greeks made use of points. He mentions these under the appellation of *librariorum notæ;* and in several parts of his works he speaks of '*interpunctæ clausulæ in orationibus.*'

"Seneca, who died A. D. 65, expressly says that Latin writers in his time had been used to punctuation. '*Nos, cum scribimus, interpungere consuevimus.*' Muretus and Lipsius imagined that these words alluded to the insertion of a point after each word; but they certainly were mistaken, for they must necessarily refer to marks of punctuation in the division of sentences, because in the passage in which these words occur, Seneca is speaking of one Q. Haterius, who made no pauses in his orations.

"According to Suetonius, Valerius Probus procured copies of many old books, and employed himself in correcting, pointing, and illustrating them; devoting his time to this and no other part of grammar: *Multa exemplaria contracta emendare, ac distinguere et adnotare curavit; soli huic, nec ulli præterea, grammatices parti deditus.* It appears from hence that, in the time of Probus, or about the year 68, Latin manuscripts had not been usually pointed, and that grammarians made it their business to supply this deficiency. Quintillian, who wrote his celebrated treatise on Oratory about the year 88, speaks of commas, colons, and periods; but it must be observed that by these terms he means clauses, members, and complete sentences, and not the marks of punctuation. Ælius Donatus published a treatise on Grammar in the fourth century, in which he explains the *distinctio*, the *media distinctio*, and the *subdistinctio;* that is, the use of a single point in the various positions already mentioned.

"Jerome, who had been the pupil of Donatus, in his Latin version of the Scriptures made use of certain distinctions or divisions, which he calls *cola* and *commata*. It has however been thought probable that these divisions were not made by the addition of any points or stops, but were formed by writing, in one line, as many words as constituted a clause, equivalent to what we distinguish by a comma or a colon. These divisions were called στιχοι or ϱηματα, and had the appearance of short irregular verses in poetry. There are some Greek manuscripts still extant which are written in this manner."

PUNCTUM SALIENS, in *Anatomy*, the first rudiments of the heart in the formation of the fœtus, where a throbbing motion is perceived.

PUNCTUM *Stans*, a phrase by which the schoolmen vainly attempt to bring within the reach of human comprehension the positive eternity of God. Those subtile reasoners seem to have discovered that nothing which is made up of parts, whether continuous or discrete, can be absolutely infinite, and that therefore eternity cannot consist of a boundless series of successive moments. Yet, as if such a series had always existed, and were commensurate in duration with the Supreme Being, they compared his eternity to one of the moments which compose the flux of time arrested in its course; and to this eternal moment they gave the name of *punctum stans*, because it was supposed to stand still, whilst the rest followed each other in succession, all vanishing as soon as they appeared.

PUNDA, or PUNDY, a town of Hindustan, province of Bejapore, twenty-five miles south-east from Goa, and near the south-west extremity of the territories belonging to the Poonah Mahrattas. Long. 74. 3. E. Lat. 15. 20. N. There is another place of the same name in the Northern Circars. Long. 84. 40. E. Lat. 18. 43. N.

PUNDERPOOR, or PUNDEPORE, a town of Hindustan, in the province of Bejapore, situated on the left bank of the river Beemal. It is not very large, but is a prosperous and populous place. The streets are broad and well paved, and adorned with very handsome houses, almost all the principal members of the Mahratta empire having dwellings there, where they spend some months of every year, when they are not engaged in hostilities with each other, or with some foreign power. It has an extensive market, well supplied not only with grain, cloth, and the productions of the country, but with many articles of English manufacture. There is also a handsome temple dedicated to Vishnu, which is regarded as of peculiar sanctity. The surrounding country is well wooded and watered, and near the town the soil is good. It is eighty-six miles south-east from Poonah. Long. 75. 12. E. Lat. 17. 56. N.

PUNDUAH, or PURRUAH, a town of Bengal, and for a short period the capital of that province, but now in ruins. Long. 88. 9. E. Lat. 25. 9. N.

PUNGANOOR, a fortified town of Hindustan, in the province of Golcondah, and district of Balaghaut, ceded to the British by the nizam in 1799, and dependent on Madras. It is a hundred and seventeen miles west by north from Madras. Long. 78. 42. E. Lat. 13. 19. N.

PUNISHMENT

In noticing the present state of the science of penal law, the course we shall adopt, as best suited to the narrow space within which our observations must be confined, is, in the first place, to give an outline of the theory of punishment, according to the opinions of some distinguished modern writers, and afterwards to offer a sketch of the progress which penal legislation has recently made, as well on the Continent as in Great Britain.

Slow progress of jurisprudence.

Experience abundantly proves, that the establishment of a tolerably good, much less of a perfect system of law, whether civil or criminal, is a very slow and difficult operation. Criminal law everywhere begins, where, amongst savages, it continues and ends, with the pursuit and gratification of the passion of revenge. Injuries, or presumed injuries, are punished according to the will and power of the injured, whose might, in truth, constitutes their right. The first step in civilization is the social union for the protection of every member of it from injury, by the exercise of the aggregate power of the whole in his defence. But in some countries ages have elapsed before, and in others it has never come to pass, that any comprehensive view is taken of penal jurisprudence, so as to enumerate and classify offences, and to annex to them the punishments best adapted to prevent their recurrence. Unless the public feeling is outraged by some glaring enormity, the mass of the people concern themselves little with the relations existing between crimes and punishments; and it is only by opening upon a nation the lights of reason and philosophy, that it can be brought to appreciate the blessing of a wise and just criminal code. It is the task of the philosopher to direct the opinion of the multitude in the direction of truth and justice; nor is it possible to estimate too highly the benefits which mankind are deriving from the wisdom which has been bequeathed to them by a Montesquieu, a Filangieri, a Beccaria, or a Bentham.[1]

Theory of Beccaria.

The Marquis of Beccaria's well-known treatise, *De' Delitti e Delle Pene*, has acquired a great and deserved celebrity.[2] That remarkable man was the first to promulgate to Europe the outlines of a system of jurisprudence founded upon the principle of "the greatest happiness of the greatest number." Assuming the general utility to be the only legitimate object of law, Beccaria professes to inquire, What is the origin of punishments, and what is the foundation of the right to punish? What are the practicable means, under a good legislation, of seizing the criminal, and of discovering and ascertaining the crime? Is torturing the criminal just, and does it lead to the end proposed by the laws? Ought not punishments to be proportioned to crimes, and how is this proportion to be established? What is the measure of the gravity of crimes? Is the punishment of death useful and necessary for the security and good order of society? What punishments ought to be inflicted on different crimes? Are the same punishments equally useful at all times? What influence have they upon manners? What are the most efficacious means of preventing crimes? In offering solutions of these problems, Beccaria proclaims, in the outset, that political morality, of which punishment is a part, ought to be founded upon the permanent sentiments of the human heart, and that the right to punish is derived from the social contract, wherein every individual has surrendered to the society so much of his liberty as the necessities of the whole require him to sacrifice, and no more. Every exercise of power, every punishment, is an abuse of justice, unless it is necessary for the preservation of the common deposit of public liberty. Three consequences follow: first, that it belongs to law alone, as the condition of the social contract, to award punishment to crime; secondly, that it is the province of the judge, not of the sovereign power, to determine the fact of the violation of the law; thirdly, that the inutility of a punishment is sufficient to constitute its injustice, as contrary to the social contract. In regard to the gravity of punishment, Beccaria held that it should be relative to the actual circumstances of a nation, because it may be requisite to awe more strongly the minds of a people recently elapsed from barbarism than those of a people whose sensibilities have been softened by the influence of civilization. The punishment of death is declared not to be authorized by any right belonging to society, but to be rather the act of the nation making war against a citizen whose destruction is regarded as useful and necessary to the society's preservation. An extreme case may arise, in times of national troubles, when the death of a citizen may be justifiable by necessity, but never under the ordinary and tranquil reign of the law. In other words, it is only when necessary, in the strictest sense, that capital punishment is just. Punishment should be prompt, because the less time that intervenes between it and the offence, the closer and stronger will be the association of ideas, so that the punishment will be regarded as the effect of the crime. It should also be analogous to the crime; should be public; and, above all, certain and inevitable, subject to the rare exercise of the prerogative of mercy. A due proportion must exist between crimes and their punishments; and if mathematical calculations could be rendered applicable to the infinite and obscure combinations of human actions, there should be a progressive scale of punishments, corresponding with all crimes, from the gravest down to the lightest. Beccaria divides crimes into three classes: viz. those destructive to society; those which attack the citizen in life, wealth, or honour; and those which are generally injurious to the public welfare. In his judgment, the way to prevent duels is to punish the aggressor who gives the first provocation; thefts are to be corrected by fine, or compensative labour; and suicide is not to be regarded as a crime in the sight of men. Such are some of the ideas promulgated by Beccaria, as flowing from the principle, that public utility is the only solid basis of human justice. We shall presently see, that this principle has by no means obtained the general assent of jurists; but the views of Beccaria are throughout consistent and luminous, and were extraordinarily in advance of the age in which he lived. The following general theorem is given as the conclusion of his essay: In order that a punishment should not be a violence of one, or of several, against a citizen, it should be public, prompt, necessary, the least possible under given circumstances, proportioned to the offence, and fixed by the law.

Works of Bentham.

It is to our distinguished countryman, Bentham, that belongs the honour of having been the first to travel over the whole field of penal legislation; to shew the intimate connexion that exists between all its parts; the mutual dependence and relation of the civil and penal codes; and the impossibility of framing either of these portions of law without having previously taken a comprehensive survey of the whole. For the details we must refer to the works themselves, which so completely exhaust the subject, that the theory offered is complete in all its parts. In that portion of the *Traités de Législation Civile et Pénale*, entitled, *Principes du Code Pénale*, and in the later and more comprehensive treatise, entitled, *Théorie des Peines et des Récompenses*, will be found the principles of a complete penal code, laid down with scientific precision, definitions, and classifications.[1] Like Beccaria, Bentham recognized the general utility as the sole object of legislation. A crime or offence, therefore, under his theory, is an act which ought to be prohibited by reason of some evil to which it gives rise, or tends to give rise. Crimes are then divided into four classes, viz:

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[1] The first two of these writers not having offered any thing like a regular theory of penal law, it will suffice to refer the reader to their respective works, without more particular notice here.

[2] The translation into French by Morellet, with Diderot's notes, (Paris, 1797), is the preferable edition.

1st, Private offences.
2d, Self-regarding offences.
3d, Semi-public offences.
4th, Public offences.

And under these four general heads, and the combination of them, all offences may be classed and arranged. These heads are again subdivided, thus:

Private offences are, either against the person, against property, against the reputation, or against the condition in life.

Self-regarding offences may be similarly subdivided, and are enumerated rather to remind the legislator that they are out of his sphere.

Semi-public offences consist in the violation of the laws designed to prevent physical calamities to the inhabitants of a given district, or malicious injuries to particular classes of persons.

Public offences are of nine kinds, viz: against the external security of the state, against justice and police, against the national forces, against the public revenue, against the population and the national wealth, against the sovereign power, and against religion.

The remedies applicable to these offences, and the means, direct and indirect, of preventing their commission, form the subject of the *Principes du Code Pénal*.

The subsequent work *(Théorie des Peines, &c.)* sets out by thus defining legal punishment: "According to the principle of utility, legal punishments are evils inflicted, with judicial forms, on individuals convicted of some hurtful act, forbidden by the law, and in order to prevent similar acts."[2] The same division as that of private offences is then made applicable to punishments, inasmuch as an individual can only be punished by affecting either his person, his property, his reputation, or his condition. Personal or corporal punishments are then subdivided into,

1st, Punishments simply afflictive.
2d, ... afflictive by complication.
3d, ... restrictive.
4th, ... active or laborious.
5th, ... capital.

Those affecting property, reputation, or condition, alike deprive the individual of some advantage which he before enjoyed, and are either privations, losses, or forfeitures. Thus are punishments reduced to two classes; viz. 1st, corporal, and 2d, privative punishments.

According to Bentham, the end of punishment is twofold; to prevent the repetition of similar offences, and to repair, as much as possible, the evil of the offence committed. He lays down the following rules, which serve to explain the general proposition of Beccaria, that a proportion should be established between crimes and punishments, viz:

1st, The evil which the person punished is to sustain from the punishment, must exceed the advantage derivable by him from the crime.

2d, When the act is of a nature to furnish a conclusive proof of habitude, the punishment must be severe enough to exceed not only the advantage of the particular offence, but also of all similar offences which may be supposed to have been committed with impunity by the same offender.

3d, The punishment ought to exceed the advantage of the crime to the extent of making up that which the punishment wants in point of certainty and of proximity.

4th, If two or more crimes concur, the most hurtful ought to be subjected to a more severe punishment, in order that the offender may have a motive to stop at the least offence.

5th, The more hurtful a crime, the more may a heavy punishment be hazarded for the chance of preventing it.

6th, The same punishment ought not to be inflicted for the same crime on all offenders without exception. Regard must be had to the circumstances which influence sensibility.

These rules will better serve as a guide to the measure of punishment, than any attempt at the mathematical scale suggested by Beccaria, which seems inapplicable to the infinite varieties of the human mind. An ancient writer has bequeathed us a plainer maxim on this point:

> ——— adsit
> Regula peccatis, quæ pœnas irroget æquas,
> Nec scuticâ dignum, horribili sectere flagello.[3]

The qualities enumerated by Bentham as desirable to every mode of punishment, in order that it may answer its proper ends, are these:—

1st, Divisibility; so that it may be susceptible of addition or diminution, either in intensity or duration. Corporal chastisement, hard labour, and imprisonment, are instances of punishments alike possessing this quality.

2d, Certainty. A punishment is uncertain and unequal in itself, when an offender may possibly undergo it, without suffering any evil. Banishment, for example, may be good or evil according to various circumstances.

3d, Commensurability. If death were inflicted on three offences of different degrees of guilt, the punishment would not be commensurate, but would leave to the offender the choice of the crime which might be easiest of execution.

4th, Analogy. There should be some characteristic resemblance between the crime and the punishment. Not exactly "eye for eye, and tooth for tooth," but something to strike the memory and imagination by association.

5th, Exemplarity, so that there be not only the reality, but the appearance of penality; otherwise the effect on the public will be lost.

6th, Economy; viz. that the degree of severity be not greater than the end requires, and also that the public charge be not enhanced more than is necessary.

7th, Remissibility. There should be an opportunity for remission or revocation. Capital punishment is the strongest instance of a deficiency of this quality.

8th, Suppression of the power of injury. It may be possible, under extraordinary circumstances, that death is the only available punishment possessing this quality.

9th, Tendency to moral amendment. If fear alone operates, the criminal will not be reformed. Reformation is a change in the character and moral habits. The association of prisoners is the grand obstacle in the way of imparting this quality to imprisonment.

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[1] We quote from M. Dumont's translations. The first complete edition of Bentham's works in English, is now in the course of publication, under the superintendence of his executor.

[2] Dr. Johnson's definition of punishment was, "any infliction or pain in vengeance of a crime;" that of Grotius, "malum passionis quod infligitur ob malum actionis." The latter is obviously the better of the two.

[3] *Horat* lib. i. sat. 3.

10th, Convertibility to profit. This quality belongs only to certain kinds of punishments, such as pecuniary fines, or deprivation of employments, which may be conferred on more worthy persons.

11th, Simplicity in description is so obviously desirable as to require no comment.

12th, Popularity; that is to say, that in the choice of punishments, the legislature should carefully avoid such as would shock established prejudices.

The above catalogue will assist the judgment in determining how far a given punishment is desirable; but Bentham adds a caution, that in this as in every inquiry, we should begin by forming an abstract idea of the qualities which an object ought to possess, in order to reason pertinently about it, otherwise approbation or disapprobation is merely a confused sentiment of sympathy or antipathy. It should also be observed, in reference to the catalogue, that regard is to be had not only to one quality in particular, but to all taken together. No mode of punishment unites them all, but, according to the nature of the offences, some are more important than others. Thus, for graver crimes, exemplarity and analogy are especially to be regarded; for lighter offences, economy and reformation; for crimes against property, convertibility to profit, from whence compensation may be derived for the party injured.

To illustrate the applicability of Bentham's penal qualities, let us refer to one or two of the most familiar punishments. Imprisonment, for instance, is very efficacious for suppressing the prisoner's power of doing injury, whilst he continues in custody. It may, or may not be made profitable, according to the mode in which the prisoners are employed; but under the plan of the Panopticon, the profit derivable from the earnings is a leading feature of that establishment. In respect of certainty, or equality, imprisonment is evidently very defective, as the evil of it depends so much upon the age, the health, the habits, and frame of mind of the prisoner. It is divisible, both in time and severity; and is in some sort exemplary, since either the public may be admitted, as proposed in the Panopticon plan, or the sight of the building will strike the imagination with a degree of terror. In point of simplicity of description it is perfect, since all understand what confinement means. In respect of reformation, the effect of imprisonment must depend upon the system of discipline adopted. Bentham stigmatises the association of prisoners in general as pregnant with evil, and as constituting a punishment evidently uncertain, unequal, unexemplary, unprofitable, productive of a variety of suffering, of which no one who has not experienced it, can form a tolerably just idea. The hurtful consequences of such association, which are vaguely expressed by the word *corruption*, are thus defined by Bentham:

1st, The strengthening of the motives which excite to the commission of crimes.

2d, The weakening of the considerations which tend to the repression of crimes.

3d, The instruction acquired in the art of accomplishing crimes.

Bentham's views of what a prison should be are fully developed in his Panopticon, wherein labour is made the main engine of reformation. We have treated this subject more fully in another place, (see article PRISONS); but although great advances have been lately made in regard to it, the opinions of Bentham are still full of instruction, and should by no means be lost sight of in determining the nature and conditions of imprisonment, the punishment *par excellence* of civilized nations, and the most important of any in respect of the numbers to whom it is applied.

There are three other descriptions of confinement, which Bentham also discusses. *Quasi-imprisonment*, when the individual is confined within the district of his ordinary residence. *Relegation*, when he is sent away from his ordinary residence, and confined within a certain district in the state. *Banishment*, when he is removed from and forbidden to return to the state. All these are preferable to imprisonment in point of economy; they are defective in equality of operation; and though divisible in time, are scarcely so otherwise. Banishment has too little of example in it, but, under some circumstances, may prove reformatory. *Quasi-imprisonment*, by continuing the offender in old habits, may be corrupting, but *relegation*, by removing him from bad associations into a new sphere, holds out, in general, favourable prospects of his amendment.

The punishment of transportation, as enforced for many years past in the Australian colonies by the British government, has scarcely one of the qualities above mentioned as desirable. It fails especially in the great object of *example*; it neither deters others, nor corrects the offender himself. Instead of suppressing the power of commission, it is the fertile source of crimes. It does not supply the means of compensation to the party injured; it is not economical, but very costly to the state. Experience has fully confirmed the sagacity of Bentham's objections to this mode of punishment, and of Archbishop Whately's subsequent denunciation of it, both as a penal measure and as a branch of colonial policy. A valuable Report from the late Select Committee on Transportation,[1] has furnished unquestionable proofs "that the two main characteristics of transportation as a punishment are, inefficiency in deterring from crime, and remarkable efficiency, not in reforming, but in still further corrupting those who undergo the punishment; and that these qualities of inefficiency for good and efficiency for evil, are inherent in the system, which is not, therefore, susceptible of any satisfactory improvement." The committee have, therefore, recommended its abolition as soon as practicable. (See article TRANSPORTATION.)

The rules of Bentham serve as well for the examination of capital, as of secondary punishments. Death has the advantageous qualities of completely annihilating the power of injury; of being analogous, as well as popular, in the case of murder; and of being always exemplary. On the other hand, it is not profitable, but costly, in depriving the community of one of its members; it is extremely unequal, according to the sentiments and condition of the offender; it is irrevocable, and, except in the case of murder, unpopular. Balancing all these considerations, the conclusion is arrived at, that the prodigality of capital punishment has been an error of legislators, and that there has been a want of reflection in applying it to a class of unhappy and degraded men, who attach but little value to life. If, for the purpose of deterring, it should be preserved at all, it should be for crimes which excite the public horror to the highest degree, such as atrocious murders, and those by which several lives are destroyed; in which cases the execution should be accompanied by every means of tragic effect. The non-execution of the law is mentioned as a collateral effect of the abuse of capital punishment; and this has indeed been the main argument of those, who, from Sir Samuel Romilly, down to the present day, have laboured for the mitigation of the criminal law of England. It is certain that excessive severity defeats its own object, in so far as it induces the persons entrusted with the administration of the laws, to substitute their own notions of right, from time to time, for the will of the legislature.

Bentham's nomenclature and classifications have been objected to as too arbitrary for the state of the science; but taking his theory of punishment as a part of his general system of legislation, it cannot but be regarded as a masterpiece of jurisprudence. It is only time to dismiss such a guide, when the inquirer shall have formed for himself a better abstract idea of punishment than Bentham's suggestions have furnished.

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[1] See Report of the Select Committee of the House of Commons on Transportation, ordered to be printed 3d August 1838.

Theories of other jurists

The writers on different branches of penal law, since the commencement of the present century, have been so numerous, particularly on the Continent, that it would be vain to attempt to recapitulate here the various theories of punishment which have been offered. The names of Feuerbach, Mittermaier,[1] and of a host of other learned men in Germany, are an honour to jurisprudence, however little practical result may have arisen from their labours. Several recent French writers are worthy of reference; especially M. Charles Lucas, and the Duc de Broglie, on the punishment of death. Mr. E. G. Wakefield's essay on the same subject, and Mr. Montagu's collection of opinions on capital punishment, may be consulted with advantage. Archbishop Whately, in his well known Letters to Earl Grey on Secondary Punishments, has laid down very clearly and forcibly the principles by which the infliction of punishment ought to be regulated. "There are," says the Archbishop, "three and only three objects with a view to which punishments can be inflicted or threatened; 1st, *retribution*, or *vengeance*, or a desire to allot a proportionate suffering to each degree of moral guilt, independent of any ulterior consideration, and solely with a view to the past ill-desert of the offender. 2dly, What may be called *correction*, or the prevention of a *repetition* of offence by the same individual, whether by his reformation or removal. 3dly, The *prevention* of the offence generally by the terror of a punishment denounced, whether that object be attained by the example of a culprit suffering the penalty, or simply by the mere threat and apprehension of it. To these appropriate objects may be added another incidental advantage, not belonging to *punishment as such*, but common to them with other legislative enactments; the public benefit in an economical point of view which may be conceivably derived directly from a punishment, as when criminals are usefully employed on any public work, so as to make, in that way, some compensation to society for the injury done to it. Such a compensation, however, we should remember, must necessarily be so very inadequate, that this object should always be made completely subordinate to the main end, or ends, proposed in the denunciation of punishment." The archbishop then proceeds to shew that, regarding the prevention of crime as the great object, the infliction of just vengeance on the guilty is clearly out of man's province, inasmuch as the degree of moral turpitude can never be perfectly known but to the searcher of all hearts, and that no man, nor number of men, can be authorised thus to render evil for evil for its own sake, but on the contrary such a procedure is expressly forbidden, both by morality and the Christian religion. Of the other two objects of punishment, the archbishop explains that the prevention of a repetition of the offence by the same individual, is of less importance than the prevention of crime generally by the terror of example or threat, and after shewing that every man punished is an instance, *pro tanto*, of the inefficacy of the law, remarks, "this absolute perfection, indeed, the entire prevention of crime, is a point unattainable; but it is a point to which we may approach indefinitely; it is the point towards which our measures must be always tending, and we must estimate their wisdom by the degrees of their approach to it." Passing over thus briefly Archbishop Whately's exposition of penal principles, we proceed to notice a recent masterly work by a distinguished foreign jurist on this subject.

Theory of Rossi.

The work in question contains a complete theory of penal law, founded upon ethical principles different from those of Beccaria and Bentham. We refer to Rossi's valuable treatise. (*Traité de Droit Pénal*, par M. P. Rossi, Professeur du Droit Romain à l'Académie de Genève.) M. Rossi examines at large the foundation of the right to punish; whether it depends on a moral principle, or a material interest; whether it is to be traced to justice, or merely to utility? He rejects the notion of either individual, or general interest, conferring any such right; not admitting the ground of necessity, direct or indirect, or the existence of the social contract, upon which Beccaria relies. He holds that there exists a moral order in the world, binding upon all free and intelligent beings who are cognizant of it; that absolute justice is in perfect harmony with this moral order; and that all human justice, though not able to attain such perfection, ought to strive to approach it. Upon this justice, then, the right of punishment is founded; and punishment is defined as "the retribution made, by a legitimate judge, with ponderation and measure, of evil for evil." Thus, penal justice only acts when some duty is violated; for law and right are, under this theory, the same; and the natural effects of justice are instruction, intimidation, and amendment. A crime is defined as the violation of a duty towards society or individuals, requirable *(exigible)* in itself, and useful to the maintenance of public order; of a duty whose accomplishment can only be assured by the penal sanction, and whose infraction can be appreciated by human justice: and an enumeration of crimes and offences follows. In his third book, M. Rossi treats of the nature and end, the measure and effects of punishments, and then proceeds to give directions for the choice of them, pointing out the characteristics which should mark them, in order that the ends of human justice may be attained. Social justice, to be legitimate, must respect the conditions of moral justice; must take into account the imperfection of our means of knowledge and action; and must satisfy the exigencies of the material order in civil society. These rules will direct the choice of punishments, which in their application must be proportionate to the crime, and sufficient for the protection of the right. In order, then, to conform to the principle of justice, the legislator should choose such punishments as are,

(1st class) Personal,
Moral,
Divisible.

To be in relation with our imperfect means of knowledge and action, he should choose such as are,

(2d class) Appreciable,
Reparable, or remissable.

To satisfy the exigencies of the material order, punishments should be adapted to produce the effects which the legislator has in view, and should therefore be,

(3d class) Instructive and satisfying,
Exemplary,
Reformatory,
Fortifying (rassurante.)

Trying different kinds of punishments by these conditions, it will appear that the punishment of death is of the first class, except that it is not divisible; that it is appreciable, because applicable to every one, but not remissible; that it is instructive, because when applied to a small number of crimes, it is a moral lesson to society; that it is only under particular circumstances that it is exemplary, or calculated to intimidate those disposed to commit crimes; that of course the dead cannot be reformed; and that it so far fortifies or assures society, that it suppresses the individual's power of injury. In the result, M. Rossi declares capital punishment admissible in itself, but in extreme cases only, and that its abolition is desirable when the advance of civilization shall have prepared men for so important a change.

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[1] Feuerbach's *Manual of Penal Law* has run through twelve editions, and the last edition, enriched with the notes of Mittermaier, is especially recommended. (*Lehrbuch des gemeinen in Deutschland gültigen peinlichen Rechts*, von Dr. Anselm Ritter von Feuerbach, herausgegeben von Dr. C. J. A. Mittermaier. Giessen, 1836.)

M. Rossi regards all corporal punishment as of an immoral tendency, and considers imprisonment as the punishment best fitted to civilized society. He states the most essential object to be, such a separation of the convicted, as completely corresponds with the ends of penality, and moral amendment. But he seems to intend rather a kind of classification, than the entire separation of the prisoners from each other. He is opposed to transportation, and in a less degree to relegation and banishment, as being defective in the exemplary and reformatory qualities. Local interdiction, restraining the offender from frequenting particular districts, may, he thinks, be used with more advantage. He shows the immorality of infamous punishments, such as the pillory, and the impolicy and injustice of those which deprive offenders of civil rights, or of the whole, or the greater portion of their property. Lastly, he cautions the reader not to expect to find a punishment combining *all* desirable qualities, much less one that unites them all in the same degree.

In his fourth book, M. Rossi offers instructions as to the formation of a penal code; for the details of which the enquirer is referred to this very systematic and philosophical work. M. Rossi concurs with Beccaria and Bentham in many important particulars; and although the principle upon which the right to punish rests may not have been satisfactorily determined by any of these authorities, still the short notice we have given of them will shew how far they have advanced the science of penal jurisprudence.

Progress of penal legislation on the Continent.

The efforts made in penal legislation have, from a variety of causes, been bolder on the Continent than in Britain. The result has assuredly not been always successful; but it is by such beginnings that the true course is pursued for the formation of a good penal code; and no doubt can be entertained, that imperfect as these efforts have been, the condition of the people for whose use they were made, has been greatly benefited by them. Of all of them it may be said that they are deficient in respect of humanity, and the establishing a just proportion between crimes and punishments; and moreover erroneous in the including cases unfit, and excluding others fit for punishment, still leaving a vast discretion to the judges; but they have however, to the extent of the surface which they have covered, rendered a knowledge of the penal law practicable, and given great facility to its improvement by the recordation of its provisions. We shall give from one or two of the codes of criminal law now before us, an outline of their most prominent features.

The "Carolina."

The famous code collected under the auspices of the Emperor Charles V., and known under the name of the "Carolina," and which, we are told in the preface, "is properly the collection and confirmation of the laws which have been, from time immemorial, in use in the tribunals in Germany," is an elaborate work on penal jurisprudence; and in particular, is extremely copious and minute on the subject of torture, which was at that time deemed a highly efficient and indispensable instrument of criminal procedure.

The code commences, very properly, in respect of arrangement, with the judicial establishment; but after all, leaves it indeterminate with respect to the manner in which it is to be composed, and omits to give any exact and precise definition of the relative power of each of the several classes of individuals that enter into its formation. It appears clearly that there were to be certain established judges, and that to them were to be added all the nobles, *in the quality of judges and assessors*, not precisely fixing in what quality they are to act, or whether the decision was ultimately to rest with the judges, under the advice simply, or under the control, of those other judges or assessors. Next follows, not as might have been expected, an enumeration and definition of offences, and of the punishments annexed to them, but a minute account of cases, consisting of forty-one articles, in which torture may be employed to extract a confession of guilt. Afterwards come several articles respecting proof by witnesses; and then the distribution of offences, not as such, but by the punishment annexed to them.

In this code, the torture, as has been already mentioned, is most extensively applied. By article XLI. it is provided, that it shall be a sufficient ground for applying torture, in order to produce confession, in the instance of a man accused of incendiarism, whenever, in other respects, his conduct shall be suspicious. It is upon similar slight grounds throughout the code, that this most dreadful instrument is brought into action. The code, although defective in the arrangement of offences, contains some observations with regard to the indications of guilt from accompanying circumstances, that might not be found altogether useless at the present day.

The *Code Carolina* appears in the nineteenth century a barbarous piece of legislation, but was unquestionably a progress in its time. It had for its object the introduction of more regularity and measure in criminal proceedings and sentences. Its establishment was not effected without modification in some places, and even resistance in others. The following is a curious instance of an attempt to pervert its meaning. Article XI. declares, "it is never to be lost sight of, that prisons ought to be made and established for the safe custody of those detained, and not to be used as a dangerous punishment." A French translation of the *Carolina*, for the use of the councils of war of the Swiss troops, printed at Bienne in 1767, contains this commentary: "Although the law recommends humanity with respect to the nature of the prison in general, we may say that in cases of atrocious crimes, and where the vengeance of the public is absolutely interested, *the hardest and darkest dungeons ought to be used* for the confinement of criminals, provided only that their lives are not risked."[1] This code is still the foundation of criminal law throughout the greater part of Germany and Switzerland, subject to many modifications which it has undergone in the course of modern legislation.

Code of Corsica.

A criminal code was prepared for Corsica, under the direction of Louis XV. *(Code Corse, ou Recueil des Edits, &c., publiés dans l'Isle de Corse depuis sa soumission à l'obéissance du Roi*, Paris, 1778.) After enumerating the most prominent species of offences, such as treason, murder, theft, and homicide, and giving a view very far short of a complete one, of the field of criminal law, the framer of this code, (title IX.) has this article: "In respect of all other crimes and offences which are not mentioned above, we leave it to the prudence of the judges to condemn those who shall be guilty of them, to the punishment fitting for them, according to the exigence and circumstances of the case; not however allowing them the power of punishing with death, either natural or civil, except in the cases above enumerated;" leaving them, however, a considerable latitude of power in the cases so unprovided for; that is, in the cases in which they were thus invested with despotic authority; namely, that of punishing by hard labour in the galleys, either for a limited period, or for life.

Bavarian code.

In the above two instances, we have specimens of two penal codes, formed at comparatively early periods. Next follow examples of others of a more modern date. A code for Bavaria was drawn up, by direction of the king, by M.

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[1] Rossi, Introduction, chap. ii.

Bexon, and published by him in a folio volume at Paris in 1807. It professes to contain a complete system of criminal jurisprudence, including punishments and police. M. Bexon, however, has by no means pursued the clear and natural course, of first enumerating what are to be deemed offences, and then declaring the penal consequences of committing such offences. He begins with a system of police, under the title of *Legislation de la Sureté*, and then proceeds to state the several purposes to which this branch of administration is applicable. Now the characteristic feature of a system of police, is, that it is to serve for the prevention of offences; so that we have, at the outset, the rules of a system of administration employed for the prevention of certain acts which remain to be stated. In the subdivisions of the work, the dispositions are neither clear nor convenient. Crimes, punishments, tribunals, and procedure, are mixed together, instead of being kept separate and distinct, as they ought to be. The penal code itself adopts the old principle of division, and classes offences under the several heads of crimes against the public; crimes against persons; and crimes against things. But what is new in this work, is the distribution of these several species of offences into three distinct classes, according to their supposed delinquency, and which are denominated, 1. *Contraventions et Fautes*. 2. *Delits*. 3. *Crimes*. This is obviously an unnatural and inapposite system of division, as it supposes that each class of offences is susceptible of only three stages of extenuation or aggravation, while, in fact, the same act is capable of varying, and continually does vary, and that by extremely minute steps, throughout all the gradations of guilt.

Code Napoleon.

The present penal legislation of France is, without doubt, far more rational and humane than that which existed before the Revolution. Still the Code Napoleon, the offspring of that imperial power which re-established confiscation, and re-opened Bastilles, is, in many respects, unworthy of the present state of French civilization. The penal branch of the Code Napoleon was decreed the 12th of February 1810, and promulgated the 22d of the same month. It is comprised within 114 moderately-sized octavo pages. It begins by declaring that a violation of the law, cognizable by the police, is a *contravention;* that a violation of the law, which is visited by a correctional punishment, is an *offence;* and that a violation of the law, which is visited by an afflictive and infamous punishment, is a *crime*. This division is quite arbitrary, and displays too much disregard of the intrinsic nature of human actions. Certainly it does not coincide with M. Rossi's theory of the concordance of penal law with the moral order of things; for actions are in many instances placed in the catalogue of crimes and offences (such as the assembling together of twenty-one persons in one place, art. 291,) which have nothing like immorality about them. The several species of punishments employed are then enumerated, and are, 1. Death. 2. Hard labour for life. 3. Transportation. 4. Hard labour for limited periods. 5. Seclusion. 6. The *carcan*, (analogous to the pillory). 7. Banishment. 8. Civil degradation. 9. Imprisonment during a limited period in a house of correction. 10. Suspension, temporary, of certain civil rights. 11. Making satisfaction to the party injured. To these are added, in the cases specified, the drawing a ball, to be attached to the feet; imprinting on the right shoulder, by means of a red-hot iron, certain letters; standing on the *carcan*, having above the head affixed a writing in large and legible characters, mentioning the name of the patient, his profession, residence, punishment, and the occasion of it. Some of the punishments are also attended with certain civil disabilities, of which some are temporary, others perpetual. With regard to forfeiture, which figures to so great an extent in the English penal code, it is here declared not to attach in any case as the necessary consequence of conviction, but to have place only when expressly pronounced to be a part of the punishment, and the instances in which it is used are comparatively few; and even then the forfeited property remains liable to all just encumbrances, and to the rightful portions of the children, or other descendants.

Offences are divided into two classes, 1st, those affecting the public; and 2dly, those affecting individuals. Under the first class, the principal offences comprised are, offences against the exterior and interior of the state, levying war, counterfeiting the coin; and malversation on the part of public functionaries. Under the second head are included, offences affecting particular assignable persons, such as murder, and other personal injuries, perjury, and offences against property.

Under this code, the judges and officers of justice are placed in a somewhat undignified light, by various pecuniary fines of from 16 to 200 francs, for pronouncing judgment notwithstanding an appeal, or other acts of misconduct. The policy of thus setting a money price on infractions of judicial duty is very questionable, although the judges should clearly be amenable to punishment of some kind for the slightest malversation of their functions.

Capital punishment is authorized by the Code Napoleon in many cases where it is obviously not justifiable by necessity, such as, for counterfeiting the coin, for destroying the national fortifications, &c. And the application of such degrading punishments as branding and the *carcan*, to a pretty wide class of offences, savours little of refinement. The establishments for hard labour, called the *bagnes*, though lately improved, are carried on upon a brutal system of force, which is disgraceful, as the penal instrument of a highly civilized nation.

Prussian code.

The present criminal code of Prussia consists of 1577 articles. With much that is wise and humane, it mixes some enactments of quite revolting barbarity. It, in fact, confuses together a number of moral precepts, of administrative regulations, of legal dogmas, and penal enactments. More than twelve articles authorise the breaking the offender on the wheel, making nice distinctions where the punishment is to begin at the upper part of the body, and where at the legs. Hanging, decapitation by the axe, flogging with rods, and whips, are all specified as modes of punishment, and incendiaries are, in certain cases, to be burned alive. The definition of treason is fearfully vague. "The voluntary act of a subject, by which the state, or its chief, are attacked in an immediate manner," art. 91; and there is the most striking immorality in the manner in which the wives of deserting soldiers are punished, if they do not betray their husbands, even in certain cases in which they may be declared innocent by the law.

Austrian code.

The penal code of Austria is, upon the whole, of a milder character than that of Prussia, but its forms of procedure commit so much discretionary power to the administrators of the law, as to leave the people little real security against oppression. The 14th article authorizes solitary imprisonment of so severe a kind, as almost to amount to a lingering death. The punishment consists in "shutting up the convict in prison, without any communication, with as much light and space as is requisite to keep the prisoner in health, who is to have heavy irons constantly on his hands and feet, and round his body an iron ring fixed by a chain, except during labour; his diet shall be wholly bread and water, and every other day a warm mess, but never of meat; some bare boards are to form his bed, and all conversation is forbidden him." Men are to be flogged with a staff, and women and children with rods, for many offences. Forging paper-money is punished with death; blasphemy, or spreading false religious doctrines, with imprisonment from six months to ten years. We will only add one curious specimen of a *contravention*, "Whoever endeavours to persuade an Austrian subject to establish himself in a foreign country, shall be punishable with confinement from one month to six months."

Penal laws in America.

The criminal law varies in every one of the States which form the United States of America, and consequently, taking the whole Union, there is a great inequality in the system of punishments, and more especially of capital punishments. The disproportionate penalties inflicted in different States for the same offence cannot but have an unfavourable tendency upon morals, in a country which, for all purposes of intercourse and traffic, is essentially *one*, although possessing various local legislatures. Many of these criminal laws will be found abstracted in Mr. Crawford's Report, and in the Second Report of the Criminal Law Commissioners. The criminal code of Louisiana, drawn up by Mr. Livingston, is deservedly celebrated, and is remarkable for not inflicting capital punishment upon any crime whatsoever.

Having thus adverted to some specimens of criminal legislation abroad, we shall conclude with a notice of the progress that has of late years been made in England in this respect.

State of the penal law of England.

Notwithstanding the examples that have been thus set us abroad, the British legislature has shewn little disposition to collect into one body of criminal jurisprudence the various decisions and enactments which now constitute the penal system of this country. Great authorities, both dead and living, may indeed be quoted in support of a revision of our whole penal system, among whom none are entitled to more weight than Mr. Justice Blackstone, who in his Commentaries expressed himself decidedly in favour of such a revision, (b. iv. ch. 1.) Little or nothing, however, was done towards the improvement of the criminal law, until the late Sir Samuel Romilly, when he obtained a seat in Parliament, brought in a series of bills, having for their object to mitigate, in certain cases, the severity of the penal law, by substituting for the punishment of death transportation for life, or for limited periods. He procured the repeal of so much of the statute of 8th Elizabeth, as took away the benefit of clergy from persons stealing privily from the person, and also the repeal of capital punishment in cases of stealing to the amount of 40s. on navigable rivers, and of stealing from bleaching-grounds. He failed in his attempts to repeal the punishment of death in cases of stealing to the amount of 5s. privately in a shop, and to the value of 40s. in a dwelling-house; but as we shall presently see, these objects have been subsequently effected. Sir Samuel Romilly, and after him Sir James Mackintosh, had the merit of contending against the erroneous principle of severe punishment rarely inflicted, and advocating that of the uniform infliction of milder punishments, duly proportioned to the magnitude of offences; and it is to their exertions that is attributable much of the attention which the legislature has since bestowed upon the subject. We proceed to enumerate some recent statutes which have gradually mitigated the severity of our penal law, and otherwise improved the administration of criminal justice.

Recent legislation.

The act 7th Geo. IV. cap. 64, (1826), "for improving the administration of criminal justice in England," among other provisions, enables bail to be taken in cases of felony, where there is not a strong presumption of guilt.

The act 7th and 8th Geo. IV. cap. 27, (1827), repeals upwards of 130 statutes, and parts of statutes, relative to the benefit of clergy, and to larceny and other offences connected therewith, and to malicious injuries to property, and to remedies against the hundred, thereby clearing the way for the four acts next mentioned, (commonly called Sir Robert Peel's), viz.:

The act 7th and 8th Geo. IV., cap. 28, (1827,) which, among other provisions, wholly abolishes the benefit of clergy, and declares that no person shall suffer death, unless for some felony previously excluded from benefit of clergy.

The act 7th and 8th Geo. IV., cap. 29, (1827,) for "consolidating and amending the laws relative to larceny, and other offences connected therewith," which abolishes the distinction between grand and petty larceny, and declares that larceny shall be punished with transportation, or imprisonment with whipping. It then proceeds to inflict punishment on various offences of this description, amongst which, for robbery from the person, death; for stealing from the person, transportation, or imprisonment with whipping; for burglary, housebreaking, stealing in a dwelling-house to the value of L.5, and cattle and sheep-stealing, death. It also gives summary jurisdiction to justices of the peace over a variety of petty depredations.

The act 7th and 8th Geo. IV., cap. 30, (1827,) "for consolidating and amending the laws relative to malicious injuries to property," inflicts the punishment of death for arson; for setting fire to coal mines, or to ships; and for riotously demolishing buildings, or machinery; also transportation, or imprisonment with whipping, for the destruction of manufactures, or machinery, or the destruction, or injury of sea-banks, turnpikes, dams, cattle, stacks of corn," &c. It also gives summary jurisdiction to justices, in cases of injuries to trees, or fruit, and of various other petty trespasses.

The act 7th and 8th Geo. IV., cap. 31, (1827,) which consolidates and amends the laws relative to remedies against the hundred, for riotous destruction of property.

The act 9th Geo. IV., cap. 31, (1828,) repeals upwards of fifty statutes relative to offences against the person; enacts the punishment of death for murder, malicious shooting, cutting and maiming, administering poison, attempting to drown, suffocate, &c. and for rape and sodomy; and transportation or imprisonment for various other offences of a personal nature. It also gives summary jurisdiction to justices of the peace over common assaults.

The act 11th Geo. IV., and 1st Will. IV., cap. 66, (1830,) abolishes capital punishment in all cases of forgery, except those particularly specified, viz., forgery of the royal seals, or sign manual, of Exchequer bills, bank notes, wills, bills of exchange, promissory notes, or money-orders, of transfers of stock, or powers of attorney, and other forgeries connected with the preceding. Forgeries of other descriptions are subjected to transportation or imprisonment.

The act 2d Will. IV., cap. 34, (1832,) abolishes capital punishment for all offences whatever relative to the coin, and subjects them to transportation, or imprisonment.

The act 2d and 3d Will. IV., cap. 62, (1832,) substitutes transportation for life for capital punishment, in cases of stealing in a dwelling-house to the value of L.5, and of cattle and sheep stealing; so far altering the provisions of the larceny act, 7th and 8th Geo. IV.

The act 2d and 3d Will. IV. cap. 123, substitutes transportation for life for capital punishment in all cases where the latter is inflicted by the 11th Geo. IV., and 1st Will. IV., except only the forgery of wills, and of powers of attorney for stock.

The act 3d and 4th Will. IV., cap. 44, (1833,) abolishes capital punishment for dwelling-house robbery as inflicted by the larceny act, and substitutes transportation or imprisonment.

The act 4th Will. IV., cap. 26, (1834,) abolishes the practice of dissecting, or hanging in chains, persons convicted of murder.

The act 4th and 5th Will. IV., cap. 67, (1834,) abolishes capital punishment in case of returning from transportation.

The act 5th and 6th Will. IV., cap. 33, (1835,) extends the powers of taking bail in cases of felony, notwithstanding confession, or presumption of guilt.

The act 5th and 6th Will. IV., cap. 81, (1835,) abolishes capital punishment for letter stealing and sacrilege, and substitutes transportation or imprisonment.

The act 1st Victoria, cap. 23, (1837,) abolishes the punishment of the pillory in all cases whatsoever.

The act 1st Victoria, cap. 84, (1837,) abolishes entirely the punishment of death for forgery, as retained by the 2d and 3d Will. IV., or any other existing laws, and substitutes transportation or imprisonment.

The act 1st Victoria, cap. 85, (1837,) makes new provisions for the punishment of offences against the person. Capital punishment is inflicted for administering poison, or doing bodily injury with intent to murder. Other offences with intent to commit murder, or for acts with intent to maim or disfigure, or to procure abortion, are made punishable with different degrees of transportation or imprisonment.

The act 1st Victoria, cap. 86, (1837,) limits capital punishment for burglary, to cases where that offence is accompanied by violence. In other cases, transportation or imprisonment.

The act 1st Victoria, cap. 87, (1837,) alters the former laws relative to robbery, and some other offences. The punishment for robbery, attended with cutting or wounding, is declared to be death, but in other cases, transportation or imprisonment. Obtaining property, by accusation of unnatural crimes, stealing from the person, assaults with intent to rob, obtaining property by menace, and plundering wrecks, are subjected to transportation or imprisonment.

The act 1st Victoria, cap. 88, (1837,) amends the laws relating to piracy, and subjects that offence to death, where murder is attempted, or to transportation or imprisonment, at the discretion of the court.

The act 1st Victoria, cap. 89, (1837,) amends the laws relating to arson, punishing with death the offences of setting fire to a dwelling-house, any person being therein, of setting fire to ships with intent to murder, and of hanging out false lights to shipping. For other offences under this head, transportation or imprisonment.

The act 1st Victoria, cap. 90, (1837,) substitutes transportation, during specified terms of years, for transportation for life, in a variety of cases particularized in the act.

Lastly, the act of 1st Victoria, cap. 91, (1837,) mitigates the punishment of death still further, by substituting transportation or imprisonment for it, in the cases of riotous assemblies, of seducing from allegiance, of certain offences against the revenue laws, and others enumerated in the act.

A reference to the acts above cited, will shew the gradual mitigation which has, within the last few years, been taking place in the severity of the ancient criminal law of England. Much has thus been effected in the way of the consolidation and arrangement of different branches of law under their proper heads, in particular statutes. Still, since nothing like codification has yet been attempted, the definitions and classifications of both crimes and punishments continue very vague and uncertain. All that we can usefully record here on the subject, is to state what crimes and punishments are understood, in a general sense, to mean by English lawyers.

Definitions of crimes &c.

A crime, says Blackstone, is the commission, or omission, of an act, in violation of a public law, either forbidding or commanding it. (Commentaries, vol. iv. ch. 5.)

A misdemeanour imports a crime which does not amount to felony, but is the subject of indictment. (Commentaries, vol. iv. ch. 5.) It is generally punishable with fine and imprisonment.

A felony is such a crime as, independently of other punishments, occasioned at common law a total forfeiture of lands, or goods, or both. (Commentaries, vol. iv. ch. 55.) A felony generally carries with it the idea of a capital crime. But felonies are either punishable with death, or not. Felonies are punishable with death, where the offence was excluded from benefit of clergy by the common law, or by any statute, before the 7th and 8th Geo. IV., cap. 28, or where, since that statute, they have been made capital; provided that in neither case the capital punishment has been taken away by any subsequent statute. In other cases, felonies are punishable either in the particular manner described by the statute relating thereto, or otherwise by transportation, or imprisonment, with whipping, if a male, at the discretion of the court.

Misprisions, and contempts, are a species of misdemeanour, affecting the king, or his government, or courts of justice.

Misprision of felony, however, in its ordinary sense, is a misdemeanour consisting in the knowledge or concealment of a felony committed by another, and is punishable by fine and imprisonment. (Burn's Justice, title *Felony*.)

Commission of inquiry into criminal law.

We should add, that on the 23d July, 1833, a Royal Commission was issued for the purpose of digesting into one statute all the statutes and enactments touching crimes, and the trial and punishment thereof, and also of digesting into another statute all the provisions of the common or unwritten law touching the same, and for inquiring and reporting how far it might be expedient to combine both those statutes into one body of the criminal law, repealing all other statutory provisions, or how far it might be expedient to pass into a law the first mentioned statute only, and generally for inquiring and reporting as to the consolidation of the other branches of the existing statute law. The question of codification is discussed in the first report of the commissioners dated 24th June, 1834, which, after a very elaborate statement of the difficulties which the present uncertain state of the law presents to such an undertaking, expresses a confident opinion that a digest of the statute with the common law, into one criminal code, would tend greatly to the improvement of the jurisprudence of the country. The second report, dated 9th June, 1836, is devoted partly to the question of the defence of prisoners by counsel, (since authorized by the act 6th and 7th Will. IV., cap. 114,) and to that of the infliction of capital punishment. The commissioners think that the punishment of death ought to be confined to the crime of high treason, and to offences which consist in, or are aggravated by such acts of violence to the person as directly endanger human life, a list of which acts they subjoin. The third report, dated 10th March 1837, is specially devoted to the subject of juvenile offenders, and expresses the opinion of the commissioners, that it would not be advisable to make any distinction in the mode of trial between adult and juvenile offenders, except by increasing the summary jurisdiction of magistrates in the manner therein mentioned; and that the extension of such summary jurisdiction within certain limits, would be a safe and beneficial alteration of the law, and would tend to diminish juvenile crime.

The reader is referred to these reports for very valuable information and suggestions, in regard to the amendment and consolidation of the penal law of England, and in particular for a full explanation of the difficulties with which those important objects have been, and continue to be, surrounded, and which, without some technical knowledge, it is by no means easy to appreciate.

PUNJAB, or Five Waters, an extensive region of Hindustan, principally situated in the province of Lahore, but including Moultan. The province of Lahore is also frequently named the Punjab. This tract has no very definite boundary. On the east the boundary is properly the ridge of the Snowy Mountains, from which spring the five rivers by which it is watered; but, in its more restricted sense, it means the country situated to the west of this hilly tract. This territory is watered by five celebrated streams, that fall into the Indus, namely, the Sutleje, the Beyah, the Ravey, the Chinaub, the Jhylum or Belut. It is very extensive, and remarkably fertile, abounding in all the necessaries of life, besides wine, sugar, indigo, cotton, and many luxuries. The tract between the Jhylum and the Indus contains salt-mines, that furnish inexhaustible stores of this article, which is largely exported. The lower part of the country is inundated, like Bengal, by the overflowing of the rivers during the periodical rains.

PUNO, a department and city of the republic of Southern Peru, in South America, lying to the eastward of Arequipa and to the south of Cuzco. The surface of the country is nearly all high table-land, being in few places less than 10,000 feet above the level of the sea. The climate is cold compared with that of the coast, but on that account it is very healthy. The hordes of domestic animals are numerous, consisting of llamas, sheep, horses, mules, asses, pigs, guanacas, alpacas, and cattle in great abundance. The llama is peculiar to the Peruvian Andes, and of great use, particularly upon roads impassable for mules, or in places where forage is scarce. It is employed in carrying ores from the mines, charcoal, corn, and other burdens. From the great height of this district, agriculture is limited to a few objects. The principal are, potatoes, quinoa, rye, barley, and oats; but the three latter do not ripen to seed, and are cut green for horses. Puno contains a number of silver mines, which in productiveness were at one time only second to those of Potosi. The most noted is that of Laycacota, or Salcedo, as it is now called, after its first proprietor. The mines are situated in a high range of hills forming the western boundary of the great lake of Titicaca. These mountain ridges are chiefly composed of a porphyritic rock, which reposes on a sandstone formation, similar to that of the red marl and sandstone of the British islands, and to the great red sandstone formation of the continent of Europe. In its general disposition, as well as in its mineralogical characteristics, the porphyry of Puno corresponds exactly with those metalliferous porphyries which have produced the immense riches of the Real del Monte, of the Bolanos, and partly of the Guanaxuato mines in Mexico, and with those of Hungary and Transylvania; and, like them, it abounds in veins containing the precious metals. The hills of Laycacota, Cancharani, and San José, are one continuous range formed of this porphyry nearly to their bases, and in it are situated the rich veins of silver ore which have rendered the place so celebrated. The produce of these mines, particularly that of Laycacota, during the seventeenth century, was enormous. It appears from documents of indisputable authenticity, that the ore extracted in the year 1668 from the mines of Salcedo produced upwards of a million and a half of dollars. They were afterwards neglected, and only towards the end of the last century they again began to be worked with activity. In the year 1805, they yielded 96,528 marcs of silver. The annual average produce between 1796 and 1820 amounted to nearly 30,000 marcs. Since that time they have been again neglected; and in the month of April 1831 only one mine was worked, which belonged to an Englishman. The mining district of Puno being surrounded on all sides by arid mountains, is almost destitute of wood, so that fuel is scarce. This is one of the reasons why the ores are treated by amalgamation, and not by smelting in furnaces, to which they are peculiarly well adapted, from their being very frequently associated with the ores of lead and copper.

The grandest natural feature of South America, next to the cordilleras of the Andes, is the Laguna de Puno, commonly called Titicaca or Chucuito. It is situated between the two cordilleras, and is enclosed by the surrounding mountains. According to Mr Pentland, it is placed 12,795 feet above the level of the sea, and is consequently the largest lake in the world found at such an elevation. The same traveller informs us that it occupies an area of almost 4000 geographical square miles. With regard to its depth, he states that from accidental circumstances he was not able to obtain deeper soundings than a hundred and twenty fathoms (which, however, is a much greater depth than any hitherto assigned to the lake); "but," he observes, "from the precipitous cliffs which in many parts of it form the shores, and its islands, I am persuaded that its depth in the central portion is much greater. The lake of Titicaca receives numerous streams at its northern extremity, but by no means so great a mass of water as might be expected from the height of the Andes that surround it." The principal streams which supply the lake are those which on its northern side form the rivers of Asangaro, descending from the cordillera of Crucero and San Juan del Oro, and that of Lagunillas, which rises in a chain of small lakes in the western cordillera. The latter is probably the stream which Dr Meyen calls the Rio Jussecano, which, he says, is one of the largest rivers falling into the lake of Titicaca. One of its sources is in an alpine sheet of water called Laguna Compuerta; and not far from it is another lake called Lagunilla, to which Rivero assigns an elevation of more than 15,000 feet above the level of the Pacific. The only outlet of the lake of Titicaca is the river Desaguadero, which issues from its south-western extremity in lat. 16. 38. 10. and is an inconsiderable stream when compared to the immense extent of the lake from which it proceeds. This anomaly, however, may easily be explained by the great amount of spontaneous evaporation to which its surface is exposed, in an extremely dry and rarefied atmosphere, owing to its excessive elevation. Mr Pentland found the width of the river Desaguadero, in the beginning of the rainy season, and close to its origin in the lake, to be forty-six yards; its course was scarcely two miles an hour, but its depth was considerable. The lake of Titicaca is studded with small steep islands. It derived its name of Titicaca from one of the largest of these, which is situated at the south-eastern extremity. It was held in great veneration by the natives, as they believed it to be the spot where Manco Capac received his divine commission to civilize the inhabitants of the country. Numerous Peruvian ruins are still to be seen upon it. "The low banks of the lake," says Dr Meyen, "are lined with rushes; and farther inwards its waters are covered with *Myriophyllum chuquitense*, a new species. Rushes are here a plant of great utility, being employed by the natives for almost as many uses as the bamboo in the East Indies. They supply the place of wood, which is wanting throughout the whole valley of the Desaguadero. The huts of the poor are made of rushes, as also mats for the floor, and bed-covers. The boats with which the rivers and the lakes are navigated are also made of rushes twisted together; the rudder and the mast alone are of wood, and form one of the most valuable possessions of the poor natives. These boats are frequently made with great taste and ingenuity. The smaller ones carry only three or four persons. The larger venture to some distance from the banks of the lake, which, even in calm weather, is subject to a heavy swell. The lake abounds in fish and water-fowl." Its waters are said to be "bitter" and impure, yet they are drunk by the cattle, and even by the Indians. It appears that the extent of the lake has diminished even within the historical period of this continent; for a Spanish writer, soon after the conquest of Peru by the Spaniards, in describing the gigantic Peruvian monuments of Tiaguanaco, says that the waters of the lake washed their walls. These ruins are now elevated many feet above the level of the lake, and stand at a considerable distance from it. The valley of the Desaguadero and the lake form together one continuous and immense basin, which, by a calculation of Mr Pentland, occupies an area of above 16,000 geographical square miles. The valley of the Desaguadero is necessarily in the direction of the two chains which enclose both it and the lake. In its southern portion it runs nearly parallel with the meridian; but north of latitude 17° it forms an angle of almost 45° with that line, running very nearly north-west by north, and south-east by south. It is entirely bounded by mountains, having no outlet towards the sea; and the rivers which descend into it are either lost in the sandy soil, or empty themselves into the lake of Titicaca at its northern extremity.

The city of Puno is situated upon the western shores of the lake of Titicaca, in lat. 15. 50. S. and long. 70. 22. W. from Greenwich, at an elevation of 12,832 feet above the level of the sea. It was formerly a rich and beautiful place, but has now very much declined in all respects. It possesses some woollen manufactures, with which it supplies Lima and Arequipa; and it contains a population of about 9000. The number of inhabitants in the department has been estimated at 30,917.

PUNUGGA, a village of Northern Hindustan, in the province of Bootan. The mountains in the vicinity are the highest in Bootan. Long. 89. 23. E. Lat. 27. 23. N.

PURCELL, Henry, the most distinguished musical composer that England has produced. He was born in 1658, and died in 1695. At the early age of eighteen his genius and attainments procured him the appointment of organist of Westminster Abbey. His genius for composition was original and vigorous, as is evinced by his various works for the church, the chamber, and the theatre. A detailed analysis of some of these productions is given by Dr Burney in the third volume of his History of Music. Purcell entertained the highest respect for the great Italian composers of his period. Burney (vol. iii. page 508) says, in a proper spirit of liberality, " Let those who shall think Purcell has sacrificed the national honour by confessing his reverence for the productions of Italy, compare the secular productions of English musicians, from the death of Queen Elizabeth to the year 1683, with those of Carissimi, Cesti, Stradella, and innumerable others of great abilities, and, if they do not equally hate music and truth, they will admire Purcell's probity as well as his genius." Burney remarks afterwards (page 510), with a just feeling towards Purcell's great abilities, " If a parallel were to be drawn between Purcell and any popular composer of a different country, reasons might be assigned for supposing him superior to every other great and favourite contemporary musician in Europe." Purcell was interred in Westminster Abbey, and a monument erected there to his memory.

PURCHAS, Samuel, an English divine, famous for compiling a valuable collection of voyages, was born in 1577, at Thacksted, in Essex. After studying at Cambridge, he obtained the vicarage of Eastwood, in his native county; but leaving that cure to his brother, he settled in London, in order to carry on the great work in which he was engaged. He published the first volume in folio in 1613, and the last four twelve years afterwards, under the title of Purchas his Pilgrimage, or Relations of the World, and the Religions observed in all Ages and Places. Meanwhile he was collated to the rectory of St Martin's, Ludgate, in London, and made chaplain to Dr Abbot, archbishop of Canterbury. His Pilgrimage, and the learned Hackluyt's Voyages, led the way to all the other collections of the same kind, and have been justly valued and esteemed. But unhappily, by his publishing, he involved himself in debt, and died in embarrassed circumstances, about the year 1628. The works of Purchas and Hackluyt form the most valuable collections of the kind in existence; and, were such things ever done in this country, we should strongly recommend the republication of *annotated* editions of both at the public expense; for such an undertaking, though of the highest utility, would far transcend the means of any individual publisher.

PURDHAUNGUR, a hill-fortress of Hindustan, in the province of Bejapore, taken by the Mahratta chief Savajee in 1668. Latitude not ascertained.

PURDIE'S Isles, a ledge of rocks and small islets, situated on the southern coast of New Holland, opposite Point Bell, in long. 133. 5. E. lat. 32. 16. S. They form part of Nuyt's Archipelago.

PUREG, a village of Mekran, in Persia, on the site of Para, the ancient capital of Gedrosia, where Alexander terminated his march on his return from India.

PURFLEW, a term in heraldry, expressing ermines, peans, or any of the furs, when they compose a bordure round a coat of arms. Thus it is said, he beareth gules, a bordure, purflew, vairy; meaning that the bordure is vairy.

PURGATION, the art of purging, scouring, or purifying a thing, by separating or carrying off any impurities that may be found therein. Thus, in pharmacy, purgation is the cleansing of a medicine by retrenching its superfluities; in chemistry, it is used for the several preparations of metals and minerals intended to clear them of their impurities; and in medicine, purgation is an excretory motion arising from a quick and orderly contraction of the fleshy fibres of the stomach and intestines, whereby the chyle, corrupted humours, and excrements, lodged therein, are protruded further and further, and at length quite excluded by stool.

Purgation, in *Law*, signifies the clearing a person's self of a crime of which he is suspected and accused before a judge. This purgation is either canonical or vulgar. Canonical purgation is prescribed by the canon law, and the form of it in the spiritual court is usually thus: The person suspected takes his oath that he is innocent of the crime charged against him, and at the same time brings some of his neighbours to make oath that they believe he swears truly. Vulgar purgation was anciently by fire or water, or else by combat, and was practised here till abolished by the canons.

PURGATORY, a place in which the just, who depart out of this life, are supposed to expiate certain offences which do not merit eternal condemnation. Broughton has endeavoured to prove that this notion was held by Pagans, Jews, and Mahommedans, as well as by Christians; and it cannot be questioned that, in the days of the Maccabees, the Jews believed that sin might be expiated by sacrifice after the death of the sinner.

Much abuse has been poured upon the Church of Rome for her doctrine of purgatory, and many false representations have been made of the doctrine itself. The following view of it is taken from a work which is considered as a standard by the British Catholics. First, every sin, how slight soever, though no more than an idle word, as it is an offence to God, deserves punishment from him, and will be punished by him hereafter, if not cancelled by repentance here. Secondly, such small sins do not deserve eternal punishment. Thirdly, few depart this life so pure as to be totally exempt from spots of this nature, and from every kind of debt due to God's justice. Fourthly, few will therefore escape without suffering something from his justice for such debts as they have carried with them out of this world, according to that rule of divine justice, by which he treats every soul hereafter according to its works, and according to the state in which he finds it in death. From these propositions, which the Catholic considers as so many self-evident truths, he infers that there must be some third place of punishment; for since the infinite goodness of God can admit nothing into heaven which is not clean and pure from all sins, both great and small, and as his infinite justice can permit none to receive the reward of bliss who as yet are not out of debt, but have something in justice to suffer, so there must of necessity be some place or state where souls, departing this life, pardoned as to the eternal guilt or pain, yet obnoxious to some temporal penalty, or with the guilt of some venial faults, are purged and purified before their admission into heaven. This is what the Catholic is taught concerning purgatory; and though he knows not where it is, of what nature the pains are, or how long each soul is detained there, yet he believes that those who are in this place, being the living members of Jesus Christ, are relieved by the prayers of their fellow members here on earth, as also by alms and masses offered up to God for their souls. And as for such as have no relations or friends to pray for them or give alms, or procure masses for their relief, they are not neglected by the church, which makes a general commemoration of all the faithful departed in every mass, and in every one of the canonical hours of the divine office.

Such is the doctrine of purgatory as taught by the Church of Rome. (See 2 Macc. xii. 43, 44, 45; St Math. xii. 31, 32; and 1 Cor. iii. 15.) By Protestants the books of Maccabees are not acknowledged as inspired Scripture; but if they were, the texts referred to would rather prove that there is no such place as purgatory, since Judas did not expect the souls departed to reap any benefit from his sin-offering till the resurrection. Our Saviour in St Luke speaks of remission in this world, and in the world to come, but surely neither of these is purgatory. The world to come is the state after the resurrection, and the remission spoken of is the sentence of absolution to be pronounced upon the penitent from the seat of general judgment. In the obscure verse referred to in the epistle to the Corinthians, the apostle is, by the best interpreters, thought to speak of the difficulty with which Christians should be saved from the destruction of Jerusalem. Of the state of souls departed he cannot well be supposed to speak, as upon disembodied spirits fire could not make any impression. We cannot help, therefore, thinking, with the Church of England, that "the Romish doctrine of purgatory is a fond thing, vainly invented, and grounded on no warranty of Scripture."

PURIFICATION, in matters of religion, a ceremony which consists in cleansing any thing from a supposed pollution or defilement.

The Pagans, before they sacrificed, usually bathed or washed themselves in water; and they were particularly careful to wash their hands, because with these they were to touch the victims consecrated to the gods. It was also customary to wash the vessel with which they made their libations. Previously to the duty of prayer the Mahommedans also use purifications, which are of two kinds; namely, either bathing, or only washing the face, hands, and feet. The first is required only in extraordinary cases, as after having lain with a woman, touched a dead body, or the like. But lest so necessary a preparation for their devotions should be omitted, either where water cannot be had, or when it may be of prejudice to a person's health, they are allowed in such cases to make use of fine sand or dust instead of it; and then they perform this duty by clapping their open hands on the sand, and passing them over the parts, in the same manner as if they were dipped in water.

There were also many legal purifications amongst the Hebrews. When a woman was delivered of a male child, she was esteemed impure for forty days, and when of a female, for sixty; at the end of which time she usually carried a lamb to the door of the temple to be offered for a burnt-offering, and a young pigeon or turtle for a sin-offering, and by this ceremony she was cleansed or purified.

PURIM, or *the Feast of Lots*, a solemn festival of the Jews, instituted in memory of the deliverance they received, by means of Mordecai and Esther, from Haman's wicked attempt to destroy them.

PURITAN, a name formerly given in derision to the dissenters from the Church of England, on account of their profession to follow the pure word of God, in opposition to all traditions and human constitutions. It was likewise given in the primitive church to the Novatian schismatics, because they would never admit to communion any one whom dread of death had led to apostatize from the faith.

PURLINS, in building, those pieces of timber which lie across the rafters on the inside, to keep them from sinking in the middle of their length.

PURNEAH, an extensive district of Bengal, forming the north-western division of that province, and situated about the twenty-sixth degree of north latitude. Its boundaries are, to the north the Morung Hills, in the Nepaul territories; on the south Monghir and Rajemahl; on the east Dinagepoor; and on the west Tirhoot and Baglipoor. It is a fertile, compact, and well-watered flat, comprehending 5119 square miles, intersected by various streams, is extremely fertile, and abounds in luxuriant pastures, on which are fed remarkably fine cattle, which are employed in the work done by horses in Europe. These bullocks are of fine proportions, and of a large size, and very superior to the draught cattle in Calcutta. It produces also rice, oil, pulse, wheat, besides other vegetables; opium and saltpetre for foreign commerce; and valuable timber from the Morung forests, which is cut in hot weather, and floated down the rivers in the rainy season. It is also celebrated for its sugar and indigo, the latter being one of its staple commodities; and it exports a considerable quantity of ghee, or butter of buffaloes, clarified. About 1796, from an official inquiry into the population of Purneah, it was found to contain 89,914 husbandmen holding leases, 22,324 artificers paying ground-rent, in 2784 villages, and on 2531 square miles. From official inquiries in 1801, it was found to contain 1,450,000 inhabitants, in the proportion of seven Mahommedans to ten Hindus. The chief rivers are the Cosah and Muhanada. In 1722 Sief Khan was appointed governor of Purneah, with absolute power over that district, and with permission to conquer from the independent rajahs near him all the territory that he could. He accordingly made considerable additions to the territory during the twenty-seven years which he ruled over it; and whilst other parts were overrun by the Mahrattas, his dominions continued to increase in prosperity and in population. In 1749 the son-in-law of Aliverdy Cawn succeeded, and he handed down the inheritance to his son. After various revolutions, the government devolved on an officer, Khadem Hussein, who engaged in a war with the British, but was finally obliged to retire to Oude. The principal towns are Purneah and Tajepore. The former is pleasantly situated on the eastern bank of the Seraw River, and carries on a considerable trade. Long. 88. 23. E. Lat. 25. 45. N.

PURPURE, in *Heraldry*. The colour so called, which signifies *purple*, is an engraving represented by diagonal lines from the left to the right.

It may serve to denote an administrator of justice, a lawgiver, or a governor equal to a sovereign; and, according to Leigh, if it is compounded with

Or,	it signifies	Riches.
Arg.		Quietness.
Gul.		Politics.
Az.		Fidelity.
Ver.		Cruelty.
Sab.		Sadness.

PURRAH, a town of Hindustan, in the province of Bengal, and district of Rajemahl. In 1353 it was a royal residence, the capital of Hyas, the second independent sovereign of Bengal, when it was taken by the Emperor Ferose. The city was much extended during the reign of Rajah Causa, the Hindu monarch of Bengal, who died in 1392. His son removed the seat of government back to Gour. Some of the ruins of this city still remain. It is ten miles north-east from Maulda. Long. 89. 9. E. Lat. 25. 9. N.

PURSER, an officer on board a ship of war, who receives the victuals from the victualler, sees that they be well stowed, and keeps an account of what he every day delivers to the steward. He also keeps a list of the ship's company, and sets down exactly the day of each man's admission, in order to regulate the quantity of provisions to be delivered out, and that the paymaster or treasurer of the navy may issue out the debursements, and pay off the men, according to his book.

PURVIEW, a term used by some lawyers for the body of an act of parliament, or that part which begins with the words "Be it enacted," as contradistinguished from the preamble.

PURULENT, in *Medicine*, something mixed with, or partaking of, pus or matter.

PUS, in *Medicine*, a white or yellowish matter, designed by nature for the healing and cementing of wounds and sores.

PUSTULE, a pimple, or small eruption on the skin, full of pus, such as the eruptions of the small-pox.

PUTEOLI, a town of Campania, so called either from its wells, there being many hot and cold springs thereabouts, or from the stench caused by sulphureous exhalations. It is now called *Puzzuoli*, and is pleasantly and advantageously situated for trade. In a very remote age the Cumeans made it their arsenal and dock-yard, and to this naval establishment they gave the sublime appellation of *Dicearchia*. The Romans were well aware of the utility of this port, and took great pains to improve its natural advantages. Nothing remains of their works but a line of piers, built to break the force of a rolling sea, and which are vulgarly called the *bridge of Caligula*, because that madman is said to have marched in triumph from Puzzuoli to Baiæ on a bridge, which however was a bridge of boats.

PUTIWL, a city of Russia, in the government of Kursk, the capital of a circle of the same name. It stands at the junction of the Putiwl with the Gem, and is a very ancient place, surrounded with pallisades. It contains nineteen churches, 1276 houses, and 10,500 inhabitants, who are occupied in refining saltpetre, making vitriol, and in other branches of internal trade. It is 890 miles from St Petersburg. Long. 33. 55. E. Lat. 52. 21. N.

PUTNEY, a parish of the hundred of Brixton, in the county of Surrey. It is four miles from London, on the south bank of the Thames, over which there is a bridge that unites it to Fulham. It is situated on a gentle elevation, many of the houses in it commanding pleasant views on the river. It contains many houses of noblemen and gentlemen within it, some of the first order, and with highly ornamented gardens. It was the birthplace of Thomas Lord Cromwell, of West, Bishop Ely his contemporary, and, at a later period, of Gibbon the historian of Rome. It was also the head-quarters of Oliver Cromwell's army. The population amounted in 1801 to 2428, in 1811 to 2881, in 1821 to 3394, and in 1831 to 3811.

PUTREFACTION is the natural process of decomposition, by which the elements of organic matter are made to enter into a different state of combination, and by which new products are formed.

Putrefaction has been generally considered as a species of fermentation, which has been divided into three kinds, the *vinous*, the *acetous*, and the *putrefactive*. The first is so termed, because during its progress spirit of wine is formed; the second, because acetum or vinegar is produced; and the last, because by it the substance runs into putrefaction.

All animal and vegetable matter is liable to undergo putrefaction; certain circumstances, however, are necessary for the commencement and continuance of the process, as the presence of moisture and a due degree of heat.

With regard to the putrefaction of vegetable bodies, the substance first becomes mouldy, it then emits an offensive odour, and in the course of time is in a great measure consumed. That moisture is necessary seems evident; for if the vegetable be cautiously dried by the application of heat, it may be preserved for almost any length of time. Hence the heat at which it must be kept, so as to make it putrefy, must not be such as will expel the moisture. On the contrary, when the temperature is low, the putrefactive process is put a stop to.

The admission of air also favours putrefaction, by allowing the escape of the volatile products. Many vegetable substances, however, particularly those that contain a large amount of carbon, are not entirely consumed by putrefaction; there is left a substance called *vegetable mould*, which does not putrefy when excluded from the air, but soon does so when exposed to it.

Vegetable mould constitutes a part of the soil, and contributes to vegetation, provided it be exposed to the atmosphere; hence the necessity of turning up the soil to cause the putrefaction to go on, by which it is supposed the mould, during its decay, becomes soluble, so that it is easily taken up by plants, and thus affords them nourishment. But when this is not done, more particularly when the mould is in large quantity, it accumulates, and hence the origin of *peat* and *morass*.

Animal matter is also liable to putrefaction; indeed it decays more easily than vegetables, provided it be kept at the requisite temperature, which is between forty and eighty degrees; the nearer to the latter the better; and if below thirty-two it ceases. Moisture is also necessary, and the freer the admission of air, the more rapid is the decomposition.

The first appearance of putrefaction is a change of colour and of consistence; the matter becomes paler and softer, emits a disagreeable smell, and at the same time evolves gaseous bodies, the nature of which depends on that of the animal substance; but it in general consists of carbonic acid, sulphuretted hydrogen, and volatile alkali, the disengagement of which ceases in the course of time, and a dry hard mass remains, containing the fixed principles of the animal kingdom.

When, instead of being exposed freely to air, the matter is buried, the putrefaction goes on more slowly, especially when the earth is dry, because the moisture from the animal matter is extracted. When the air is completely excluded, the substance is not entirely destroyed; the elements, by their new state of combination, form a peculiar principle resembling spermaceti, which has been called *adipocere*, from its properties being intermediate to those of fat and of wax.

Various means are resorted to for retarding or preventing putrefaction, both of animal and vegetable matter. Perhaps the most efficacious is cold, which is supposed to act by causing the congelation of the moisture, and thus preventing the elements from entering into new states of combination. It is well known that vegetables and butcher-meat, when put into snow, may be preserved for almost any length of time; and hence the common practice of sending fish to a distance packed in ice; whilst in the northern regions the inhabitants are in the custom of laying up a store of provisions surrounded by snow, by which they are kept fresh till required.

Depriving organic matter of moisture is another mode of retarding putrefaction; and hence it is that, when the substance is exposed cautiously to heat, by which the moisture is expelled, the putrefactive process is prevented. Hence the practice of drying fish; and in some countries it is customary to cut flesh into thin slices and dry it, in which state it is kept until it be required.

As exposure to air promotes putrefaction, exclusion from it retards it; and this affords another method of preserving animal and vegetable matter. Hence the custom of rubbing eggs over with butter, and also of keeping them in lime-water. Butcher-meat, also, well packed in barrels, from which the air is completely excluded, may be kept fresh for a considerable time, and more particularly if the meat be *par-boiled* before it is packed. Strong soups, after being cooled, and of course congealed, are preserved during long voyages, by being put into earthen dishes, and in general covered with a layer of melted fat, and afterwards secured from the air by bladder or tinfoil. In many cases the meat is packed into tin boxes, the lids of which are afterwards soldered down so as to exclude the air. In this way meat has been taken to India and returned to this country as fresh as when put into the packages.

There are many substances which retard, indeed prevent putrefaction, and some of them, it is supposed, act by absorbing the moisture. The most powerful of these *antiseptics* is sea-salt, which, it is well known, is used largely in preserving meat, fish, butter, &c. Another substance which acts powerfully is pyroligneous acid; but it is generally allowed that it acts not by the acid which it contains, but by a peculiar principle formed during its formation, and in all probability similar to, if not the same as, that now called *creosote;* indeed it is also supposed that during the process of *smoking*, to which fish, and sometimes also meat, are subjected, the same principle is formed, and that it is this which acts in preventing putrefaction.

Sugar, it is well known, is also a powerful antiseptic, and hence its use in making preserves, &c.; so also is spirit of wine, and the volatile oils, as turpentine, which are much employed in preserving anatomical preparations.

Sir John Pringle made experiments to determine the powers of certain substances in promoting or preventing putrefaction. From these experiments he formed the following table, showing the relative antiseptic powers of the saline substances mentioned. Having found that two drams of beef put into a phial with two ounces of water, and placed in a heat equal to 90° of Fahrenheit's thermometer, became putrid in fourteen hours, and that sixty grains of sea-salt preserved a similar mixture of beef and water more than thirty hours, he made the antiseptic power of the sea-salt a standard, to which he compared the powers of the other salts. The algebraic character + signifies that the substance to which it is annexed had a greater antiseptic power than is expressed by the numbers.

Sea-salt, or the standard	1
Sal-gem	1+
Vitriolated tartar	2
Spiritus Mindereri	2
Soluble tartar	2
Sal diureticus	2+
Crude sal-ammoniac	3
Saline mixture	3
Nitre	4+
Salt of hartshorn	4+
Salt of wormwood	4+
Borax	12
Salt of amber	20
Alum	30

The quantities of spiritus Mindereri and of the saline mixture were such, that each of them contained as much alkaline salt as the other did neutral salts.

Myrrh, aloes, asafœtida, and terra Japonica, were found to have an antiseptic power thirty times greater than the standard. Gum ammoniacum and sagapenum showed little antiseptic power.

Of all resinous substances, camphor was found to resist putrefaction most powerfully. Sir John Pringle believes that its antiseptic power is three hundred times greater than that of sea-salt.

Chamomile flowers, Virginian snake-root, pepper, ginger, saffron, contrayerva root, and galls, were found to be twelve times more antiseptic than sea-salt.

Infusions of large quantities of mint, angelica, ground-ivy, green tea, red roses, common wormwood, mustard, and horse-radish, and also decoctions of poppy-heads, were more antiseptic than sea-salt.

Decoctions of wheat, barley, and other farinaceous grains, checked the putrefaction by becoming sour.

Chalks and other absorbent powders accelerated the putrefaction, and resolved meat into a perfect mucus. The same powders prevented an infusion of farinaceous grains from becoming mucilaginous and sour.

One dram of sea-salt was found to preserve two drams of fresh beef in two ounces of water above thirty hours uncorrupted, in a heat equal to that of the human body, or above twenty hours longer than meat is preserved in water without salt; but half a dram of salt did not preserve it more than two hours longer than pure water. Twenty-five grains of salt had little or no antiseptic quality. Twenty grains, fifteen grains, but especially ten grains only, of sea-salt, were found to accelerate and heighten the putrefaction of two drams of flesh. These small quantities of sea-salt also softened the flesh more than pure water.

The same learned and ingenious physician made experiments to discover the effects of mixing vegetable with animal matters.

Two drams of raw beef, as much bread, and an ounce of water, being beaten to the consistence of pap, and exposed to 90° of heat according to Fahrenheit's thermometer, began to ferment in a few hours, and continued in fermentation during two days. When it began to ferment and swell, the putrefaction had commenced; and in a few hours afterwards the smell was offensive. Next day the putrid smell ceased, and an acid taste and smell succeeded. Fresh alimentary vegetables, as spinach, asparagus, scurvy-grass, produced similar effects to bread on flesh, but in a weaker degree. From several other experiments, he found that animal substances excite the fermentation of vegetable substances, and that the latter substances correct the putrescency of the former.

By adding saliva to a similar mixture of flesh, bread, and water, the fermentation was retarded, moderated, but rendered of twice the usual duration; and the acid at last produced was weaker than when no saliva was used.

By adding an oily substance to the common mixture of flesh, bread, and water, a stronger fermentation was produced, which could not be moderated by the quantity of saliva used in the following experiment, till some fixed alkaline salt was added; which salt was found, without saliva, to stop suddenly very high fermentations.

Sir John Pringle did not find that small quantities of the following salts, sal-ammoniac, nitre, vitriolated tartar, sal diureticus, salt of hartshorn, salt of wormwood, were septic, as small quantities of sea-salt were. Sugar was found to resist putrefaction at first, as other salts do, and also to check the putrefaction after it had begun by its own fermentative quality, like bread and other fermentative vegetables. Lime-water made some small resistance to putrefaction.

Port wine, small beer, infusions of bitter vegetables, of bark, and the juice of antiscorbutic plants, retarded the fermentation of mixtures of flesh and bread; but an unstrained decoction of bark considerably increased that fermentation.

Crab-eyes accelerated and increased the fermentation of a mixture of flesh and bread. Lime-water neither retarded nor hastened the fermentation of such a mixture; but when the fermentation ceased, the liquor was neither putrid nor acid, but smelt agreeably. Flesh pounded in a mortar was found to ferment sooner than that which had not been bruised. The tough inflammatory crust of blood was found to be most putrescent; next to which the crassamentum, or red coagulated mass; and lastly the serum.

Dr Mackbride's experiments confirm many of those above related, especially such as show that the fermentation of vegetable substances is increased by a mixture of animal or putrescent matter; that the putrescency of the latter is corrected by the fermentative quality of the former; and that the putrefaction and fermentation of mixtures of animal and vegetable substances were accelerated by additions of absorbent earths and of Peruvian bark. He also found, that although unburned calcareous earths were septic, quicklime and lime-water prevented putrefaction, but that they destroyed or dissolved the texture of flesh.

The experiments of the author of the *Essai pour servir à l'Histoire de la Putréfaction* showed that metallic salts, resinous powders, extracts of bark, and opium, were very powerfully antiseptic; and that salts with earthy bases were less antiseptic than any other salts.

PUTTAN SOMNANT, a town of Hindustan, on the south-west coast of the Gujerat peninsula, and district of Puttan. Long. 70. 23. E. Lat. 20. 57. N.

PUTTY, in its popular sense, is a kind of paste compounded of whiting and linseed oil, beaten together to the consistence of a thick dough. It is used by glaziers for fastening in the squares of glass in sash-windows, and by painters for stopping up the crevices and clefts in timber and wainscots.

PUTTY sometimes also denotes the powder of calcined tin, used in polishing and giving the last gloss to works of iron and steel.

PUY, LE, an arrondissement of the department of the Upper Loire, in France, extending over 779 square miles. It has fourteen cantons, 117 communes, and 122,450 inhabitants. The capital is the city of the same name, distinguished by the addition *en Belay*, which is situated on the river Borne. It is the seat of the departmental boards of government, and the see of a bishop. It contains 2950 houses, with 13,100 inhabitants, whose chief employment is lace-making, and the manufacture of cotton goods, especially muslins. It has also some manufactures of copper and iron wares, and of pottery. Long. 3. 47. 40. E. Lat. 45. 2. 41. N.

PUY DE DÔME, a department in the south of France, formed out of the ancient province Lower Auvergne. It extends in north latitude from 45. 26. to 46. 11. and in east longitude from 2. 17. to 3. 54. In extent it is 3389 square miles, and is divided into five arrondissements, and these into fifty cantons and 438 communes, containing by the last census 573,100 persons. It is bounded on the north by the department of Allier, on the east by that of the Loire, on the south by the Upper Loire and the Cantal, and on the west by the Corrèze and by the Creuse. It is an elevated district, covered with hills and mountains, with few or no plains, but some beautiful valleys, not very wide, through which the streams flow. One of the most picturesque of these vales is that of Limagne, which extends along both banks of the Allier, from the entrance of that river into the department, to its passage out of it. It is remarkable for its fertility. The roads are planted with large walnut and elm trees, the sides of the hills are covered with vines, and on the tops are ornamented with towns, villages, and castles. Some of the mountains in the northern part, the highest of which reach to about 4000 feet, have marks of volcanic origin, and are composed of basalt or of lava. In the south the elevations are greater, and that called the Mont d'Or is about 6300 feet. The chief river is the Allier, which comes out of the department of the Upper Loire, is navigable in its course through Puy de Dôme, and receives the waters of various streams. There are several lakes in some of the districts, but none of them of any great extent. The climate is raw and variable on the mountains, but in the valleys it is mild, intensely hot in summer, and severely cold in winter; and occasionally most violent storms, accompanied with hail, are experienced in the most fertile of the valleys. The chief products, besides corn, of which there is a surplus for the supply of the neighbouring departments, are hemp, flax, wax, honey, fruit, especially cherries, walnuts, and wine. The last is abundant, but in general not highly estimated. The best is in the valley of Limagne; but even there the greater part of the produce of the vines is distilled into brandy. The nuts are so abundant that a great quantity of oil is made from them; and as fuel is scarce, many of the walnut trees are made use of for that purpose. There are mines both of iron and of coal, but they are not extensively worked. The manufactures are linen cloths, blond lace, silk stockings, some cotton, and thin woollens, ribbons, jewellery, leather, and paper. The population is so much beyond the means of employment, that a great number of labourers yearly go to the neighbouring department to procure work in summer, and return in winter with the wages which they have earned. The department elects four deputies to the legislature. It is in the diocese of Clermont, and under the judicial power of the courts of law at Riom.

PUZZULANA or POZZOLANA TERRA, is a grayish kind of earth employed in Italy for building under water. The best is found about Puteoli, Baiæ, and Cumæ, in the kingdom of Naples, from the first of which places it derives its name. It is a volcanic product, composed of heterogeneous substances, thrown out from the burning mouths of volcanoes in the form of ashes; sometimes in such large quantities, and with so great violence, that whole provinces have been covered with it at a considerable distance. In the year 79 of the common era, the cities of Herculanum, Pompeii, and Stabia, although at the distance of many miles from Vesuvius, were nevertheless buried under the matter thrown out during these dreadful eruptions. This volcanic earth is of gray, brown, or blackish colour, and of a loose glanular, or dusty and rough, porous or spongy texture, resembling a clay hardened by fire, and then reduced to a gross powder. It contains various heterogeneous substances mixed with it. Its specific gravity is from 2500 to 2800, and it is in some degree magnetic; but it scarcely effervesces with acids, although partially soluble in them. It easily melts *per se*; but its most distinguishing property is, that it hardens very suddenly when mixed with one third of its weight of lime and water; and forms a cement which is more durable in water than any other. According to Bergman's analysis, a hundred parts of Terra Pozzolana contain from fifty-five to sixty of siliceous earth, twenty of argillaceous, five or six of calcareous, and from fifteen to twenty of iron. Its effects, however, in cement may perhaps depend only on the iron it contains. It is evidently a martial argillaceous marl that has suffered a moderate heat. Its hardening power arises from the dry state of the half-baked argillaceous particles, which makes them imbibe water rapidly, and thus accelerates the desiccation of the calcareous part; and also from the quantity and peculiar state of the iron and manganese which it contains, on which metals its properties chiefly depend. It is found not only in Italy, but also in France, in England, and elsewhere.

PYANEPSIA, in *Antiquity*, an Athenian festival celebrated on the seventh day of the month *Pyanepsion*, which, according to the generality of critics, was the same with our September.

Plutarch refers the institution of this feast to Theseus, who, after the funeral of his father, which happened on this day, paid his vows to Apollo, because the youths who returned with him safe from Crete then made their entry into the city. On this occasion these young men, putting all that was left of their provisions into one kettle, feasted together on it, and made great rejoicing. Hence was derived the custom of boiling pulse on the occasion of this festival. The Athenians likewise carried about an olive branch, bound with wood, and crowned with all sorts of first-fruits, to signify that scarcity and barrenness had ceased, and singing in procession a song. When the solemnity ended, it was usual to erect the olive branch before their doors, as a preservative against scarcity and want.

PYCNOSTYLE, in the ancient architecture, is a building where the columns stand very close to each other, only one diameter and a half of the column being allowed for the intercolumniations. According to Mr Evelyn, the pycnostyle chiefly belonged to the composite order, and was used in the most magnificent buildings; as at present in the peristyle at St Peter's at Rome, which consists of near three hundred columns, and in such as yet remain of the ancients amongst the ruins of Palmyra.

PYGMALION, in fabulous history, a king of Cyprus, who, being disgusted at the dissolute lives of the women of his island, resolved to live in perpetual celibacy; and making a statue of ivory, he fell so passionately in love with it, that, the high festival of Venus being come, he fell down before the altar of that goddess, and besought her to give him a wife like the statue he loved. At his return home, he embraced, as usual, his ivory form, when he perceived that it became sensible by degrees, and was at last a living maid, who found herself in her lover's arms the moment she saw the light. Venus blessed their union; and, at the end of nine months, she was delivered of a boy, who was named Paphos.

PYGMY, a person not exceeding a cubit in height. This appellation was given by the ancients to a fabulous nation inhabiting Thrace, who brought forth young at five years of age, and were old at eight. They were celebrated for the bloody war which they waged with the cranes.

PYKAR, a broker in India, inferior to those called *dallals*, who transacts the business at first hand with the manufacturer, and sometimes carries goods about for sale.

PYKE, a watchman in India, employed as a guard at night. Pyke is likewise a footman or runner on business. They are generally armed with a spear.

PYLADES, was a son of Strophius, king of Phocis, by one of the sisters of Agamemnon. He was educated together with his cousin Orestes, with whom he formed the most inviolable friendship, and whom he assisted to revenge the murder of Agamemnon, by assassinating Clytemnestra and Ægysthus. He also accompanied him into Taurica Chersonesus; and for his services Orestes rewarded him, by giving him his sister Electra in marriage. Pylades had by her two sons, Medon and Strophius. The friendship of Orestes and Pylades became proverbial.

PYLADES, an actor of pantomime, who was the first to bring that species of histrionics to a high degree of perfection at Rome. He was a native of Cilicia, and had been the slave of Augustus, who gave him his freedom. He was the rival of Bathyllus, but their mode of dancing was perfectly distinct; that of Pylades was full of dignity and of passion, whilst that of Bathyllus was of a more joyous character. Pylades even wrote a book on the principles of his art. For some reason or other he was banished from Rome, and his recall by Augustus was so palatable to the people that in their joy they forgot some severe measures which the emperor had passed. According to Suetonius, his banishment was caused by his having pointed with his finger to some one who had hissed his performance.

PYLOS, a city on the coast of Messenia, fifteen miles south of Cyparissia, is usually considered as the residence of Nestor, where he was visited by Telemachus. There were two other places of the same name, one in Elis, and another in Triphylia, which claimed this honour; but all the circumstances which the poet states suit best the city in Messenia. The quickness of the voyage between Ithaca and this southern Pylos is one of the principal objections; but it must be recollected that Athenë directed the vessel. Strabo, however, believed that the city in Triphylia, which seems to have been unknown to Pausanias, was the residence of Nestor; and he satisfied himself by the following reasoning. The description of Homer shows that the dominions of Nestor stretched on both sides of the river Alpheius; but this suits neither with Messenia nor with Elis. It was not upon the coast, for a messenger was sent to the ships to invite the companions of Telemachus to supper; and when Telemachus returned from Sparta he caused Pisistratus to drive his chariot directly to the harbour, so that the road to the harbour and city could not have been the same. The return of Telemachus to Ithaca is also brought forward as a proof, for he is made to pass Cruni, Chalcis, Pheia, and the coast of Elis, which, according to Strabo, he could only have done if he started from the Triphylian Pylos. Again, in the war of the Pylians against the Eleians, the time required to drive the booty, which consisted amongst other things of swine, was so short that they could not have reached the Messenian Pylos.

PYLOS, a city of Triphylia, was thirty stadia from Samicum, on the coast, and near a river once called Amathus and Pamisus, but subsequently Mamaus and Arcadicus. It was considered by Strabo as the residence of Nestor.

PYLOS, a city of Elis, eighty stadia from the city of Elis, was founded by Pylus of Megara, destroyed by Hercules, and rebuilt by the Eleians. It was situated between the sources of the rivers Peneius and Sellecis, and under Mount Scollis.

PYLSTART, an island in the Southern Pacific Ocean, about six miles in circumference, discovered by Tasman in 1643. Long. 175. 59. W. Lat. 22. 22. S.

PYRAMID, in *Geometry*, is a solid standing upon a triangular, a square, or a polygonal basis, and terminating in a point at the vertex; or it is a solid figure, consisting of several triangles, the bases of which are all in the same plane, and have one common vertex.

Pyramid is also applied to a colossal structure, corresponding in form to the geometrical definition of the solid, and remarkable not only for its magnitude and antiquity, but likewise for the mystery which still overshadows the object contemplated in its construction.

The number of pyramids scattered over Egypt, Nubia, and Ethiopia or Meroë, is very great indeed; but by far the most remarkable are those of Djizeh, Sakhara, and Dashour, on a plain to the north of Cairo, in Egypt. The first of these places, which is situated on the western bank of the Nile, and nearly in the latitude of Cairo, is distinguished above the others by possessing the three principal pyramids mentioned by Herodotus, and still justly numbered amongst the wonders of human art.

The largest of these pyramids, which goes by the name of Cheops (a Greek corruption of the Egyptian *Kobts* or *Copts*), stands on an elevation upwards of 150 feet above the subjacent plain, and rises to an altitude above the base of about 498 English feet. It is ascended by an uninterrupted series of steps, diminishing from four feet to two and a half in height, as the structure narrows towards the vertex. The breadth of each step is equal to its height. Upon the top there is a platform thirty-two feet square, consisting of nine blocks of stone, whereon travellers of all ages and nations have inscribed their names in their respective languages. This pyramid was explored, first by our countryman Mr Davidson in 1763, and afterwards with still greater success by Captain Caviglia in 1817. A full account of the adventurous explorations of each will be found in the article EGYPT, vol. viii. p. 547 *et seq.* of the present work. In all of the pyramids the entrances are in the north front, and the descending passages slope at an angle of twenty-six or twenty-seven degrees. This line seems to be nearly directed to the pole, and hence the northern face of the pyramid is almost in the plane of the earth's equator; a circumstance which goes far to show that the passages in question were intended for the purpose of astronomical observation.

The second pyramid, called that of Cephrenes, is stated by Denon to have a base 655 feet each side, and to be 398 feet in height. The pyramids are supposed to have been all coated or cased with stucco made of gypsum and flint; and in fact forty feet of coating still adhere to that of Cephrenes. But the great pyramid has no appearance of having been touched in this way; and on that of Cephrenes the coating was probably never completed, as no indications of it were discovered on removing the sand from its base. In 1816, Belzoni discovered the entrance in the north front of the second pyramid. Advancing along a narrow passage, he found that it terminated in a chamber at the centre of the pyramid, cut out of the solid rock, the dimensions of which he ascertained to be forty-six feet in length, sixteen in breadth, and nearly twenty-four feet in height. This chamber contained a sarcophagus of the finest granite, half sunk in the floor, with the lid drawn to one side and broken, and within were bones, supposed to be those of a bull, mixed with rubbish. An Arabic inscription on the wall proved that it had been explored by the curious of a former age. The dimensions of the pyramid were ascertained to be, the base 684 feet each side, the perpendicular height 456 feet, and the coating from the top to where it terminates 140 feet. (See the article EGYPT, *ubi supra.*)

The third pyramid, situated beyond that of Cephrenes, and called by the name of Mycerinus, appears to have been cased with granite, at least fragments of that material were found amongst the rubbish. But it still remains to be opened by some future traveller, Belzoni, with all his enterprise, having failed in the attempt. It is only 280 feet at the base, and 162 in height; and beyond it there is another of still smaller dimensions, having its summit crowned by one large block of stone, as if for a pedestal. The stability of these enormous piles was increased by the stones having been so fixed as to slope inwards, and the perfection of the adjustment may be inferred from this, that not one of them has yet swerved from its position. The structures raised by the ancient Egyptians were intended to last for ever.

The pyramids of Sakhara are three miles south of those of Djizeh, and the pyramids of Dashour are beyond those of Sakhara, whilst more of brick or of stone are scattered over the plain, intermixed with the excavations, cemeteries, and fragments of statues or edifices, which mark out the site of the second capital of the Pharaohs. Some of them are rounded at the top, and resemble hillocks cased with stone. One has steps like that of Cheops, the ranges, six in number, being twenty-five feet in height and eleven feet in width; and the total height is 150 feet. There is another, built also with steps or ranges, and not much inferior in altitude to that of Cheops. The stones of these pyramids are much decayed, and gradually crumbling into dust, evidently from great age. One of them is built of unburned bricks, containing shells, gravel, and chopped straw, and is altogether in a very mouldering state.

For some notices of the various opinions stated by travellers as to the purposes for which these extraordinary structures are supposed to have been intended, the reader is again referred to the article EGYPT in this work. The bones found in the chamber of the pyramid of Cephrenes, not to mention other circumstances, seem to have some connection with the worship of the sacred bull Apis; and besides, from the care with which the entrances appear to have been concealed, it is not impossible that there may yet be many undiscovered chambers, both in the pyramid of Cheops and in that of Cephrenes. It is very remarkable, too, that not a single sculpture or hieroglyph has been discovered in any pyramid which modern enterprise and research have yet explored. (A.)

PYRAMIDOID, a term which is occasionally employed to denote the parabolic spindle, or the solid formed by the rotation of a semiparabola about its base or greatest ordinate.

PYRENEAN MOUNTAINS, or PYRENEES, are the mountains which divide France from Spain, and are the most celebrated in Europe, excepting the Alps. They reach from the Mediterranean as far as the Atlantic Ocean, and are about 212 miles in length. They have different names, according to the different places where they stand. Mont Perdu, the highest of the Pyrenees, has an elevation of 11,283 English feet.

PYRENEES, EASTERN. The eastern extremity of the Pyrenees gives its name to a department watered by the Agly, the Tet, and the Tech, which flow in an easterly direction towards the Mediterranean Sea. It possesses a warm and genial climate, very favourable to the culture of the vine; but the lands near the sea are marshy, from which arise exhalations prejudicial to health. The chief towns are Perpignan, the seat of a prefecture and a diocese, on the right bank of the Tet; Elne, on the left bank of the Tech, the site of the ancient Illiberis, under whose walls Hannibal encamped; Foix, in the valley watered by the Ariège; and Saint Giron's, on the Salat, a small river, on which are several paper-mills and other manufactories. The extent of territory of the department is 209 geographical square miles. It is divided into three arrondissements, seventeen cantons, and 226 communes. The inhabitants in 1837 amounted to 164,325.

PYRENEES, *Upper*, a department of France, which derives its name from the highest part of the Pyrenees. It is formed almost entirely of the ancient country of Bigorre. From the plains in the confines of Gers, to Mont Perdu, the highest point of the department, is experienced every gradation of European climate. No great quantity of corn is raised, but the country abounds in wine. The shepherds who inhabit the mountains are an active and hardy race of men. The principal towns are, Vicq en Bigorre, on the right bank of the Lachez; Tarbes, on the banks of the Adour; Bagnères de Bigorre, remarkable for its mineral waters; Campan, which carries on a considerable trade in paper and woollen stuffs; Cauterets, not far from the summits of the Pyrenees, celebrated as the residence of Margaret of Valois. The thermal springs of Barèges vary in temperature from 106° to 122° of Fahrenheit. The department consists of 229 geographical square miles, divided into three arrondissements, twenty-six cantons, and 492 communes. The population in 1837 amounted to 244,170.

PYRENEES, *Lower*, includes part of Navarre and the ancient principality of Béarn. The Pyrenees do not occupy one half of the department, and do not rise to a great elevation. The heights are crowned with forests, and the valleys are fruitful and well peopled. The Bidassoa bounds the department on the west, and determines the line which separates the kingdoms of France and Spain. Near the extremity of the heights that command the fruitful valley watered by the Gave, stands Pau, a town of some elegance, celebrated as the birthplace of many extraordinary persons, amongst whom may be mentioned Henry IV., Gaston de Foix, the celebrated Duke de Nemours, and Joan d'Albert. Further down the river stands Orthés, renowned as the scene of a destructive battle fought at the gates of the town in 1814, where the Duke of Wellington purchased a victory over Marshal Soult with the loss of 10,000 men. Bayonne, a place of considerable trade, and a strongly fortified town, stands at the confluence of the Nive and Adour, about two miles from the Bay of Biscay. The department contains 379 geographical square miles, divided into five arrondissements, forty cantons, and 630 communes. The population in 1837 amounted to 244,170.

PYRITES, a metallic substance, combined with sulphur; as iron pyrites, composed of sulphur and iron, and copper pyrites, of sulphur and copper. See MINERALOGY.

PYRMONT, a city of the principality of Waldech, in Germany, and the capital of the district of the same name. It is a well-built place, containing 320 houses, and 2400 resident inhabitants. It is chiefly remarkable for its mineral springs, which are much frequented in the summer months by invalids. It is situated at the northern extremity of a picturesque valley on the river Emmer. It is surrounded with pleasing groves and other public walks, as well as with all the accommodations which can contribute to the gratification of those who resort to its waters. The principal spring, called the holy well, has an intoxicating quality and a vinous spirited taste, and has long been the most celebrated of the steel waters. From this well more than 400,000 jugs are annually filled, and despatched to other parts of the world; and it is said to lose none of its qualities by the longest journey. There are other springs, of various component parts; and one from which a large quantity of culinary salt is made. The Prince of Waldech has a palace near the city, which was formerly occupied by Frederick the Great, who frequently had recourse to these springs in his latter years. Lat. 51. 59. 28. N.

PYROMANCY, a kind of divination by means of fire.

PYROMETER.

INSTRUMENTS for ascertaining the effects of a given change of temperature on the dimensions of solids are named *pyrometers*, from πυρ, *fire*, and μετρεω, *I measure*. The same name is also given to such instruments as are employed for the converse purpose of inferring from some of the various effects of heat, temperatures higher than those to which ordinary thermometers are applicable. Both classes of these instruments have been constructed in a variety of forms; but, unless where the temperature was to be high, the most of them formerly acted on the principle of rendering the minute expansions sensible or appreciable by means of machinery. Accordingly, such an instrument generally consisted of an apparatus for producing the requisite change of temperature, coupled with machinery so contrived, that when to one part of it an imperceptibly small motion is given by the expansion of the substance under trial, a very sensible motion is thereby produced in another part. However, in almost no case can the machinery for increasing the sensibility be with safety or propriety exposed to any high temperature; and frequently the heat of a furnace is now inferred from or denoted by the fusing point of the particular metal, alloy, or other substance which it is just able to melt, such fusing points being supposed to be previously known. But the methods as yet employed to determine high temperatures, however useful some of them may be for recording particular intensities of heat, and showing when the intensity in one case is equal to that in another, are insufficient to indicate their absolute values, or in what ratio unequal intensities differ among themselves. Nay, even their values in terms of the common scales of temperature are as yet but very imperfectly known in the higher part of the range.

In most of the earlier pyrometers the substance under trial was heated by the immediate contact of the flames of lamps; a method which not only produced an entirely unknown temperature, but probably gave to different bodies, or even to different parts of the same body, very different temperatures. This was greatly improved upon by applying the lamps to a metallic trough or boiler, containing some liquid, in which the bar under trial and a thermometer were immersed. Sometimes an inner case or trough has been used to keep the specimen dry; and when only a very moderate heat is required, steam has also been used to heat the specimen. This, though generally supposed to be a recent application of steam, had, according to Mr Nicholson (*Journal* for February 1805), been used by J. H. de Magellan in 1784.

To obtain an appreciable indication of the expansions of bodies, Muschenbroeck, to whom we owe the first instrument of this sort, as well as the name *pyrometer*, made the expansion of a rod of the substance under trial move a toothed rack, turning a pinion fixed on the axis of a wheel, which again turned a second pinion on the axis of the index, and the latter revolved over a graduated dial. Some have added more wheels and pinions, or have used a system of levers, or one consisting partly of levers and partly of wheels and pinions; and did the accuracy keep pace with the sensibility, such instruments might be correct enough. Other contrivances for increasing the sensibility are very numerous, but they are generally so readily referrible to similar principles as to render particular descriptions of them unnecessary, more especially since none of them is free from the objections about to be stated. Smeaton employed one lever, and observed how many turns and parts of a turn of a fine screw, whose end was just in contact with a piece touching the lever, would make it be again barely in contact with that piece, after the bar under trial, and acting near the fulcrum of the lever, had undergone the requisite heating. Lavoisier and Laplace made the expansion of the bar under trial act upon one lever, which again acted on a telescope hung as a second lever. This telescope being directed to a large graduated scale placed at a known distance, the slightest deflection which the expansion of the bar under trial occasioned in the direction of the telescope was thus rendered very conspicuous. Had the accuracy of this mode of operating, therefore, been as great as the sensibility thereof, it would certainly have given the expansions to a great degree of exactness.

But the preceding kinds of pyrometers, however useful for exhibiting in a general way the expansions of bodies, or for illustrating the subject in a public lecture, are by no means entitled to much confidence; for, in using wheels and pinions, as well as levers, or any of these coupled with other machinery, there is always considerable uncertainty in the result, owing to the loose connection of the several parts, and their sometimes bending under the strain, as also to the friction and obliquity of action. Nay, an error of some consequence may even arise from the bar itself under trial being compressed by its giving motion to the machinery, more especially at the time when it is softened by heat; and those parts of the mechanism which touch the ends of the heated bar, and that in particular which is moved by its contact, will be apt to partake in its temperature, to an uncertain extent, and to occasion a corresponding uncertainty in the result.

Microscopic pyrometer.

The celebrated artist Mr Ramsden invented a method of measuring the expansions, as seen greatly magnified through microscopes, which is not only free from the uncertainties of the instruments just noticed, but is much more manageable than they are. A particular description of the pyrometer which Mr Ramsden constructed on this principle, for ascertaining the expansions of the rods employed in measuring a base on Hounslow Heath for the trigonometrical survey, is given by General Roy, in the *Philosophical Transactions* for 1785; though, owing to the scarcity of letters of reference, the engraving must be nearly unintelligible to those who are not versed in such subjects. This apparatus appears to be susceptible of acting with great accuracy under moderate heats; but neither it, nor indeed any other instrument of the sort, seems directly applicable under very high temperatures, though we shall afterwards see how the microscopes may be rendered equally available for appreciating or measuring the expansions marked by register pyrometers, or those which, even after they have again become cold, preserve an indication of the extent of the expansion which has occurred during their previous exposure to a great heat.

We can only give here a very general description of Mr Ramsden's pyrometer, which consists of a strong deal frame, five feet in length, nearly twenty-eight inches in breadth, and about forty-two inches in height. The bar of the material whose expansion is to be measured, and which may be even two feet long, is placed with water in a copper trough or boiler fully five feet in length. Beneath this trough are set twelve spirit-lamps, whose flames may heat the water in the trough, and the bar placed therein for trial, to the boiling point, if required. But it is evident, that by filling the trough with a liquid having a higher boiling point, a still higher temperature might be attained. On each side of the copper trough, and parallel to it, at a little distance, is placed a wooden trough filled with water, and each of these contains a cast-iron prismatic bar. For greater simplicity, we shall suppose that there are also two cross pieces, which can be fixed anywhere on the cast-iron bars, and at right angles to them, and that each cross piece carries a microscope to look directly down upon each end of the bar under trial.[1] The one microscope has only a simple mark or point in its field of view; but the other is furnished with such a wire-micrometer as is described under the article Micrometer.

Whilst operating with this apparatus, it is of consequence that the temperature of the two cast-iron prisms in the wooden troughs should continue as steady as possible, which can be easily tested by placing thermometers beside them in the water; or a steady temperature may be insured by keeping the troughs filled with melting ice, as was done by General Roy. Suppose, now, the cross piece carrying the microscope which has the point in its field of view, to be so set over one end of the bar under trial, that this point or mark may appear directly coincident with the extremity of the bar to be examined, or with a point or mark near its extremity. In like manner, let the other microscope be fixed over the other extremity of the bar under trial, so that its moveable wire may be accurately coincident with the other extremity of the bar, or with a point or mark near it. These adjustments being made, suppose the temperature of the water and of the bar in the boiler to be exactly 32° Fahrenheit. By means of the spirit-lamps under the boiler gradually heat it to 140°, or any other required temperature, and look through the second microscope. As soon as the change of temperature begins to affect the length of the bar, the mark at its extremity will be seen to deviate from its previous coincidence with the wire of the micrometer, and to extend beyond it. On the bar, therefore, attaining any other temperature, we can measure the corresponding expansion which has occurred, by observing how many turns and parts of a turn of the micrometer-screw are necessary to bring the micrometer-wire into coincidence with the slowly shifting mark on the expanding bar; and as the value in parts of an inch of each turn of the micrometer-screw is accurately known, a direct measure of the expansion of the bar is thus obtained, free from the errors of a system of levers, or of a train of wheels and pinions.

Adie's pyrometer.

A different form of microscopic pyrometer has been employed by Mr Alexander J. Adie;[2] in which, instead of the horizontal iron prisms of Ramsden, the microscopes are merely attached to an upright oaken post, which supports and holds nearly all the other parts, and which was made from such an old and thoroughly seasoned piece of timber, that it scarcely expands at all by heat. The bar or rod of the substance under trial is enclosed in a vertical tube, which again is surrounded by steam flowing in a continued current through an outer tube incasing the other. Both tubes are provided with small glass windows, for the purpose of viewing the ends of the included bar through the microscopes, and likewise for excluding the steam from the inner tube. By this means, the tendency which an accession of moisture has to increase the expansions of certain bodies is obviated. But although the inner tube may thus effectually protect the specimen under trial from the humifying influence of the steam, it by no means obviates the uncertainty of the effects of such humidity as that body may already contain. For it appears from Mr Adie's experiments, that as the temperature increases, the moisture, as might be expected, gradually evaporates from the bar under trial into the air which is enclosed with it in the tube. On this account, if the humidity remaining in the bar were constant, it might add to the expansion, but the gradual drying or evaporation of it tends to a contraction. Indeed, with respect to bodies which have their dimensions affected by a change of humidity, it seems very doubtful if the experiments with slender rods, the humidity of which is so easily altered, can be regarded as determining the expansion by heat of such blocks of the same substance as are massy, and have the humidity comparatively constant.

It is further to be observed, that in heating with steam, it only occasions an unnecessary expenditure of heat to allow a continued current, or indeed any quantity, of the steam to run waste or escape from the pyrometer, except as much as is sufficient at first merely to expel, through proper apertures, the air from the apparatus; after which the closer everything can be kept so much the better. It seems to have been owing to the employment of a continually escaping current, that Mr Adie found it difficult to maintain a temperature higher than 207° Fahrenheit; whereas, if sufficient care be taken to regulate the heat of the boiler, a single pipe connecting the boiler with a proper air-tight vessel in the pyrometer is all that is required, provided that pipe be sufficiently wide, and so inclined as readily to restore to the boiler all the water formed by the condensation of the steam. A regulating stop-cock may also be useful in the connecting pipe.

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[1] In Ramsden's machine, the microscopes look horizontally; but their connection with the other parts is so complex that we could scarcely pretend to make them intelligible, without diagrams and a very long detail.

[2] Transactions of the Royal Society of Edinburgh, vol. xiii. p. 354, where it is described at great length, with an account of experiments, which, however, were made chiefly on building materials, from the temperature of 50° Fahrenheit, up to 207°. Some of the results are also given under the article Heat. It is neither said, nor is it at all likely, that the expansion of any of the stones which had a laminar texture was ever tried in the direction perpendicular to the scales or plates composing them. For the specimens being long slender slips or rods, their parts could scarcely have stuck together had their component plates run across. At any rate, the expansion was only tried in one direction, namely, in that which happened to lie in the length of the rod. But there is reason to think that, with the exception of brick, perhaps, and a few other amorphous bodies, almost every building material is likely to expand at different rates in its different linear dimensions. Such is known to be the case with certain bodies, particularly calcareous spar, which is said to expand in one dimension whilst it contracts in another. Now, since some of the marbles which had been heated in these experiments were found to have thereby acquired a permanent increase of length, we have been led to conjecture whether the caverns which abound in calcareous rocks may not be, in a great measure, owing to their having expanded permanently, but at different rates in their different dimensions.

eluc's
ompensat-
g rods.

In order to ascertain the relative expansions of different materials for the construction of compensating pendulums, or what length of one material would by its expansion accurately compensate a certain length of another, Deluc suspended the one bar from an arm projecting horizontally from an upright deal plank; and the other bar he supported by resting its lower end upon a small cock or stage projecting from the lower end of the former bar. Whilst the first or hanging bar, therefore, expanded downward by heat, the second or standing bar expanded upward. A microscope was attached to the plank in such a manner that, while it was constantly supported by an horizontal arm, and directed horizontally to the standing bar, it could be shifted up or down the deal plank. When, therefore, heat was applied to the bars, and, by repeatedly shifting the microscope up or down the plank, a point was found in the standing bar which was neither raised nor depressed by the changes of temperature, the compensation was exact, or the respective lengths of the two bars (reckoning that of the standing bar from its base up to the immoveable point) were inversely as the rates of their expansions. The plank would remain nearly at the same temperature during the experiments, or it might be kept so by such means as are pointed out by the ingenious author, in his account of these and other experiments, described in the *Philosophical Transactions* for 1777. This method, however, Deluc owed to a hint which had been previously given him by Ramsden. A similar process has frequently been employed for testing and adjusting the compensation of the gridiron and other pendulums, after the parts are put together; namely, by finding when the position of a point in the pendulum, situated as near as can be found to the centre of oscillation, is not affected by a change of temperature.

orda's
easuring
les.

In the grand operation of measuring a base for determining the great meridian arc in France, Borda combined metallic measuring rods in such a manner, that they indicated directly of themselves, and with more certainty than could be done with thermometers, their own variations both of temperature and of length. A rule of platina twelve feet long was attached, by one of its extremities, to a rule of brass somewhat shorter, which rested freely on its surface, when placed horizontally. Towards the loose end of the brass rule there were traced on the platina rule very exact linear divisions, the parts of which were millionths of the total length of this rule. This end of the brass rule carried a vernier, whose coincidences with the platina graduations were observed with a microscope. Now the dilatations of the platina being much smaller than those of the brass for the same changes of temperature, the vernier of the brass rule behoved to be incessantly changing its coincidence from one division to another, according as the temperature varied. Borda availed himself of these changes to know at every instant the common temperature of these two bars, and also the ratio of the absolute expansions of the two metals. The values of the vernier divisions, in degrees of the thermometer, had been previously ascertained from noting the change which took place between first surrounding the compound bar with melting ice, and afterwards placing it in boiling water. It was therefore sufficient to read the indications of this metallic thermometer, in order to learn both the actual temperature of the bars in the atmosphere, and also what compensation was to be made in the measuring rods or chains, to reduce their lengths to what they should be at the standard temperature. But, after all, we suspect that if the upper of these rules was at any time more exposed than the lower to the aspect of the sky, it might be somewhat more cooled by radiation; and the sun, again, would have just the opposite effect of heating the upper more than the lower.

Dulong's
and Petit's
experiments.

By means of a simple and ingenious process, Dulong and Petit compared the expansions of the volumes of several solid bodies with those of air and mercury. Having ascertained the absolute dilatation of mercury by heat in respect of the indications of an air-thermometer, from observing the unequal heights at which the mercury stood when at different temperatures in the two legs of an inverted glass syphon, they next measured the apparent dilatation of mercury in a glass tube. The difference gave them the absolute dilatation of the glass. Every kind of glass which they tried was found to dilate at the same rate; a result in which some are not disposed to acquiesce. The dilatation of iron, copper, and platina was determined by placing a rod of each metal of a known volume and weight in the axis of a glass tube shut at one end, and having only a capillary opening left at the other. The remaining space in the tube being then filled up with mercury, the tube was heated to different temperatures, and the quantity of the mercury noted which was in each case expelled from the tube. It is obvious that the volume of the mercury thus driven out is equal to the expansions of the mercury and of the solid metal, minus the expansion of the glass. With the exception of the groundless objections of Mr Crichton, which are noticed farther on, this method of Dulong and Petit is, so far as we know, universally acquiesced in; but since it merely gives the expansion of the volume, there is no reason to think that it can afford accurate data for estimating the linear dilatation of bodies; because it assumes that they expand at precisely the same rate in every direction, or in all their linear dimensions. Indeed, the greater part of the direct experiments on linear expansions which have been put on record, lose much of their value from involving this assumption; for it has been ascertained of certain bodies, that they expand very differently in their different dimensions; and probably something of the sort holds of most bodies. Nay, some are said to contract in one dimension, whilst they expand in another. Besides, every article which has been more or less compressed by having, whilst comparatively cold, undergone such operations as hammering, rolling, or wire-drawing, may, on after exposure to heat, be expected to acquire some permanent enlargement, and one too which, on account of the unequal compression, is likely to be very different in the different dimensions. Many fine astronomical and optical instruments we suspect to be liable to derangement from this source. Various cases of permanent expansions will be found noticed in the course of this article.

Achard's
pyrometer.

Amongst the earlier attempts at ascertaining high temperatures, M. Achard constructed a pyrometer which is quite in the form of a common thermometer. The ball and tube are of semi-transparent porcelain, highly baked. They contain a very fusible alloy, consisting of two parts of bismuth, one of lead, and one of tin, which, though solid at low temperatures, becomes liquid about 212° Fahrenheit; and then, as the heat increases from that upward, it expands in the liquid state similarly to mercury, and is seen through the semi-transparent tube, which is graduated. There seems scarcely any limit to the temperature to which this kind of instrument could be extended, provided only a material could be got for forming a ball and tube which would both bear the heat and also admit of the liquid metal being seen through it. There would be no difficulty of finding a less fusible alloy; and were there no risk of its oxidation or evaporation, it might be put into an open though perfectly opaque tube, in which a float might indicate the extent of the expansion by its top rising above the open end. But it would still be desirable to ascertain, if possible, the value of the degrees of this and every other pyrometer, in terms of the common thermometer.

Air pyrometer.

It is long since the expansion of air had been proposed by M. Schmidt as a measure of high temperatures. This was afterwards suggested by Dr Ure, and still later by Mr Mill, who proposed to employ for that purpose a differential thermometer having one ball and half the tube of platina, and the other ball and half tube of glass. The platina ball being put into the furnace, it is supposed that the instrument would indicate the excess of the heat within over that of the external air. Such might at first sight appear to be a very convenient pyrometer, but it stands greatly in need of improvement; because, unless for small differences of temperature, a differential thermometer cannot continue to give the difference of two thermometers indicating the temperatures of the respective balls. Neither can this method afford data for computing the temperature of the platina ball, unless the temperatures of the other parts were first accurately known, which is far from being the case. For although, to ascertain the temperature of the glass ball with tolerable accuracy, it would only require to be immersed in a bath along with a thermometer, which however could not be so easily done if the whole tube were straight, as proposed by Mr Mill; yet since a large proportion of the included air would necessarily be contained in the tube, it would be next to impossible to allow for its temperature, because that would vary through all the degrees intermediate between the temperatures of the two balls. Perhaps the most correct apparatus yet employed on this principle, and in which precautions are used to avoid the errors now mentioned, is that of Mr Prinsep, described farther on, for ascertaining the melting points of his pyrometric alloys, in terms of the scale of the common air-thermometer. But Schmidt's scheme, as described in Nicholson's *Journal* (vol. xi. p. 141), comes nearer the mark than any of the other two. Schmidt and Mill seem to have taken it for granted that a bulb of platina could be as easily formed as one of glass; but of this Dr Ure probably had some doubt; for he suggests that the platina might be formed into a hollow cylinder having the tube screwed in, like that of a tobacco-pipe. Perhaps the ends, too, might be screwed in. Mr Prinsep's bulb being of gold, could only be used at temperatures below the melting point of that metal.

The determination of the temperature of furnaces is an important question; but until nearly twenty years ago, when Professor Daniell took up the subject, the only instrument in repute for this purpose was Mr Wedgwood's pyrometer; "the indications of which," says Mr Prinsep, "are assumed in every chemical work as authority for some doctrines relative to the scale of temperature which savour of the marvellous, and for others which a slight practical acquaintance with metals and crucibles must at all times have proved to be fallacious." The principle on which this pyrometer depends is vague and uncertain in the extreme, namely, the permanent contraction of certain aluminous clays, when exposed to an intense heat. For it has been found, that the amount of the contraction, even of the same clay, so far from being in exact proportion to the intensity of the heat, as assumed by Mr Wedgwood, depends very much on the duration of the process, so that long-continued exposure to an inferior temperature produces as great a contraction as if the clay had been submitted for a shorter time to a more intense heat. This instrument has of course served its day, and gone into disuse.

There are many igneous operations, such as enamelling, assaying, those of the foundery, &c. which furnish tests, of themselves, on which the workman can generally place considerable confidence, though some of these require to be used with great caution. Thus, the colour which heat produces on the surfaces of metals furnishes a somewhat deceptive criterion of the temperature or temper; because the particular colour depends very much on the duration of the exposure to the heat. For example, a piece of hardened steel may become quite blue, if long enough exposed to a heat which is too low to produce the supposed corresponding effect in tempering or reducing the hardness.

Daniell's pyrometer.

In the *Quarterly Journal of Science* (vol. xi. p. 309), Professor Daniell has described an ingenious instrument, of his own invention, with which he has ascertained the fusing points of various metals, and which has served to overturn the catalogues of high temperatures deduced by means of Wedgwood's pyrometer, and so long occupying a place, with standard authority, in every chemical work.[1] But from the journal just cited it has now become unnecessary to draw any further account of Mr Daniell's pyrometer, because he has since made great improvements upon it, as described by him in the *Philosophical Transactions* for 1830 and 1831, and in his revised version of the same in the *Philosophical Magazine* for 1831 and 1832.

This instrument we regard as a very important one, but still labouring under several imperfections, and susceptible of great improvements, some of which will be particularly noticed, after giving a general description. It consists of two distinct parts: The register, which alone is to be exposed to the heat, and is also to preserve an indication of the expansion of the material under trial; and the scale, which is not so exposed to the heat, but only measures the expansion upon the register after the latter has cooled. The former of these, represented in fig. 1, Plate CCCCXIX. consists of a bar of blacklead earthenware A A, eight inches long, seven tenths broad, and of the same thickness, cut out of a common blacklead crucible. In this is drilled a hole B B, three tenths of an inch in width, and seven and a half inches deep; and about six tenths of an inch in length of the substance of this bar is cut away from its side next the open end at C C, by a plane running along the axis of the bore. When this blacklead register is held upright, and a rod of any material 6·5 inches long is dropped into the bore, it rests against the solid end; and then upon the top of this rod is set a cylindrical piece of porcelain D D, about 1·5 inch long, which Mr Daniell calls the index, and which, projecting into and beyond the open part, is firmly held to its place by a ring or hoop of platina, E E, which, passing round the blacklead bar, and over the piece of porcelain, is made to press upon the latter with any required degree of tension, by means of a small wedge of porcelain, F F, inserted between the bar and the platina ring. When the apparatus, so arranged, is exposed to a high temperature, the expansion of the rod under trial will obviously force the index D forward through a very small space, equal to the excess of its own expansion over that of the blacklead; and after the register has again cooled, the index will be left nearly at the point of greatest elongation. According to Mr Daniell, the exact indication of this amount is not in the least affected by any permanent contraction which the blacklead may undergo at a high temperature, because he assumes any such contraction to occur at the moment of the greatest expansion of the metal, and the index, in consequence, still to mark its point of farthest extension upon this contracted basis. We are not, however, so clear on this point; but admitting it at present, the problem would now consist in the accurate measurement of the distance through which the index has been shifted from its original position. For this purpose, the scale, fig. 2, is constructed of two rules of brass G G and H H, joined together at a right angle by their edges, and fitting square upon two sides of the blacklead bar A A, and of about half its length. From the end of this double rule a small bracket, I, of brass, projects at a right angle, and which, when the two sides of the rules are applied to the two sides of the register, is brought close to the shoulder formed by the notch cut away at its open end, and the whole may thus be steadily adjusted to the blacklead bar by three planes of contact. Upon the outside of this frame, another and much larger brass rule K K, is firmly attached to it by the screws L L. This rule, projecting beyond the frame, and being turned up at the end M, about half an inch, so as to bring that end opposite the cavity in the blacklead bar when applied to it, supports a moveable arm, N, exactly 5·5 inches long, turning, at its fixed extremity, upon a centre near M, and at its other end carrying an arc of a circle O O, accurately divided into degrees and thirds of a degree, whose radius is exactly five inches. At P, the centre of this arc, upon the arm N, and, of course, at the distance of half an inch from the other centre M, turns another lighter arm Q, whose length being five inches, equals the radius of the circular arc O O, and one end of which carries with it a vernier *a*, which moves upon the face of the arc, and thereby subdivides the former graduation into minutes. The other end projects half an inch beyond the centre, P; and at the exact distance of one tenth of the radius P*a*, and which equals the interval between the two centres of motion, it carries an obtuse steel point *b*, turned inwards at a right angle. This part of the apparatus may be regarded as a pair of proportional compasses attached to the end of the brass rule and frame, and whose longer legs N and Q, carrying the arc and vernier, are to the shorter, carrying the point *b*, as ten to one; and the opening of the shorter being regarded as a chord of a small circle, is enlarged in the same proportion by the longer, and measured upon a scale. A small steel spring *m m*, let into the larger arm N, is made to press upon a little pin *n*, in the smaller arm Q, so as to adjust the vernier *a* to the commencement of the graduation; and when forced back, it tends to restore it to its original position. A small lens *i* is represented as folded down, but may, by means of the joints *k* and *l*, be raised to be directly over the vernier, to facilitate the reading of the divisions which coincide.

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[1] Some of these extravagantly high numbers had been previously questioned by Morveau, in the papers which he published on his very imperfect platina pyrometer, in the *Annales de Chimie* for 1803, tome xlvi., and in the *Mémoires de l'Institut* for 1808 and 1811.

In fig. 3, A is an iron tube about two inches in diameter, and closed at the bottom. B is a blacklead tube, closed at the top, and fitted into the mouth of the former one by grinding. C is a smaller blacklead tube projecting from the side of the latter, and likewise fitted in by grinding. The whole forms a kind of alembic, in which mercury may be easily boiled, without either loss, or annoyance to the operator, by the escape of the vapour. When the register containing a rod of some substance under trial was put within the iron tube, and the remaining space filled with mercury, the boiling of the latter served the purpose of a thermometer, showing when the temperature reached about 662° Fahrenheit.

When the expansion of any substance is to be ascertained, a rod of it is to be provided, of such dimensions as will suit the cavity of the blacklead register; and being placed therein, the porcelain index D is to be pressed down upon it, and secured in its place by the platina ring E and porcelain wedge F. The scale part is then to be applied by carefully adjusting the brass rules GG, HH, to the sides of the blacklead, and pressing the cross piece I upon the shoulder. Holding the whole together steadily in the left hand, the moveable arm Q should be so placed that the steel point *b* of the short arm may rest upon the end of the porcelain index D, against which it will be pressed with some force by the spring *m*; then, moving the arm gently forward with the right hand, the point *b* will slide upon the end of the index till it drops into a small cavity formed for its reception, and which is in a line with the axis of the rod under trial in the register and the centre M on the brass rule. The minute of the degree must then be noted, which the vernier *a* indicates upon the graduated arc. A similar measurement must be made after the register has been exposed to an increased temperature and has cooled again; and the number of degrees or minutes which the vernier may then mark, will, by a simple calculation from the known length of the radii and angle, give the length of the chord comprised between the original position of the point *b* and the point to which it has been shifted, namely, the distance over which the index has been moved by the expansion.

But the preceding description, which contains the substance of Mr Daniell's view of the matter, is by no means even theoretically correct in the mode of computing the extent of the expansion. For Mr Daniell assumes that the above-mentioned chord of the small arc intercepted between the two positions of the point *b*, is always accurately in the same direction with the axis of the bore in the blacklead; whereas nothing can be more evident than that it must be owing to mere chance if it is ever so at all. Nor do we know any direct method of insuring that the chord shall have that direction. The problem obviously requires that chord to be reduced to the direction of the bore; and its length so reduced may, in every case, be obtained from considering that it is equal to the sum or difference of the sines of the two arcs which measure the angular deviations of the short arm (or rather of the straight line joining the centre of motion and the point *b*) from being perpendicular to the direction of the bore. But it is obviously by mere chance if the two arcs happen to be equal, so as to have the sum of their sines the same with the chord of their sum, as they are always assumed to be by Mr Daniell. If the graduated arc had its zero placed so as to correspond to the perpendicular position of the shorter arm, the two required arcs could then be more conveniently read off. When these lie on opposite sides of the zero, it is the sum of their sines that is to be used; but should they happen to be both on one side, the difference of their sines is to be taken. But in place of using either sines or chords, it would be preferable greatly to increase the lengths of both arms; and then if sufficient care were taken to have the shorter arm as nearly perpendicular as possible to the direction of the bore, the arc itself comprised between the two positions of the point *b*, from its now subtending a much smaller angle, might generally be taken as the measure of the expansion.

Mr Daniell, as we have seen, though he admits that during an experiment a permanent change may occur in the length of the blacklead, yet alleges that his results are not affected thereby. But since it is in respect of the shoulder at the mouth of the bore as bearing against the bracket I that his measures of expansions are taken, it is evident that the position of the bottom of the bore in respect of that bracket, and consequently the position of the index D in respect of the steel point *b*, must be affected by the full amount of any permanent change in the length of the bore of the register. However, it is equally clear that, were the rules G and H made of sufficient length to admit of the bracket I being placed at their other end, and so as to hold against the closed extremity of the blacklead bar, any permanent change which may have occurred in the length of the latter at the highest temperature, except in the mere thickness of its bottom, would not affect the result. The effect of any change of temperature on the brass rules could easily be allowed for, were it at all worth appreciating.

It will now be sufficiently manifest, without farther explanation, that instead of using Mr Daniell's scale-part, the amount of the expansion, as marked on the register by the index, might be equally well ascertained by the turns of a fine screw, as in Smeaton's pyrometer; or, still more accurately, by means of the microscopes and micrometer, as used with Ramsden's pyrometer, and others of that sort. The expansion might also be approximately measured by putting the register and index transversely between two graduated rules about 8·4 inches apart, and very slightly converging; which is similar to the mode in which Wedgwood measured his clay pieces.

But we suspect that the porcelain index itself must be a source of very considerable error or uncertainty, if its rate of expansion be different from, as it most probably exceeds, that of the blacklead. For, although it is likely that some points of the porcelain and blacklead which were in contact at the highest temperature to which they have been exposed, will continue in contact during and after the cooling, yet we are left quite in the dark as to the situation of these points; and consequently, we have no means of appreciating the length of that part of the index whose expansion is concerned. Nay, a similar uncertainty must, in consequence, attach to the effective length of the blacklead register. By shortening the length of the index, these uncertainties might be expected to be lessened; but it is by no means clear how they could be entirely obviated, except, perhaps, by using an index and wedge which should expand at precisely the same rate as the register does. Could the platina ring be got slightly to hold upon the register without the aid of a wedge, but still in such a manner that all the parts of the ring would slide equally along the register by the pressure of the bar under trial, the ring itself might serve as the index. In that case, instead of cutting away any portion from the side of the register, it would be better merely to cut a longitudinal slit in it, running quite through the axis of the bore, for the purpose of receiving and making room for the motion of a rib to be fixed diametrically in the ring, and upon which the expanding bar under trial could act, so as to move all the parts of the ring equally along the register.

By keeping a rod of platina in the register, exposing it to heats of various intensities, and ascertaining in each case the excess of the expansion of the platina over that of the blacklead, Mr Daniell determined a variety of temperatures in terms of such excess, which, unfortunately, is always a very small quantity, that between 32° and 212° Fahrenheit being counted 180 degrees. These results, though incomparably nearer the truth than those obtained by Wedgwood's pyrometer, must still be more or less tainted with some of the various errors to which we have either already alluded, or which are about to be noticed. But as our limits will by no means admit of fully discussing all the calculations, and attempting to correct them, we beg to refer the reader to the originals; and shall only attempt such an account of the principal sources of error as will sufficiently show the truth and importance of our allegations, which are, besides, applicable to most English books treating on this subject.

In deducing the numerical results from the experiments made with his pyrometer, particularly in computing the expansion of blacklead, Mr Daniell avails himself of the expansions which Dulong and Petit had obtained by the method already noticed, and these he finds to correspond surprisingly with his own. But independently of the doubts already hinted regarding their linear expansions, this agreement, as we shall presently see, argues nothing in favour of either determination; because the comparison has been made through the medium of a serious mistake, as we shall now endeavour to explain. The results of Dulong and Petit just referred to are those of the expansion of mercury and of several solids, given in the *Annales de Chimie* for 1818 (tome vii.), and regarding which they inform us, that the degrees inserted in the first columns of the tables are the upper limits of intervals of temperature, which are each of them reckoned from the freezing point, or 0° cent. Thus, regarding their Table IV., which bears more immediately on the present question, and has 100° and 300° occupying the first column, we are told that it "contains the mean dilatation of iron, copper, and platina, taken at first between 0° cent. and 100°, and then between 0° and 300°." That is to say, the first line of these dilatations contains the 100th part of the whole expansion for the interval between 0° and 100° cent., and the second line the 300th part of the entire expansion for the interval between 0° and 300°. Indeed, it is either expressly mentioned or obviously implied in the course of the Memoir, that every one of their intervals which relate to the expansions in question, is reckoned from the freezing point, and none of them from any higher temperature.

Shortly after Dulong and Petit had published this account of their valuable researches on heat, a translation of it appeared in the Annals of Philosophy (first series, vol. xiii.); and prefixed to the same volume is a Historical Sketch of the Sciences for 1818, which, amongst other things, professes to give an abstract of the principal points treated by Dulong and Petit in the Memoir referred to. But most unfortunately, in this Sketch, which seems to have been hastily got up, the results of these learned foreigners have been sadly misconstrued as far as regards expansion. For the numbers they have given as the upper limits of those intervals of temperature, which are each of them reckoned from the freezing point, are in the Sketch (page xii.) taken as so many points of temperature, at each of which respectively the expansions of the several bodies for one degree, as recorded in the other columns of the tables, take place; a mistake so egregious, that it quite unhinges the thing altogether, because the expansion, instead of being, as in the original, the mean for the whole interval, is thus made to belong to its highest degree alone. Now it would seem to have been somehow or other from this Sketch that Mr Daniell had taken up his leading ideas of the question; at least he has adopted a very similar misconstruction; for, in his Table II., which he gives as equivalent to Dulong and Petit's Table IV. above mentioned, he has, in place of 300° cent. or 540° Fahrenheit, made the second interval to be only equal to the first, which is 100° cent. or 180° Fahrenheit, a sense in which similar temperatures are also erroneously used in the Sketch (p. xii.). The effect of this unfortunate oversight is to make the expansions of iron, copper, and platina, especially that of iron, much smaller in the higher temperatures than Dulong and Petit found them to be; although, for want of data, we can only compute the effect of the error with certainty on the whole interval of 540°, without separating that of the higher temperature from the lower. Thus, Mr Daniell, by means of his very laborious but erroneous mode of computing from the numbers of Dulong and Petit, makes the linear expansion of 6·5 inches of iron, from 32° to 572° Fahrenheit, to be only ·025841887 inch. But the expansion of iron in the unit of volume, as given by Dulong and Petit for that interval, or from 0° to 300° cent., is $\frac{300}{22700}$. Now, one third of this taken as the linear expansion, and multiplied by 6·5, becomes ·028634361 inch. The error or deficiency of the former value is therefore ·002792474, and this would require to be added to ·00878 (Mr Daniell's expansion of 6·5 inches of blacklead), which will increase it to ·01157. But even this last number, if otherwise correct, is still too small, because the expansion above 572° up to the boiling point of mercury, to which he carried that of the blacklead, ought to have been computed at some higher rate, but for which we have no data. Such are specimens of the very erroneous conclusions which the above unfortunate oversight has led Professor Daniell to draw from the experiments of Dulong and Petit.

It seems to be from the same source, the Historical Sketch, that at least nine tenths of all the excerpts or abstracts that have been written in English, of the experiments of Dulong and Petit, are scarcely one whit more correct than the preceding, as far as regards expansion; although we have met with no such misconstruction of them in any foreign work. That such errors were very prevalent in this country, had been briefly noticed by Mr Meikle in the Philosophical Magazine for September 1830; which, if not quite in time to have saved the paper which Mr Daniell inserted in the Philosophical Transactions of that year from the errors in question, must have been sufficiently so for the one of next year, and for his revised version of both afterwards given, with those errors entire, in the Philosophical Magazine. It is no doubt also from the Sketch (page xvii.), that in English books, the specific heat of platina, professedly from Dulong and Petit, is usually made ·0355 at all temperatures, and therefore often regarded as a remarkable exception to the general law; whereas, between 0° and 100°, the mean value should only be ·0335; the larger number ·0355 being the mean for the whole interval between 0° and 300°. But the Sketch contains various other inaccuracies; and some, like the one last noticed, occur also in the English translation of the Memoir.

In noticing the labours of Dulong and Petit, Professor Daniell regrets that those able experimenters had not corrected their final results as to what he considers an important error of calculation, supposed to have been pointed out by Mr Crichton, regarding the expansion of mercury, particularly as employed by Dulong and Petit in determining the expansions of glass and of several metals, in the manner which we have briefly described above. It is, perhaps, rather unusual for writers of eminence to adopt any correction of errors, however important or clearly pointed out; because the public are generally expected to imbibe whatever may emanate from such authorities, and to listen to no insinuations of their being incorrect. But the following considerations will, in a great measure, account for Mr Crichton's corrections not having been adopted:—1*st*, Though it does not seem to be generally known in this country, M. Petit, who had taken the most active part in these valuable researches, particularly in the mathematical investigations and calculations, had died nearly four years before Mr Crichton's paper appeared in the Annals of Philosophy for April 1824; so that M. Petit, who was a young man of great promise, has long been outlived by his senior and distinguished colleague, M. Dulong, whose recent decease science has now to deplore. 2*d*, We have nothing like satisfactory evidence that Dulong and Petit have, after all, employed the erroneous modes of calculation imputed to them; and we shall soon see that, in at least one of these, it is Mr Crichton himself who is in the error. To determine the expansion of mercury in glass, Dulong and Petit filled with that fluid a glass tube which had its open end drawn into a capillary tube; and on heating this from zero up to different temperatures, they weighed the corresponding portions of mercury which were expelled. But they have nowhere said, nor is it so much as even implied in their Memoir, that they held the increase of volume to be in the exact ratio of the weight of mercury expelled, which would be to neglect the expansion of the expelled portion itself. This, however, Mr Crichton assumes that they did; and he thence concludes that they have made the expansion of mercury in glass, when heated up from zero to 100° cent., to be too small in the ratio of 63·8 to 64·8. We have no data for determining how far this supposed error would affect the expansions of the solid bodies operated on by Dulong and Petit; though it would no doubt be to a much smaller extent than that resulting from the above errors, into which Mr Daniell has himself fallen, in the temperatures. However, we find that it would but very slightly derange the indications of a mercurial thermometer up to 300° cent., or 572° Fahrenheit. For example, if Dulong and Petit have been right, the series of centigrade temperatures on the common mercurial thermometer would stand thus: 0°, 100°, 203°·20, 307°·69; and if they have been wrong, 0°, 100°, 203°·25, 307°·82; we mean in respect of those on their air-thermometer taken as uniform.

The preceding is by no means the only error with which Mr Crichton charges Dulong and Petit. Besides other things of which we have no means of judging, he blames them for holding the volume of mercury expelled by heat from the glass tube, to be equal to the absolute expansion of mercury diminished by the expansion of the glass; which, however, is a thing so palpably true, that scarcely any reasoning can make it clearer than it is. But the extreme palpability of this does not prevent Mr Crichton from going on with a process of reasoning *sui generis*, from which he concludes, that the expansion of the glass is much smaller than the difference between the absolute expansion of mercury and its expansion in glass. Since in this Mr Crichton has, without doubt, deceived not only himself, but many of his readers, it may be useful briefly to show how it has been done. In the first place, he has sadly obscured his formulæ, by representing by unity each of two things of very different values, more especially since both enter into the same expression. The one of these is the expansion of mercury in glass, and the other the expansion of the glass alone. The like may be said of his using the term *co-efficient* to mean what other people would call a *denominator*, or, in some cases, a *reciprocal*. But his principal error is, that in order to correct the capacity or contents of the vessel for the expansion of the glass, he makes a deduction, not from its contents as expanded at 100° cent., but from its contents at the freezing point, or at least from 63·8 times what he now uses as the expansion of mercury in glass; and in the preceding part of his paper he had made the contents of the vessel at zero to be just equal to 63·8 times the expansion which mercury seems to undergo in a glass vessel, by being heated from zero to 100° cent. In this case, therefore, the error lies with Mr Crichton himself.

Prinsep's pyrometric alloys.

The principle of the method employed by Mr Prinsep[1] for ascertaining high temperatures, particularly those of furnaces, by means of the least fusible substance each can melt, has already been briefly alluded to, and differs very materially from that of Mr Daniell. The former, which we shall now describe more in detail, was, after trying various plans, fixed upon by Mr Prinsep, as possessing considerable claims to accuracy, and having the great advantage of being identifiable, as he styles it, at any time and in any part of the world. In other words, it can show when the temperatures or intensities in different cases are equal, though it cannot determine in what ratio unequal intensities differ among themselves. The fusing points of pure metals are determinate and constant; they also comprehend a very extensive range of temperature; and the unoxidable or noble metals, gold, silver, and platina, alone embrace a range from the comparatively low melting point of silver up to the high ignition of platina. There are, it is true, only three fixed points in this scale; but between these as many more as are requisite may be interpolated, by alloying those three metals, or rather any two of them together at a time, in different proportions, though the like by no means holds with every kind of alloys. When such a series as that now proposed has been once prepared, the heat of any furnace may be expressed by the alloy of least fusibility which it is just capable of melting. Besides the unity of determinations which such a pyrometer affords, several other advantages might be mentioned: 1*st*, The smallness of the apparatus, nothing more being necessary than a little cupel, containing, in separate cells, eight or ten pyrometric alloys, each of the size of a pin's head; 2*d*, the durability of these alloys, since the specimens melted in one experiment would need only to be flattened by the hammer to be again ready for action, because without some such change of figure it would be uncertain whether they had again been melted or not; and, 3*d*, the facility of notation, since two letters with the decimal of the alloy would express the maximum heat. Thus, S·3G might be used for an alloy of seven tenths of silver with three tenths of gold; and G·23P would express gold containing twenty-three per cent. of platina. As gold melts at a heat not very much above that required by silver, Mr Prinsep assumed only ten degrees between them, distinguishing each degree by a successive addition in the alloy of ten per cent. of gold to the pure silver; the tenth degree being of course denoted by pure gold. These alloys are easily made, and require no comment; but to suit more accurate researches they may be farther subdivided, preserving still, for convenience, the decimal notation. From the fusing point of pure gold up to that of pure platina, Mr Prinsep assumed 100 degrees, adding one per cent. of the latter metal to the alloy for each successive degree. Now, although the melting points of the alloys used by Mr Prinsep apparently bear some relation to the proportions of the pure metals employed; yet, since the melting point of every alloy does not so much as lie between those of its component pure metals, but in many cases is lower than either of them, it must be merely an accidental coincidence, should any of Mr Prinsep's degrees correspond to equal increments of heat. They will, however, as was before observed, always indicate the same intensity; and their absolute values, or even those in terms of the thermometer, being a matter rather of speculation than of practical interest, are to be sought for by other expedients, such as comparing the expansions of a bar of platina with the fusing points of the alloys.

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[1] Philosophical Transactions for 1828, p. 82.

The following are a few trials which Mr Prinsep made with his pyrometric alloys in different furnaces and in different parts of the same furnace. The disparity of heat is greater than might have been supposed; and where, as in assaying the precious metals, so much depends upon the exact temperature at which that operation is performed, it would be useful to know every difference in this respect obtaining in various countries, and its effect upon the quality or standard of bullion. The temperatures are denoted by the least fusible alloys melted in the several cases.

Muffle of an assay furnace, front	S·0G
Muffle of an assay furnace, middle, average	S·3G
Muffle of an assay furnace, behind, average	S·5G
Calcutta charcoal, being better than that of Benares, heats the muffle to	G·04P
Calcutta silver-melting furnaces, of English construction, the specimens being in an iron pot	G·075P
Calcutta open native furnace	G·06P
Calcutta blast-furnace, for melting musters	G·2P
Blacklead table-furnace without chimney	G·08P
Apex of condensed air blowpipe flame	G·2P
Melting point of copper by two trials under a muffle	G·03P
Melting point of cast iron, about	G·3P
Highest heat of a forge with the charcoal of Benares	G·55P

Mr Prinsep says he lays little stress on the melting points of copper or iron, owing to their being tried on such a small scale. The alloys of gold and silver lose in weight by exposure to heat; but they are easily replaced, as the gold may always be again purified. The platina alloys are very durable, but they sometimes gain in weight. Mr Prinsep enters at considerable length into an examination of the changes which the composition of the alloys underwent by repeated fusion; but whether, or to what extent, their melting points may be altered thereby, is a question never once mentioned, though of incomparably more importance to the present subject.

Having explained the means which Mr Prinsep had provided for ascertaining the relative heat of a furnace, we turn to the more interesting portion of his experiments on pyrometric subjects, namely, the determination of the melting points of pure silver, and of its alloys with gold, in degrees of an air-thermometer. But we shall begin with the description of the apparatus employed, which at last satisfied his expectations, and furnished the results presently to be enumerated. In fig. 4, Plate CCCCXIX., it is shown in full operation. A represents a retort or bulb of pure gold, weighing about 6500 grains, and containing nearly ten cubic inches of air. B is a tube also of pure gold, which at its outer end is firmly joined by a small gold collar to a similar tube C, of pure silver; the bore of the latter tube is larger than that of the gold; but to prevent any undue influence from the unequal heating of the air contained in them both, and to confine the operation as much as possible to the gold bulb, the two tubes are nearly filled up by putting in wires of the same metals, so as to leave only a very minute crevice for the air to pass. The outer part of the tube C is kept cool with a wet towel, to protect the stopcocks and flexible tube D. This tube D completes the communication of the air bulb with the glass reservoir E, which is intended as a substitute for an inconvenient length of graduated tube. This reservoir is at first nearly filled with olive oil, and is furnished with a safety tube and bulb F, into which the oil rises when the air of the retort A begins to flow, and has a stopcock below, for the purpose of restoring the equilibrium of pressure, by drawing out a portion of the oil. In the collar of the reservoir E, however, there is another stopcock aperture leading into a graduated glass tube G, in which a small bubble of oil is made to traverse. As this tube was very accurately divided into 200ths of a cubic inch, and may be read off to a tenth of that quantity, the equilibrium of the pressure is capable of very delicate adjustment. The furnance, as the figure exhibits, was situated behind a wall in an adjoining apartment, so as to screen the exterior apparatus entirely from the heat. A small thermometer in the bulb F, however, serves to note any minute change of temperature in the reservoir E. The furnace and muffle need no description, being of the ordinary assay construction. The little pyrometric cupels *p*, *p*, *p*, contain alloys of silver and gold, as already described. Fig. 5 represents one of these cupels on a larger scale, with the lid raised, showing three of the alloys melted, and the rest retaining their previous form.

Out of the numerous experiments which Mr Prinsep made with this apparatus, we have selected the few following results; but for the full details of these and many more, we beg to refer to the original description, where they are given at great length.

No.	Inches.	Inches.	Degrees.	Degrees.	Degrees.	Cupel.
1	7·472	10·410	1492	90	1582	...
2	7·559	10·430	1578	95	1673	...
3	7·106	10·370	1239	95	1334	...
4	7·643	10·442	1644	94	1738	...
5	7·775	10·465	1771	90	1861	S
6	7·620	10·440	1627	91	1718	S
7	7·901	10·480	1917	94	2011	S·4G
8	7·717	10·460	1727	84	1811	S
9	6·876	10·350	1110	84	1194	...
10	7·851	10·475	1863	90	1953	S·3G
11	7·915	10·480	1934	90	2024	S·2G
12	7·836	10·470	1845	85	1930	S·1G
13	7·936	10·490	1959	86	2045	S·3G
14	8·088	10·158	2426	88	2514	S·7G

The second column is the volume, in cubic inches, of the air expelled from the gold bulb, after all corrections. The third gives the contents of the heated gold bulb. The fourth contains the expansion converted into degrees, at the rate of three eighths for 180 degrees. The fifth column shows the temperature of the air. The sixth is the heat of the furnace, being the sum of the fourth and fifth. The seventh shows the heat of the furnace by the pyrometric cupels. The heat, in No. 1, exhibited an orange colour; in No. 2, bright orange; No. 3, bright red; No. 4, bright orange; No. 5, silver wire melted; No. 9, full red heat; No. 10, fresh air was put into the gold bulb; and in No. 11, the cupel at the back of the bulb was S. 3G.

From the construction of the apparatus, it must be evident that the temperature is to be deduced from the measured volume of air expelled from the heated gold bulb; which volume, again, is to be found by the weight of the oil drawn from the reservoir, together with the adjustment of the bubble of oil in the graduated glass tube. The necessary calculation, however, embraces several corrections, some of them of minor effect, and of known and certain influence, as the formulæ for barometrical and thermometrical change, specific gravity of the oil, &c.; others which may affect materially the results, and are by no means so certain in their power, such as the expansion of gold at high temperatures, and the absolute law of gaseous expansion. This last has been treated at considerable length under the article HYGROMETRY (vol. xii. page 114). At high temperatures a very small difference in the quantity of air ejected produces a considerable change in the corresponding temperature; in other words, this air-thermometer has the disadvantage of becoming less sensible, in respect of the scale of the common thermometer, with every increase of heat; for the portion of air which is expelled from the hot bulb must necessarily be cooled to a known point before it can be measured.[1] But this objection, which was started by Mr Prinsep himself, does not apply to his apparatus in respect of a scale of temperature graduated on the idea that air expands in geometrical progression for equal increments of heat, as it has been shown to do in the article just cited. The substitution of a reservoir of oil or mercury in place of a mere graduated tube, is essential where the instrument is to be suddenly thrust into the fire, as the rapid motion of a bubble of liquid in a tube would either, if of oil, leave it as a film lining the tube, or, if of mercury, allow a passage for the air past the side of it. The capacity of the reservoir employed by Mr Prinsep was equal to that of a tube 50 feet long, and of the same bore as the adjusting tube G. But it is evident that a bulb of gold can only be used at temperatures lower than its own melting point, so that the temperatures for the less fusible alloys are left undetermined.

Permanent expansion of cast iron; its connection with the expansion at casting.

In the course of his pyrometric researches, Mr Prinsep repeatedly found that, on heating a cast-iron retort from 80° up to 1800° Fahrenheit, it had, even after having again become cold, acquired each time a permanent enlargement, which, by three successive heatings, amounted to fully a ninth part of its original capacity. Each successive increase, however, was so much less than the preceding, that the first heating did nearly as much in that way as both the other two. It does not appear to have occurred to Mr Prinsep that there is any connection between such an augmentation of volume and the expansion which occurs in the solidification of iron at the casting of it; but we shall now endeavour to show, that they are just parts of one and the same process. It is curious, that in almost every book in which the expansion of iron in congealing is mentioned, it is, without giving so much as the shadow of reason or evidence, said to be momentary or instantaneous. But in many of the innumerable forms of the castings of iron, we have often observed cases occurring which cannot be reconciled with its momentarily expanding in the act of solidification, unless it also continue to expand considerably as long as it is kept very hot; and more especially unless the parts which were first congealed continue to expand whilst they remain in contact with any of the liquid metal. This impossibility of reconciling the phenomena with a momentary expansion is particularly remarkable, when in the structure of the article cast there occurs a massy nucleus of metal with arms or leaves of more slender dimensions proceeding from it. In that case, the interior of the nucleus is generally the last in congealing, and if so, it is almost never quite sound, there being always a deficiency of metal to complete such part of the casting as is last in congealing, which occasions it to be of a spongy texture, and, perhaps, to have cavities in it of a very different sort from those which are really owing to mere air-bubbles. Sometimes a cavity is open through the surface, which may be owing to its occurring so near the outside that the thin crust is depressed or broken quite through by the atmospheric pressure. When a hole is cast through the middle of a massy part of the iron, by means of a previously dried core, the metal next the hole is generally amongst the last in congealing, because such a core has almost no tendency to cool it; and, therefore, owing to the foresaid deficiency of metal, the hole where it passes through the interior is usually wider than the core, and, perhaps, has one or more cavities branching off from it.

Such cases as have now been instanced are of very common occurrence; but to some people they have appeared so very paradoxical as to lead them to deny that any expansion whatever can occur during the casting. At first sight, the sponginess and cavities might, no doubt, be easily accounted for, as some have pretended to do, by supposing iron to *contract*, instead of *expanding*, at the time of congealing. But that an expansion really occurs on that occasion, is so well attested[2] as to be placed beyond any doubt; and, therefore, such expansion, taken in connection with the preceding facts, and the important one noticed by Mr Prinsep, leaves us no alternative but to conclude, that the final deficiency of metal is owing to the exterior crust having, after its own formation, continued to expand, and thereby to acquire a greater capacity within than the mere expansion of the interior parts at the time of their congelation enables them to fill up.[1] The sponginess and cavities which so often occur in the texture of the iron in the interior parts of an unbored cannon, and in those of shot, seem readily referrible to the same source.

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[1] "That the air-thermometer," says Mr Prinsep, "cannot be expected to give indications perfectly accordant, those who have kept registers of the sympiesometer will be ready to grant." But the case of the sympiesometer furnishes no authority on the subject; because one very good reason for its own incongruities is to be found in the faulty mode of correcting it for temperature, which is such that its indications can never keep pace with those of a good barometer, even were it liable to no other objection.

[2] Particularly by Mr Mushet, in the Philosophical Magazine, vol. xviii. p. 1, first series.

Water and iron are usually supposed to follow similar laws of congelation, but their phenomena are certainly very different; for water, in place of continuing to expand, as iron may do, for an indefinite time, seems to cease to expand as soon as it assumes the solid form. We have often observed, that on exposing water in a thin vessel during intense frost, the exterior parts congeal first all around, next the vessel as well as on the top, so as to incase completely the remaining liquid with a crust of ice, which at length bursts, perhaps the vessel too, and part of the water escapes through the fissures. This no doubt is owing partly to the atmospheric pressure having prevented such crust from ever being larger than just to contain the water, and partly to the interior parts expanding subsequently to the crust having ceased to expand; so that, in place of a deficiency, there is here an excess of material within. On the contrary, nothing like bursting ever occurs in the case of iron; though frequently it happens that its more slender parts, in cooling, crack or break spontaneously, from their not having been able to preserve a temperature sufficiently high to continue the permanent part of the expansion so long after congelation as the rest has done, and also from their contracting sooner than the rest by the more sudden cooling. That the temporary part of the whole expansion which obtains in cast iron at a high temperature, is so great as to exceed the permanent part, appears from the subsequent contraction which occurs in cooling, as displayed by the well-known fact, that any lengthy casting is always sensibly shorter than its pattern; notwithstanding that the walls or inner surfaces of the mould, especially when formed of soft materials, have, by yielding to the weight of the liquid iron, and to the just-mentioned permanent part of the expansion, made room for some addition to all the dimensions of the pattern; so that the breadth, thickness, or such other of these dimensions as are small, generally exceed the corresponding ones of the pattern. From Mr Prinsep's experiments, however, we may learn the very important caution, that after trying to what extent any substance has been expanded whilst hot, it should also be ascertained whether any of its dimensions have thereby undergone any permanent change. Some of the stories so often repeated regarding remarkable exceptions to the general laws of expansion, are very likely referrible to this kind of source. Thus, glass vessels have sometimes been observed to acquire a permanent enlargement by long exposure to heat; and, in many researches, such a change in the vessel is apt to be mistaken for one of the opposite sort in any fluid it may contain. The case noticed by Mr Prinsep being that of a little iron retort, the mass would be small and the metal thin; and, therefore, at the time it had been cast, it must have cooled so soon that it could then have had almost no opportunity of continuing to expand permanently after its solidification. Hence, on being afterwards heated by Mr Prinsep, it would likely be in a state to expand so much the more. For, supposing the volume to undergo no change from oxidation or other chemical action, it is probable that long-continued annealing at a high temperature would give to cast iron a volume which it would not afterwards exceed, unless exposed to a still greater heat. On this principle, it might be supposed that a sufficient annealing might expand all the parts in the same ratio, and thereby ultimately fill up all the vacancies of the interior; but the rigidity of the iron puts this out of the question; and at any rate, granting that the annealing did bring the parts quite close together, they would not likely be united by cohesion at a heat so far below that required for welding.

The preceding view of the subject, we presume, will be found to trace to a common source, and thereby to reconcile in a satisfactory manner, the various phenomena above mentioned, which depend upon the permanent expansion of cast iron, and have so often been regarded as paradoxical. The continued enlargement of the crust is most probably owing to some change of texture or arrangement, such as crystallization occurring not only, as is usually supposed, at the instant of congelation, and perhaps, too, before it, but continuing to go on in the solid part of the iron for a long while after, if it be kept sufficiently hot; and the nature of the mould very likely modifies this result, as it certainly does several others. Thus, a piece of iron cast in a metallic mould, being more suddenly cooled than if cast in sand, is much harder, and has, besides, a very different texture. But whilst it is not improbable that the contact of the metallic mould may be equally or more favourable to a particular arrangement of the particles, such process will be so much the sooner stifled by the more sudden cooling. As to wrought iron, its fracture sometimes exhibits a crystalline texture, which is a particularly bad symptom of its strength, but one, perhaps, which may have some connection with a permanent expansion. Bismuth and antimony are known to expand at the time of congealing; but how closely in this respect they may resemble cast iron, has not, as far as we know, been ascertained. (E. E. E.)

PYROPHORUS, formed of πυρ, *fire*, and φερω, *I bear*, the name usually given to a chemical preparation which possesses the singular property of kindling spontaneously when exposed to the open air, or when breathed upon. There are various kinds of pyrophorus.

PYROTECHNY, from πυρ, *fire*, and τέχνη, *art*. The usual modern meaning of the word is the art of making fireworks, and of disposing them to the best advantage when exhibited on occasions of rejoicing, or in theatres, gardens, and other places. A moment's consideration will show how very comprehensive a term *pyrotechny* may become if extended to all operations in which the skilful management of fire is required. It was anciently confined chiefly to alchemy, or incipient chemistry.[2]

Under the term pyrotechny we may properly enough include the making of the different sorts of gunpowder, and the preparation of all those combustible or detonating materials and projectiles used in war; but then it should be distinguished by the adjunct *military*. Military pyrotechny will then serve only to indicate a portion of one of the most deplorable arts ever invented, that is, the art of war. The miserable necessity of this art is, however, a matter of daily experience in the present state of human nature and unsocial relations; also the unhappy and slavish condition of all nations which are not able, by skill in this diabolical art, to resist effectually the aggressions of their invaders.[1]

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[1] Mr Prinsep not only never hints at there being any connection between the expansion which occurs in casting, and that which he observed; but the following quotation from the Philosophical Transactions for 1828, page 87, besides being curious, and the only remark he has made on the subject, sufficiently shows that he had no idea of the nature of the latter increase. "The augmentation," says he, "which is more remarkable, exceeds the dilatation due to the temperature to which it was exposed; for as iron expands ·0105 in 180 degrees, the increase of bulk upon 10 cubic inches should be ·105 × 3 = ·315 at 1800° Fahrenheit, or near the melting point of silver; whence it may be concluded that the dilatation of iron is not equable, as has been also proved by Messrs Dulong and Petit." We shall only add, that the experiments of these distinguished foreigners having been made on wrought iron, it is very doubtful if they bear on the question of permanent expansion.

[2] See Davidson's *Philosophia Pyrotechnica*, &c. 1635; and G. Starkey's Pyrotechny Asserted and Illustrated, &c. 1658.

We do not mean to give an account of the various substances, mixtures, and manipulations necessary in the construction of different fire-works; but, for the reader's amusement and instruction, we shall mention a few things which are not generally known, and then conclude with the titles of a few works upon pyrotechny.

The combinations of the different substances employed in the pyrotechny connected with fire-works ought to be guided by a chemical knowledge of these substances. The want of this knowledge causes most of our fire-workers to compound ineffective mixtures, and to follow old and absurd recipes. Great skill in pyrotechny, in its more general sense, was possessed by the Chinese long before the art was known in Europe. The invention of gunpowder seems to be due to them, and perhaps also the invention of fire-works. All those persons we ever conversed with who had been in China, concurred in assuring us that the Chinese fire-works are at this day quite unrivalled in variety, splendour, and beauty. In the account of Lord Macartney's Embassy to China there is an amusing passage describing the contempt of the Chinese for the best English fire-works that were exhibited to them, and the astonishment of the embassy on witnessing the superb display of fire-works given by the Chinese in return. The most imposing exhibitions of European fire-works used to be those that took place annually at Rome, during certain holidays, on the ramparts of the Castle of St Angelo.

We shall now give a very few notices of practical pyrotechny.

Lightning.—The fine seeds of the *lycopodium clavatum*, or common club-moss, are extremely inflammable, and are used in theatres to imitate a vivid flash of lightning, by blowing them from a tube, &c. through the flame of a lamp, &c. These seeds are also used in the composition of some fire-works.

Red Fire.—The nitrate of strontia is the chief ingredient in the composition. A beautiful purplish flame is produced by a composition containing chlorate of strontia. To aid in reddening the flame of the former composition, a little lamp-black of the finest quality is generally used; for a red jet of fire from a paper-case formed like that of a serpent, or of a Roman candle, &c., fifteen parts of pulverized gunpowder and four parts of dry nitrate of strontia; a slow and bright-red fire, forty parts of nitrate of strontia, thirteen of pulverized sulphur, five of chlorate of potash, and four of sulphuret of antimony. In this last mixture, to avoid the danger of premature combustion, the chlorate of potash must not be ground in a mortar with the other ingredients, but ground separately, and afterwards mixed with them by shaking and stirring upon a sheet of paper.

Green Fire.—Seventy-seven parts of nitrate of barytes, thirteen of pulverized sulphur, five of chlorate of potash, three of charcoal in powder, and two of pure arsenic. The same precautions to be taken as before with regard to the chlorate of potash. The effect of this composition, when burned on the stage of a theatre, is to give a cadaverous and unearthly aspect to the actors. It occurred to us many years ago, that an extension of some of the effects of De Loutherbourg's *Eidophusikon* might be easily and effectively adapted to the stage. Where the foot-lights are, or else above the proscenium or front of the stage, an apparatus might be contrived to throw variously-coloured lights upon the actors and the scenery in the representation of magical incantations, supernatural appearances, &c. The disposition and reflection of these variously-coloured lights might be diversified in such a manner as to produce the most singular contrasts and unexpected effects.

Brilliant and sparkling jets of Fire.—These are produced from compositions rammed into paper-cases of various sizes. One of these compositions may consist of eighteen parts of pulverized gunpowder, five of bright steel-filings, and two of saltpetre; another of sixteen parts of pulverized gunpowder, seven of steel-filings, one of saltpetre, and one of sulphur.

Sparks.—The composition for these is mixed with pure alcohol. Small pellets of cotton are steeped in this mixture, and dried, after rolling them in pulverized gunpowder.

Stars.—Very brilliant stars, such as we see issue from sky-rockets, Roman candles, &c., may be made from a composition of one part of alcohol, one of antimony in powder, two of pounded crystal, one of gum-arabic, two of pulverized gunpowder, fifteen of saltpetre, six of sulphur, and two of zinc-filings. The composition for these and other stars is made into a stiff paste with alcohol, and then cut into small cylindrical or square pieces, which are rolled in pulverized gunpowder, and dried in the shade.

Brilliant Chinese Fire.—Four parts of charcoal, five of pounded cast iron, eight of pulverized gunpowder, six of saltpetre, six of sulphur; or three parts of pounded cast iron, eight of pulverized gunpowder, two of saltpetre, and one of sulphur; all rammed into paper-cases or other cases.

Jasmine Flowers.—This beautiful fire is generally seen in the vertical fire-wheels, &c. When the composition is well made, the sparks drop down somewhat like burning flowers of the jasmine. Its excellence depends chiefly on the use, in the composition, of bright filings or raspings from the steel-springs of clocks or watches, carefully deprived of all the finer dust that may be amongst them. The minute shavings of steel, procured from turners in metal, may also be used. Compositions for this kind of fire, six parts of steel-filings or shavings, sixteen of pulverized gunpowder, one of saltpetre, one of sulphur; or five parts of same filings, &c., sixteen of pulverized gunpowder, one of saltpetre, one of sulphur; or four parts of filings, twenty of pulverized gunpowder, one of saltpetre, one of sulphur, and four of zinc-filings or raspings, or pounded zinc rendered pulverizable by being heated to about 205 of the centigrade scale. The compositions for the Chinese fire and the jasmine flowers are to be mixed up in the same manner. The sulphur, the pounded cast iron, or the steel-filings, are mixed with the addition of a little pure alcohol, and then the other ingredients are added. It must be observed, that the size of the particles of pounded cast iron or of steel-filings should be proportioned to the size of the cases that are to be filled with the composition; the smallest filings, &c. being used for the smallest cases.

Bengal Lights.—The common ones are made of one part of antimony, five of saltpetre, and two of sulphur; the sparkling ones, of one part of antimony, two of fulminating composition (of fulminating mercury and gunpowder), four of saltpetre, and four of sulphur; or one, two, five, two parts of the same ingredients in their order; or one, two, six, one parts of the same in their order. Vases are filled with these compositions, a light gunpowder dust sprinkled over the top, and the whole closed up by a piece of paper pierced with some holes from which pieces of quick-match project. These lights may be made of any size. They sometimes weigh upwards of 200 pounds.

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[1] See the articles GUNNERY, GUNPOWDER, PROJECTILES, WAR.

It is necessary to warn the reader that fulminating mercury requires great caution in handling it; and, as it is so apt to explode, it had better be left out of the composition for these lights, or any other fire-works. Indeed the pyrotechnist has need to exercise the greatest possible caution in all his operations. For instance, it may, in ignorance, be imagined that no harm can happen from pounding gunpowder in a mortar along with iron or steel-filings, &c. and yet the most serious accidents may result from manipulations of this kind incautiously conducted.

One of the most formidable pyrotechnical inventions is the Congreve rocket. We have conversed with some officers who served in the war against the Burmese, and they described the effect of these rockets as appaling, not only to the Burmese, but even to the stout-hearted Britons who fired them off.

Without entering into any very minute description of the process of making such popular fire-works as the common sky-rocket, the Roman candle, &c. we shall content ourselves with a brief account of the general construction of these two. The common sky-rocket consists of a strong paper or thin pasteboard case, the lower end of which, where the cotton quick-match is inserted, is drawn so close by means of a cord as to leave only a circular opening of about one third of the interior diameter of the case. This is technically called *choking* the case. The case, when dried after pasting, is placed in a hollow cylinder of wood, into which it fits. This mould is furnished with a moveable bottom having a central nipple and a tapering spike of iron, which last, entering the aperture at the lower end of the case, rises within it nearly to the top. The space left round this spike is filled gradually, and by repeated blows from a mallet upon a hollow rammer, with a composition of pulverized gunpowder, saltpetre, and charcoal, or of sixteen parts of saltpetre, twelve of elm charcoal, and four of purified flour of sulphur. The rammer, which fits the inner diameter of the case, and to which the mallet is applied, has in its centre a deep hollow adapted to the iron spike before mentioned. The composition which forms the charge of the case must be put in by small quantities at a time, and driven down compactly by regulated blows of the mallet upon the rammer. The filling of the case in this manner requires skill and experience, because if the charge is not uniformly compacted in the case, the rocket will not rise evenly and regularly. When the charge has been driven a little higher than the top of the spike, a round piece of doubled paper is put in; and upon this one half of the inner paper of the remainder of the case is folded down and rammed firmly, so as to close the case. This plug is then pierced with a few holes, and above it are placed, along with some of the composition, or with some gunpowder, the stars, sparks, &c. that are intended to appear when the rocket has reached its highest ascent. The top of the case is then covered in, and fitted with a paper cone. In signal-rockets, that are intended to end with a report without stars, &c. the round piece of double paper before mentioned is pierced with a hole in the centre, and a little gunpowder is pressed firmly in above it, but without crushing the grains. The top of the case is then choked *close*, and the paper cone fitted on. In some other rockets that contain what are called *decorations*, that is, stars, sparks, serpents, crackers, &c., these are placed with meal-powder in a wider cylindrical case, which is fitted to the top of the case containing the charge. These rockets are also terminated by a conical cap. We may remark, that in our common rockets the conical cap is not sufficiently stiff to maintain its form invariably, and so to aid in the regular ascent of the rocket. The balance-stick has next to be fastened to the rocket. The length, thickness, and weight of this stick, require calculation to suit it to the dimensions and weight of the case. On the Continent, rockets have been made to ascend without sticks by means of a triangle of pasteboard passing round the case, or by means of three pasteboard wings glued to the case. Each of these wings forms an isosceles triangle, in height six interior diameters of the rocket-case, and a little more than two of these diameters at the base. Each of these wings must be glued on quite parallel to the axis of the case, otherwise the flight of the rocket will be irregular. A short stick with similar wings has also been employed for rocket-cases. It is stated that all these winged rockets rose beautifully, even in a violent wind and bad weather; but some allowance must surely be made for the lateral action upon them of a strong wind.

The Roman candle consists of a strong case of paper or of thin pasteboard, which is completely closed at the lower end. It is generally charged with the same composition as sky-rocket cases, alternating with gunpowder and stars, as follows: First a small quantity of composition is placed at the bottom of the case, and rammed down compactly by a rammer and mallet; next a small quantity of gunpowder, and above that a star without any ramming, but a gentle push to secure the contact of the star with the gunpowder; then a quantity of the composition, which is rammed down as before; next a little more gunpowder and a star, and then more composition rammed down; and so on till the case is filled. The case is then closed by a piece of paper-match pasted round the outside, and twisted to a point at the top. The charges of Roman candles might be diversified by variously-coloured fires and stars, &c.

The reader may consult the works of which the titles are subjoined. *Essai sur les Feux d'Artifice pour le Spectacle et pour la Guerre*, Paris, 1750; *Manuel de l'Artificier*, Paris, 1757; *L'Art de faire à peu de frais les Feux d'Artifice*, Paris, 1828; *Manuel de l'Artificier*, par A. D. Vergnaud, Paris, 1828. (G. F. G.)

PYROTICS, in *Medicine*, caustics or remedies either actually or potentially hot, and which accordingly will burn the flesh, and raise an eschar.

PYRRHICA, in *Antiquity*, a kind of exercise on horseback, or a feigned combat, for the exercise of the cavalry. It was so called from its inventor Pyrrhichus or Pyrrhus of Cydonia, who first taught the Cretans to march in measure and cadence to battle, and to observe the Pyrrhic pace. Others derive the name from Pyrrhus the son of Achilles, who instituted this exercise at the obsequies of his father; but Aristotle says that it was Achilles himself who invented it. The Romans called it *ludus Trojanus*, the Trojan games; and Aulus Gellius, *decursus*. It is doubtless this exercise which we see represented on medals by two cavaliers in front running with lances, and the word *decursio* on the exergue.

PYRRHICHIUS, in Greek and Latin poetry, a foot consisting of two syllables, both short, as *Deus*. Amongst the ancients this foot was also called *periambus*, and by some *hegemona*.

PYRRHO, the founder of a school of philosophy, was the son of Pleistarchus, a native of Elis, and flourished B. C. 336, in the time of Philip the Great. He was originally a painter, but subsequently devoted himself to the study of philosophy, having been the pupil of Anaxarchus, whom he attended to India. There he became acquainted with the magi of Persia and the gymnosophists of India. On his return to Greece he acquired great renown, and was presented by the Athenians with the freedom of their city. He lived to the age of ninety. Pyrrho was the chief advocate of the sceptical school of philosophy; and from him all those who adhered to such doctrines were called Pyrrhonists. He denied that it could be proved that there was any thing in itself just or unjust, honourable or dishonourable. He considered every action and event as indifferent, and carried this idea so far as to assert that he saw no difference between life and death. It is said that he showed no fear of death when the vessel in which he was sailing was threatened with shipwreck, and pointed to a pig, which was feeding in the utmost unconcern, remarking, that such ought to be the security of the wise man. The principle of his philosophy was, that there existed no motive for belief to which one cannot oppose a doubt of equal weight. Thus he affirmed nothing, and denied nothing. Amongst his disciples were Timon of Phlius, and Nausiphanes, who taught Epicurus. The life of Pyrrho has been written by Sextus Empiricus, and by Diogenes Laertius.

PYRRHUS, the name of two kings of Epirus. See EPIRUS.

PYTHAGORAS, a celebrated philosopher of antiquity, but one respecting the time and place of whose birth the learned are much divided. Eratosthenes asserts, that in the 48th Olympiad, about 588 years before Christ, when still very young, he was a victor at the Olympic games. Hence Dr Bentley[1] determines the date of his birth to be the fourth year of the 43d Olympiad; whilst Lloyd,[2] who denies that the Olympic victor was the same person with the philosopher, places it about the third year of the 48th Olympiad. Mr Dodwell[3] differs from both, and wishes to fix the birth of Pythagoras in the fourth year of the 52d Olympiad. Of the arguments of these learned writers, Le Clerc has given a summary in the *Bibliothèque Choisie* (tom. x. p. 81, *et seq.*); and from a review of the whole, it would appear that he was not born earlier than the fourth year of the 43d Olympiad, or later than the fourth year of the 52d; but in what particular year of that period his birth took place, cannot with any degree of certainty be ascertained. It is generally believed that he was born in the island of Samos, and that he flourished about five hundred years before Christ, in the time of Tarquin, the last king of Rome.[4] His father, Mnesarchus, who is supposed by some to have been a lapidary, and by others a merchant of Tyre, appears to have been a man of some distinction, and to have bestowed upon his son the best education.

Jamblicus[5] relates a number of wonderful stories respecting the descent of Pythagoras from Jupiter, as well as in regard to his birth and early life; and represents him even in his youth as a prodigy of wisdom and manly seriousness. But most of these idle tales confute themselves, and prove nothing but the credulity, carelessness, and prejudice of their author. Of his childhood and early education we know nothing, except that he was first instructed in his own country by Creophilus, and afterwards in Scyrus by Pherecydes. According to the custom of the times, he was made acquainted with poetry and music; eloquence and astronomy became his private studies; and in gymnastic exercises he often bore the palm for strength and dexterity. He first distinguished himself in Greece at the Olympic games, where, besides gaining the prize, he is said to have excited the highest admiration by the elegance and dignity of his person, and the brilliancy of his understanding.

Soon after his public appearance at these games, Pythagoras commenced his travels in quest of knowledge. He first visited Egypt, where, through the interest of Polycrates, tyrant of Samos, he obtained the patronage of Amasis king of Egypt, by whose influence, combined with his own assiduity, patience, and perseverance, he at length won the confidence of the priests, from whom he learned their sacred mysteries, theology, and the whole system of symbolical learning. In Egypt, too, he became acquainted with geometry and the true solar system; and, before he left that country, he had made himself master of all the learning for which it was so famed amongs the nations of antiquity. He afterwards visited Persia and Chaldæa, where from the Magi he learned divination, the art of interpreting dreams, and the science of astronomy. He is likewise said to have travelled into India, conversed with the Gymnosophists, and acquired from them a knowledge of the philosophy and literature of the East; and such was his ardour in the pursuit of science, that, according to Cicero,[6] he crossed many seas, and travelled on foot through many barbarous nations, in prosecution of his researches.

After Pythagoras had spent many years in gathering information on every subject, especially respecting the nature of the gods, the rites of religion, and the immortality of the human soul, he returned to his native island, and attempted to render his knowledge useful by there instituting a school for the instruction of his countrymen. Failing of success in this laudable undertaking, he repaired to Delos, where he pretended to receive moral dogmas from the priestess of Apollo. He then visited Crete, where he was initiated into the most sacred mysteries of Greece. He likewise repaired to Sparta and Elis, and again assisted at the Olympic games, where in the public assembly he was saluted with the title of *sophist* or wise man, which he declined for one more humble, namely, that of *philosopher*, or lover of wisdom. Having returned to Samos enriched with mythological learning and esoteric rites, he again instituted a school in that island. His mysterious symbols and oracular precepts rendered this attempt more successful than the former had been; but meeting with some opposition, or being detected in some pious frauds, he suddenly left Samos, and, retiring to Magna Græcia, settled at Crotona.

Here Pythagoras founded the Italic sect, nor was it long ere his mental and personal accomplishments, the fame of his distant travels, and his Olympic crown, procured him numerous pupils. His bold and manly eloquence and his graceful delivery attracted the most dissolute, and produced a remarkable change in the morals of the people of Crotona. His influence was increased by the regularity of his own example, and its conformity to his precepts. He punctually attended the temples of the gods, and paid his devotions at an early hour; he lived upon the purest and most innocent food, clothed himself like the priests of Egypt, and, by his continual purifications and regular offerings, appeared to be superior in sanctity to the rest of mankind. He endeavoured to assuage the passions of his scholars by means of verses and numbers, and made a practice of composing his own mind every morning, by playing on the harp, and singing along with it the pæans of Thales. To avoid the temptations of ease and the seductions of idleness, bodily exercises also formed a considerable part of his scheme of discipline.

At Crotona he had a public school for the general benefit of the people, in which he taught them their duty, praising virtue, condemning vice, and particularly instructing them in the duties of social life. Besides this, he had a college in his own house, which he denominated κοινοβιον, in which there were two classes of students; the ἐξωτερικοι, who were also called *auscultantes*, and the ἐσωτερικοι. The former of these were neophytes, and were kept under a long probation. A silence of five years was imposed upon them, which Apuleius thinks was intended to teach them modesty and attention; but Clemens Alexandrinus is of opinion that it was for the purpose of abstracting their minds from sensible objects, and inuring them to the pure contemplation of the Deity. The latter class of scholars were called *genuini*, *perfecti*, *mathematici*, and, by way of eminence, Pythagoreans. They alone were admitted to the knowledge of the arcana of the Pythagorean discipline, and were taught the use of ciphers and hieroglyphical writings.

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[1] Dissertation on the Epistles of Phalaris.

[2] Chron. of Pythagoras.

[3] Two Dissertations on the age of Phalereus and Pythagoras.

[4] *Quæst. Tusc.* lib. iv. cap. 1.

[5] *Vit. Pythag.* 6, n.

[6] *De Finibus*, lib. iv. sect. 29.

Clemens observes, that these orders corresponded very exactly to those amongst the Hebrews. For in the schools of the prophets there were two classes; the sons of the prophets, who were the scholars, and the doctors or masters, who were also called *perfecti*, and, amongst the Levites, the novices or tyros, who had their quinquennial exercises, by way of preparation. Lastly, even amongst the proselytes there were two orders; *exoterisci*, or proselytes of the gate, and *intrinseci* or *perfecti*, proselytes of the covenant. It is highly probable, he adds, that Pythagoras himself had been a proselyte of the gate, if not of the covenant. Gale endeavours to prove that Pythagoras borrowed his philosophy from the Jews; and with this view he produces the authorities of many fathers and ancient authors, and even points out traces of Moses in several parts of Pythagoras's doctrine. But the learned author was, we believe, misled by the Christian Platonists.

The authority of Pythagoras amongst his pupils was so great that it was even deemed a crime to dispute his word; and their arguments were considered as infallibly convincing, if they could enforce them by adding that "the master said so," an expression which afterwards became proverbial, *jurare in verba magistri*. This influence over his school was soon extended to the world, and even his pupils themselves divided with their master the applause and approbation of the people; whilst the rulers and the legislators of all the principal towns of Greece, and Sicily, and Italy, boasted of being the disciples of Pythagoras. To give more weight to his exhortations, as some writers mention, Pythagoras retired into a subterranean cave, where his mother sent him intelligence of everything which happened during his absence. After a certain number of months he again re-appeared on the earth with a grim and ghastly countenance, and declared in the assembly of the people that he was just returned from the shades. From similar exaggerations, it has been asserted that he appeared at the Olympic games with a golden thigh; that he could write whatever he pleased in letters of blood on a looking-glass; and that by setting it opposite to the moon, when full, all the characters which were on the glass became legible on the moon's disc. They also relate, that by some magical words he tamed a bear, stopped the flight of an eagle, and appeared on the same day and at the same instant of time in the cities of Crotona and Metapontum.

At length his singular doctrines, and perhaps his strenuously asserting the rights of the people against their tyrannical governors, excited a spirit of jealousy, and raised against him a powerful party, which soon became so outrageous as to oblige him to fly for his life. His friends withdrew to Rhegium; and he himself, after being refused protection by the Locrians, fled to Metapontum, where he was obliged to take refuge in the temple of the Muses, and where it is said he died of hunger, about 497 years before Christ. Respecting the time, place, and manner of his death, however, there are various opinions, and many think it uncertain when, where, or in what manner he ended his days. After his death his followers paid him the same respect they would have done to the immortal gods; they erected statues in his honour, converted his house at Crotona into a temple to Ceres, appealed to him as a deity, and even swore by his name.

Pythagoras married Theano of Crotona, or, according to others, of Crete, by whom he had two sons, Telauges and Mnesarchus, who, after his death, took care of his school. He is also said to have had a daughter called Damo.

Whether he left any writings behind him is disputed. It seems probable, however, that he left none, and that such as went under his name were written by some of his followers. The *golden verses* which Hierocles has illustrated with a commentary, have been ascribed to Epicharmus or Empedocles, and contain a brief summary of his popular doctrines. From this circumstance, and from the mysterious secrecy with which he taught, our information concerning his doctrine and philosophy is very uncertain, and cannot always be depended upon.

The main purpose of philosophy, according to the system of Pythagoras, is to free the mind from encumbrances, and to raise it to the contemplation of immutable truth and the knowledge of divine and spiritual objects. To bring the mind to this state of perfection is a work of some difficulty, and requires a variety of intermediate steps. Mathematical science was with him the first step to wisdom, because it inures the mind to contemplation, and takes a middle course between corporeal and incorporeal beings. The whole science he divided into two parts, numbers and magnitude; and each of these he subdivided into two others, the former into arithmetic and music, and the latter into magnitude at rest and magnitude in motion, the one comprehending geometry and the other astronomy. Arithmetic he regarded as the noblest science, and an acquaintance with numbers as the highest good. He considered numbers as the principles of everything, and divided them into scientific and intelligible. Scientific number is the production of the powers involved in unity, and its return to the same. Number is not infinite, but it is the source of that infinite divisibility into equal parts which is the property of all bodies. Intelligible numbers are those which existed in the divine mind before all things. They are the model or archetype of the world, and the cause of the essence of beings. Of the monad, duad, triad, tetrad, and decad, various explanations have been given by different authors; but nothing certain or important is known of them. In all probability numbers were used by Pythagoras as symbolical representations of the first principles and forms of nature, especially of those eternal and immutable essences which Plato denominated ideas; and in this case the monad was the simple root from which he conceived numbers to proceed, and, as such, analogous to the simple essence of Deity, from whom, according to his system, the various properties of nature are derived.

Music followed numbers, and was held as useful in raising the mind above the dominion of the passions. Pythagoras considered it as a science to be reduced to mathematical principles and proportions, and is said to have discovered the musical chords from the circumstance of several men successively striking with hammers a piece of heated iron upon an anvil. This story Dr Burney[1] discredits, but at the same time allows, from the uniform testimony of writers ancient and modern, that he invented the *harmonical canon*, or monochord. The music of the spheres, of which every one has heard, was a most fanciful doctrine of Pythagoras. It was produced, he imagined, by the planets striking on the ether through which in their motion they passed; wherefore he considered their musical proportions as exact, and their harmony perfect.

Pythagoras, as we have already seen, learned geometry in Egypt; but, by investigating many new theorems, and by digesting its principles, he reduced it to a more regular science. A geometrical point, which he defines to be a monad, or unity with position, he says corresponds to unity in arithmetic, a line to two, a superficies to three, and a solid to four. He discovered several of the propositions of Euclid; and on discovering the 47th of the first book, he is said to have offered a hecatomb to the gods; but as he was averse to animal sacrifices, this assertion is most probably false.

Wisdom, according to Pythagoras, is conversant with those objects which are naturally immutable, eternal, and incorruptible; and its end is to assimilate the human mind to the divine, and to qualify us to join the assembly of the immortals. Active and moral philosophy prescribes rules and precepts for the conduct of life, and leads us to the practice of public and of private virtue. On these heads many of his precepts were excellent, whilst some of them were whimsical and useless. Theoretical philosophy treats of nature and its origin, and is, according to Pythagoras, the highest object of study. It included all the profound mysteries which he taught, of which but little is now known. God he considers as the universal mind, diffused throughout all things, and the self-moving principle of all things (αὐτοματισμος τῶν παντῶν), and of whom every human soul is a portion.[1] It is very probable that he conceived of the Deity as a subtile fire, eternal, active, and intelligent; which is not inconsistent with the idea of incorporeality, as the ancients understood that term. This Deity was primarily combined with the chaotic mass of passive matter, but he had the power of separating himself, and since the separation he has remained distinct. The learned Cudworth contends that Pythagoras maintained a trinity of hypostases in the divine nature, similar to the Platonic triad. We cannot say that his arguments appear to have much force; but we think the conclusion which he wishes to establish extremely probable, as Plato certainly drew his doctrine from some of the countries which Pythagoras had visited before him.

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[1] History of Music, vol. i. p. 441.

Subordinate to the Deity there were in the Pythagorean creed three orders of intelligences; gods, demons, and heroes, of different degrees of excellence and dignity. These, together with the human soul, were considered as emanations from the Deity, the particles of subtile ether assuming a grosser clothing the farther they receded from the divine fountain. Hierocles defines a hero to be a rational mind united with a luminous body. God himself was represented under the notion of monad, and the subordinate intelligences as numbers derived from and included in unity. Man is considered as consisting of an elementary nature and a divine or rational soul. His soul, a self-moving principle, is composed of two parts; the rational, seated in the brain, and the irrational, including the passions, in the heart. In both these respects he participates with the brutes, whom the temperament of their body and other circumstances allow not to act rationally. The sensitive soul perishes; the other assumes an ethereal vehicle, and passes to the region of the dead, till sent back to the earth to inhabit some other body, brutal or human. It was unquestionably this notion which led Pythagoras and his followers to deny themselves the use of flesh, and to be so peculiarly merciful to animals of every description. Some authors, however, say that flesh and beans, the use of which he also forbade, were prohibited because he supposed them to have been produced from the same putrefied matter out of which, at the creation of the world, man was formed.

The scantiness and uncertainty of our information respecting Pythagoras renders a regular and complete account of his life and doctrines impossible. A modern author,[2] of profound erudition, pronounces him to have been unquestionably the wisest man that ever lived, if his masters the Egyptian priests must not be excepted. This is perhaps saying too much; but that he was one of the most distinguished philosophers of antiquity, or, as Cicero expresses it, *vir præstanti sapientia*, appears very evident; and his moral character has never been impeached. The mysterious air which he threw over his doctrines, and the apparent inanity of some of his symbols, have indeed subjected him to the charge of imposture; and perhaps the charge is not wholly groundless. But when we consider the age in which he lived, and the nature of the people with whom he had to deal, and who would in all probability have resisted more open innovations, even this will not appear so blameable as at first sight we are apt to think it; and it is worthy of notice, that the worst stories of this kind have come down to us in a very questionable shape, and show every appearance of being fabulous.

PYTHAGOREANS, a sect of ancient philosophers, so called from their being the followers of Pythagoras.

PYTHEAS, an ancient navigator, was a native of Marseilles, and is supposed to have lived some time about the age of Alexander the Great, 330 B. C. We have no information respecting the private circumstances of his life; but we know that he explored the northern seas of Europe, though the ancient geographers appear to have placed little dependence on the statements which he made. Both Polybius and Strabo treat him with great severity, and ridicule his accounts as absurd and incredible. It would appear that he sailed through the English Channel, and, after a voyage of six days to the north, reached an island which he calls Thule, where he says that the sun never descends below the horizon for a certain period at the summer solstice. This statement would apply to Iceland, but then it seems unlikely that he could reach that island within six days. He next sailed to the north-east, and entering the Baltic, reached a river which he calls Tanaïs, and is thought to be the *Vistula*. Here he found a people who made use of amber instead of wood; and as that substance is still found in large quantities in Prussia, there is little doubt that he must have visited this part of Europe. He gave an account of his voyages in two works which he published. The one was entitled a Description of the Ocean, and contained his voyage from Gades to Thule; the other work was entitled Periplus. It is said that Pytheas was the first who suspected that the tides were influenced by the moon. (See *Eclaircissements sur la Vie et sur les Voyages de Pythéas*, by Bougainville, in the *Récueil de l'Académie des Inscriptions*, xix. 46.)

PYTHIA, the priestess of Apollo at Delphi, by whom he delivered oracles. She was so called from Pythius, a name of that god, which is said to have been given him on account of his victory over the serpent Python. The Pythia was at first required to be a young girl, but in later times a woman of about fifty years of age usually officiated as priestess. The first and most famous Pythia was Phemonöe, by whom oracles were at first delivered in hexameter verse. All the Pythias were pure virgins, and all of them delivered their oracles with great enthusiasm and violent agitations.

PYTHIAN GAMES, in Grecian antiquity, sports instituted near Delphos in honour of Apollo, on account of his slaying the serpent Python. These games, at their first institution, were celebrated only once in nine years; but afterwards every fifth year, from the number of the Parnassian nymphs who came to congratulate Apollo, and to make him presents on his victory. The victor was crowned with garlands.

PYTHON, in fabulous history, is the name given to a monstrous serpent, produced by the earth after Deucalion's deluge. Juno being exasperated at Latona, who was beloved by Jupiter, commanded this serpent to destroy her; but Latona flying from the pursuit of the monster, escaped to Delos, where she was delivered of Diana and Apollo, the latter of whom at length destroyed Python with his arrows, and in memory of this victory the Pythian games were instituted.

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[1] Cicero *de Senectute*, sect. 21.

[2] Monboddo's Ancient Metaphysics.

Q.

Q, or *q*, the sixteenth letter and twelfth consonant of our alphabet, but one not to be found either in the Greek, old Latin, or Saxon alphabets; and indeed some would entirely exclude it, pretending that k ought to be used wherever this occurs. But as it is formed by the voice in a different manner, it is undoubtedly a distinct letter; for, in expressing this sound, the cheeks are contracted, and the lips, particularly the under one, are put into a canular form, for the passage of the breath.

The q is never sounded alone, but in conjunction with u, as in *quality*, *question*, *quite*, *quote*, and the like, and never ends any English word. As a numeral, Q stands for 500; and with a dash over it, thus, $\bar{Q}$, for 500,000. Used as an abbreviature, *q* signifies *quantity* or *quantum*. Thus, amongst physicians, *q. pl.* is *quantum placet*, as much as you please; and *q. s.* is *quantum sufficit*, as much as is necessary. Q.E.D. amongst mathematicians, is *quod erat demonstrandum*, which was to be demonstrated; and Q. E. F. is *quod erat faciendum*, which was to be done. Q. D. amongst grammarians is *quasi dictum*, as if it were said, or, as who should say. In the notes of the ancients, Q stands for *Quintus* or *Quintius;* Q. B. V. for *quod bene vertat;* Q. S. S. S. for *quæ supra scripta sunt;* Q. M. for *Quintus Mutius*, or *quomodo;* Quint. for *Quintilius;* and Quæs. for *quæstor*.

QUADI, a people of Germany, situated to the south-east of the mountains of Bohemia, on the banks of the Danube, and extending as far as the river Marus, running by Moravia, which country they occupied.

QUADRAGESIMA, a denomination given to Lent, from its consisting of forty days.

QUADRANGLE, in *Geometry*, the same with a quadrilateral figure, or one consisting of four sides and four angles.

QUADRANS, the quarter or fourth part of any thing, particularly the *as*, or pound.

QUADRANS, in English money, the fourth part of a penny. Before the reign of Edward I. the smallest coin was a *sterling* or penny, marked with a cross, by the guidance of which a penny might be cut into halves for a halfpenny, or into quarters or four parts for farthings. But, to avoid the fraud of unequal cuttings, that king afterwards coined halfpence and farthings in distinct round pieces.

QUADRANT, in *Geometry*, the arch of a circle, containing ninety degrees, or the fourth part of the entire periphery.

QUADRANT also denotes a mathematical instrument, of great use in astronomy and navigation, for taking the altitudes of the sun and stars, as also for taking angles in surveying.

This instrument is variously contrived, and furnished with different apparatus, according to the various uses it is intended for; but they all have this in common, that they consist of a quarter of a circle, the limb of which is divided into ninety degrees. Some have a plummet suspended from the centre, and are furnished with sights to look through.

The principal and most useful quadrants are the common surveying quadrant, astronomical quadrant, Adams's quadrant, Cole's quadrant, Gunter's quadrant, Hadley's quadrant, horodictical quadrant, Sutton's or Collins's quadrant, and the sinical quadrant. See SEXTANT.

QUADRANTAL, in *Antiquity*, the name of a vessel in use amongst the Romans for the measuring of liquids. It was at first denominated *amphora;* and afterwards quadrantal, from its form, which was square every way like a die. In capacity it contained eighty *libræ* or pounds of water, which made forty-eight *sextaries*, two *urnæ*, or eight *congii*.

QUADRAT, a mathematical instrument, called also a *Geometrical Square*, and *Line of Shadows*. It is frequently an additional member on the face of the common quadrant, as also on those of Gunter and Sutton.

QUADRAT, in printing, is a piece of metal used to fill up the void spaces between words. There are quadrats of different sizes, as m-quadrats, n-quadrats, and the like, which are respectively of the dimensions of these letters, only lower, that they may not receive the ink.

QUADRATIC EQUATIONS, in *Algebra*, those in which the unknown quantity is of two dimensions, or raised to the second power.

QUADRATRIX, in *Geometry*, a mechanical line, by means of which we can find right lines equal to the circumference of circles, or of other curves, and their several parts.

QUADRATURE, in *Geometry*, denotes the squaring, or reducing a figure to a square. Thus, the finding of a square which shall contain just as much surface or area as a circle, an ellipsis, or a triangle, is the quadrature of a circle, an ellipsis, or a triangle. The quadrature, especially amongst the ancient mathematicians, was a great postulatum. The quadrature of rectilinear figures is easily found, for it is merely the finding their areas or surfaces, that is, their squares; for the squares of equal areas are easily found by extracting the roots of the areas thus found. The quadrature of curvilinear spaces is of more difficult investigation; and in this respect extremely little was done by the ancients, except the finding the quadrature of the parabola by Archimedes. In the year 1657, Sir Paul Neil, Lord Brouncker, and Sir Christopher Wren, geometrically demonstrated the equality of some curvilinear figures to rectilinear spaces; and soon afterwards the same thing was proved both at home and abroad of other curves, and which were brought under an analytical calculus. The first specimen of this was given to the public in 1688, by Mercator, in a demonstration of Lord Brouncker's quadrature of the hyperbola, by Dr Wallis's reduction of a fraction into an infinite series by division. Sir Isaac Newton, however, had before discovered a method of attaining the quantity of all quadruple curves analytically by his fluxionary calculus. It was disputed between Sir Christopher Wren and Mr Huygens which of them had first discovered the quadrature of any determinate cycloidal space. Leibnitz afterwards found that of another space; and in 1669 Bernoulli discovered the quadrature of an infinity of cycloidal spaces, both segments and sectors.

QUADRATURE, in *Astronomy*, that aspect of the moon when she is ninety degrees distant from the sun; or when she is in a middle point of her orbit, between the points of conjunction and opposition, namely, in the first and third quarters.

QUADREL, in building, a kind of artificial stone, so called from its being perfectly square. The quadrels are made of a chalky earth, &c. and dried in the shade for two years. These were formerly in great request amongst the Italian architects.

QUADRIGA, in *Antiquity*, a car or chariot drawn by four horses. On the reverses of medals we frequently see the Emperor or Victory in a quadriga, holding the reins of the horses; and hence these coins are amongst the curious called *nummi quadrigati* and *victoriati*.

QUADRILATERAL, in *Geometry*, a figure, the perimeter of which consists of four sides and four angles, and which is also called a *quadrangular figure*.

QUADRILLE, a little troop or company of cavaliers, pompously dressed and mounted, for the performance of carousals, jousts, tournaments, and other gallant divertisements.

QUADRILLE, a game played by four persons, with forty cards, which are the remains of a pack after the four tens, nines, and eighths are discarded. These are dealt three and three, and one round four, to the right-hand player; and the trump is made by him who plays with or without calling, by naming spades, clubs, diamonds, or hearts, and the suite named is trumps. If the person who names the trump should mistake, and say spades instead of clubs, or if he name two suites, the first named is the trump.

In this game the order of the cards, according to their natural value, is as follows. Of hearts and diamonds, *king, queen, knave, ace, deuce, three, four, five, six, seven*, in all ten; of spades and clubs, *king, queen, knave, seven, six, five, four, three, deuce*, in all nine. The reason why the ace of spades and ace of clubs are not mentioned is, because they are always trumps, in whatever suite they may be played; the ace of spades being always the first, and the ace of clubs the third trump. The cards rank according to their value, when trumps stand in the following order: Hearts and diamonds, SPADILL, or the *ace of spades;* MANILL, the *seventh* of the two *red suites;* BASTO, the *ace of clubs;* PONTO, *the ace of hearts and diamonds; king, queen, knave, deuce, three, four, five, six;* in all twelve. Spades and clubs, SPADILL, the *ace of spades;* MANILL, the *deuce of spades and clubs;* BASTO, the *ace of clubs; king, queen, knave, seven, six, five, four, three;* in all eleven. It is here to be observed, that the card which is *manill* and the second trump is always the lowest in its suite when not trumps; and that the ace of hearts or diamonds, which when trump is above the king, is below the knave when not trump.

There are three matadores, spadill, manill, and basto; the privilege of which is, that when the player has no other trumps but them, and trumps are led, he is not obliged to play them, but may play what card he thinks proper, provided, however, that the trump led is of an inferior rank; but if spadill should be led, he that has manill or basto only is obliged to play it. It is the same of manill and basto with respect to the superior matadore always forcing the inferior. Though there are properly but three matadores, nevertheless all those trumps which follow the three first without interruption are likewise called matadores; but the three first only enjoy the privilege above mentioned.

Each person is to play as he judges most convenient for his own game. He is not to encourage his friend to play; but each person ought to know what to do when it is his turn to play. The stakes consist of seven equal mils, or *contrats*, as they are sometimes called, comprising the ten counters and fishes, which are given to each player. A mil is equal to ten fish, and each fish to ten counters. The value of the fish is according to the players' agreement, as also the number of tours, which are generally fixed at ten, and marked by turning the corners of a card.

If the cards should happen not to be dealt rightly, or that there should be two cards of the same sort, as two deuces of spades, for example, there must be a new deal, provided it is discovered before the cards are all played. The cards must likewise be dealt over again in case a card is turned in dealing, as it might be of prejudice to him who should have it, and of course if there should be several cards turned. There is no penalty for dealing wrong; he who does so must only deal again.

When each player has got his ten cards, he that is on the right hand of the dealer, after examining his game, and finding his hand fit to play, asks if they play; or if he has not a good hand he passes, and so the second, third, and fourth. All the four may pass; but he that has spadill, after having shown or named it, is obliged to play by calling a king. Whether the deal is played in this manner, or that one of the players has asked leave, nobody choosing to play without calling, the eldest hand must begin the play, first naming the suite and the king which he calls; he who wins the trick plays another card, and so of the rest till the game is finished. The tricks then are counted; and if the ombre, that is, he who stands the game, has, together with him who is the king called, six tricks, they have won and are paid the game, the consolation, and the matadores if they have them, and divide what is upon the game, and the beasts if there are any. But if they make only five tricks, it is a remise, and they are beasted what goes upon the game, paying to the other players the consolation and the matadores. If the tricks be equally divided between them, they are likewise beasted; and if they make only four tricks between them it is a remise; if they make less they lose codill, and in that case they pay to their adversaries what they should have received if they had won, that is, the game, the consolation, and the matadores if they have them, and are beasted what is upon the game. They who win codill divide the stakes. The beast, and everything else that is paid, is paid equally between the two losers; one half by him that calls, and the other half by him that is called, as well in case of codill as a remise; unless the ombre does not make three tricks, in which case he that is called is not only exempted from paying half the beast, but also the game, the consolation, and the matadores if there are any, which the ombre in that case pays alone; and as well in case of a codill as a remise. This is done in order to oblige players not to play games that are unreasonable. There is nevertheless one case in which, if the ombre makes only one trick, he is not beasted alone, and that is when, not having a good hand, he passes, and all the other players have passed likewise; he having spadill is obliged to play. Here it would be unjust to oblige him to make three or four tricks. In this case, therefore, he that is called pays one half of the losings; for which reason he that has spadill with a bad hand should pass, that if he is afterwards obliged to play by calling a king, which is called *forced spadill*, he may not be beasted alone. He who has once passed cannot be admitted to play; and he who has asked leave cannot refuse to play, unless any one should offer to play without calling.

He who has four kings, may call a queen to one of his kings, except that which is trump. He who wants one or more kings, may call one of those kings; but in that case he must make six tricks alone, and consequently he wins or loses alone. The king of that suite in which he plays cannot be called. No one should play out of his turn, although he is not beasted for so doing. If he who is not the eldest hand has the king called, and plays spadill, manill, or basto, or even the king called in order to show that he is the friend, having other kings that he fears the ombre should trump, he is not to be allowed to go for the vole; he is even beasted, if it appears to be done with that intent. It is not permitted to show a hand though codill may already be won, that it may be seen whether the ombre is beasted alone. If the ombre or his friend shows their cards before they have made six tricks, thinking that they have made them, and there appears a possibility of preventing their making them, the other players can oblige them to play their cards as they think proper.

A player need only name his suite when he plays without calling a king. He who plays without calling must make six tricks alone to win; for all the other players are united against him, and they are to do what they can to prevent his winning. He who plays without calling, is admitted to play in preference to him who would play with calling; however, if he that has asked leave will play without calling, he has the preference of the other who would force him. These are the two methods of play without calling that are called forced.

As he who plays without calling does not divide the winnings with any person, he consequently, when he loses, pays all by himself. If he loses by remise he is beasted, and pays each of the other players the consolation, the *sans appeller* (which is commonly, but improperly, called the *sans prendre*), and the matadores if there are any; if he loses codill he is likewise beasted, and pays to each player what he would have received from each if he had won. They who win codill divide what there is; and if there are any counters remaining, they belong to him of the three who shall have spadill or the highest trump the next deal. It is the same with regard to him who calls one of his own kings; he wins alone or loses alone as in the other case, except the sans appeller, which he does not pay if he loses, or receive if he wins, although he plays alone.

If he plays sans appeller, though he may have a sure game, he is obliged to name his suite; which if he neglects to do, and shows his cards, and says, "I play sans appeller," in that case neither of the other players can oblige him to play in what suite he pleases, although he should not have one trump in that suite.

He who has asked leave is not permitted to play sans appeller unless he is forced; in which case, as was said before, he has the preference of the other who forces him.

A player is not obliged to trump when he has none of the suite led, nor play a higher card in that suite if he has it, being at his option although he is the last player, and the trick should belong to the ombre; but he is obliged to play in the suite led if he can, otherwise he renounces. If he separates a card from his game, and shows it, he is obliged to play it, if by not doing it the game may be prejudiced, or if he can give any intelligence to his friend, but especially if it should be a matadore. He who plays sans appeller, or by calling himself, is not subject to this law. He may turn the tricks made by the other players, and count what has been played, as often as it is his turn to play, but not otherwise. If, instead of turning a player's tricks, he turns and sees his game, or shows it to the other players, he is beasted, together with him whose cards he turned; and each of them must pay one half of the beast.

If any one renounces, he is beasted as often as he has renounced and it is detected; but a renounce is not made till the trick is turned. If the renounce is discovered before the deal is finished, and has been detrimental to the game, the cards must be taken up again, and the game replayed from that trick where the renounce was made; but if the cards are all played, the beast is still made, and the cards must not be replayed; except there should be several renounces in the same deal: then they are to be played again, unless the cards should be mixed. If several beasts are made in the same deal, they all go together, unless it is otherwise agreed at the beginning of the party; and when there are several beasts, the greatest always goes first.

A great advantage accrues from being eldest hand at quadrille, which often renders it very disagreeable to the rest of the players, being obliged to pass with a good hand unless they choose to play alone; and when it happens that the eldest hand having asked leave, the second player has three matadores, several trumps in back, and all small cards, he cannot then even play alone; and having no chance of being called, he must pass with this good hand: on account of which, this method has been thought expedient, to remedy this defect of the game; each player having an opportunity of availing himself of the goodness of his game, by adding to the usual method of playing the game that of the mediateur, and the favourite suite.

The first thing to be observed is that of drawing for places, which is done in this manner: One of the players takes four cards, a king, a queen, a knave, and an ace; each player draws one of these cards, and commonly he who comes in last draws first. The person who draws the king sits where he pleases, the queen at his right hand, the knave next the queen, and the ace on the left of the king. The king draws the favourite suite. The number of cards and persons is the same at this game as the other, and is played in the same manner.

The favourite suite is determined by drawing a card out of the pack, and is of the same suite, during the whole party, of the card so drawn.

A king is the mediateur, which is demanded of the others by one of the players, who has a hand he expects to make five tricks of; and through the assistance of this king he can play alone and make six tricks.

In return for the king received, he gives what card he thinks proper with a fish; but must give two fish if it is in the favourite suite. He who asks by calling in the favourite suite, has the preference to him who asks by calling in another; he who asks with the mediateur has the preference to him who asks by calling in the favourite suite, and by playing alone is obliged to make six tricks to win. He who asks with the mediateur in the favourite suite, has the preference to him who asks with the mediateur in any other suite, and is obliged to play alone, and to make six tricks.

If sans prendre is played in any other suite than the favourite, he who plays it has the preference to him who asks only, or with the mediateur, or even he who plays in the favourite suite with the mediateur; and the sans prendre in the favourite suite has the preference to all other players whatever.

The only difference between this method of playing the game and the other is, that when one of the players demands the mediateur he is obliged to play alone, and to make six tricks, as if he played sans prendre. In this case he should judge, from the strength of his hand, whether the aid of the king will enable him to play alone or not.

With the mediateur and without the favourite suite it is played in this manner. The game is marked and played the same as in common, except that a fish extraordinary is given to him who plays the mediateur, and to him who plays sans prendre; that is, he who wins the mediateur receives thirteen counters from each; and if he loses by remise he pays twelve to each, and thirteen if by codill. The winner of sans prendre receives seventeen counters from each; and if by remise he loses, he pays sixteen to each, and seventeen if by codill.

The vole with the mediateur receives one fish only, as at common quadrille. The beasts are also the same as the common game. The last game is generally played double, and is called *paulans;* but for those who choose to play a higher game, they may play the double colour, which is called the *Turk*, and is double of the favourite suite. There is also a higher game than this, which is paying whatever is agreed to him who happens to hold the two aces in his hand.

QUADRIPARTITION, the dividing by four, or into four equal parts. Hence comes the term *quadripartite*, the fourth part, or something divided into four.

QUADRUPEDS, in *Zoology*, those animals which have four limbs or legs proceeding from the trunk of their body.

QUADRUPLE, fourfold, or something taken four times, or multiplied by four, on which account it is the converse of quadripartition.

QUAIL. See Ornithology.

QUAKERS.

Ideas commonly entertained of Quakers and Quakerism.

QUAKERS, a body of Protestant Dissenters, so named by the public at large, but styled by themselves, "The Society of Friends." This society was founded by George Fox, in the year 1647. The Friends are remarkable for differing from the community in religious doctrines, mode of worship, and social customs, more than any other body of Christians; and it may safely be asserted, that their character has been less understood, and more seriously misrepresented, than that of almost any other religious association of modern times. Mosheim, Neale, Formey, Voltaire, and Hume, have given us descriptions of the Society of Friends, of which it would be difficult to say which abounds most in ignorant mistakes or wilful distortions. Of late years a fairer estimate of these people has manifested itself in the public mind. Men of deep thinking and eminent genius have been led to examine their history and writings, and have pronounced decisions upon them very different from those of the authors just mentioned. Coleridge, in his *Biographia Literaria*, says, "One assertion I will venture to make, as suggested by my own experience, that there exist folios on the human understanding, and the nature of man, which would have a far juster claim to their high rank and celebrity, if, in the whole huge volume there could be found as much fulness of heart and intellect, as bursts forth in many a simple page of George Fox." Thomas Carlyle, in his *Sartor Resartus*, pronounces George Fox "the greatest of modern reformers;" and Charles Lamb, in the *Essays of Elia*, declares, that "Sewel's History of the Quakers is worth all other ecclesiastical history put together."

We shall now proceed to give such an account of the rise, progress, and opinions of this society, as an intimate acquaintance with it and the writings of its members enables us to furnish, and as will be found amply borne out by a careful reference to the most authentic records, and to its existing condition.

It has commonly been stated, that this society was, at its commencement, termed the *Family of Love*, or *Seekers*. But this is a mistake. The *Seekers* were a people of prior origin, and of very different notions. From their peculiar extravagance they acquired the name of *Ranters*, and seem to have been the very people that Butler had in his eye when writing his Hudibras. They held that

> Saints may do the same things by
> The spirit in sincerity
> Which other men are tempted to,
> And at the devil's instance do,
> And yet the actions be contrary,
> Just as the saints and sinners vary.[1]

rigin of he term uaker.

The attempt to confound the Quakers with this sect, was one of the first acts employed by the enemies of Quakerism to stamp it with opprobrium. Fox occasionally fell in with them in his travels, and sharply reproved them for their errors. The Friends, for some time after they had been gathered into a distinct body, were known only by the name of "the Professors of the Light," or "Children of the Light," from "their fundamental principle, which," to use the words of William Penn, "is as the corner-stone of their fabric; and, indeed, to speak eminently and properly, their characteristic, or main distinguishing point or principle, viz. the light of Christ within, as God's gift for man's salvation; the root of the goodly tree of doctrine that grew and branched out of it."[2] They were known by no other name till 1650, three years after the commencement of their society, when George Fox being brought before the magistrates of Derby for preaching there, and telling them to "quake at the name of the Lord," one of them, Gervase Bennett, an independent, caught up the word, and called him and his friends QUAKERS. That was the real origin of the term Quaker; "a term which," says Sewel, their historian, "so caught the public fancy, and especially that of the priests, that they sounded it gladly abroad, never after that time giving any other name to the professors of the Light, so that it soon ran all over England, and making no stand there, it quickly reached the neighbouring countries; and that English name sounding very oddly in the ears of foreigners, hath given occasion to many silly stories."[3]

Real character of George Fox.

Perhaps to no great reformer has so little justice been done as to George Fox. Beyond the pale of his own society his character has, in fact, never been understood. By some grave and even eminent writers, he has been denounced as a silly enthusiast; by others as a blasphemer; and others, again, have denied that he was the founder of Quakerism at all. No statements can be more at variance with the truth. For three or four years after his first setting out, he was the sole preacher of the society.[4] It was he, as may be abundantly seen in the histories of the society, and the writings of his most celebrated disciples, who gave its character and constitution to this religious association. They are his opinions, his feelings, his tone of mind, which stamped it with its peculiar form and spirit. That in the fervour of his enthusiasm, and the elation of brilliant success, he ran into some fanatical extravagances, and even absurdities, is what is perhaps inseparable from the career of a sanguine advocate of great moral and social changes; and we shall soon point to some of these, in tracing his exertions for the organization of his infant society. There have, indeed, been one or two documents, a letter to Cromwell, and a letter to himself from the wife and daughters of Judge Fell, raked up out of a vast mass of manuscripts left behind him, and eagerly and repeatedly pushed before the public by his enemies, and recently again by some seceders from the Quakers themselves, in order to stamp him as a blasphemer, and a man open to the silliest adulation. It is not by such a mode, however, that the genuine character of any man is to be decided, but by a careful examination and candid judgment of his whole life and works. Did we apply so one-sided and unphilosophical a test to that of any great reformer, what should we now think of Luther, Jerome of Prague, Calvin, Knox, Wesley, or many others? If we shut our eyes to the nobler points of their characters, and opened them only to their defects; if we estimated Jerome of Prague by his recantation, Luther by his notions of combats with the devil, Calvin by the burning of Servetus, Knox by his zeal in the demolition of cathedrals, or Wesley by his belief in omens and apparitions, what an absurd verdict should we pass upon these great men! Such, however, has generally been the mode of judging of George Fox; whilst his labours, and religious and moral doctrines recorded by himself and the historians of the society, mark him as one of the most extraordinary men of his age. We shall soon have to observe upon how many important points of morals and manners he called in question the received opinions of his time: for, whatever his sagacious mind had once embraced as truth, he had the integrity and boldness to proclaim everywhere. He advanced into the presence of princes, and proclaimed it there in the same fulness, and with the same ease and freedom, as he did amongst his own peers. Yet with this daring and determined spirit, his contemporary disciples are unanimous in attesting his gentleness and unassuming modesty amongst them. The testimony of his eminent friend, William Penn, who had seen much of society in all its gradations, is that of all those who knew him best. "He was a man that God endued with a clear and wonderful depth; a discerner of others' spirits, and very much master of his own. . . . He was of an innocent life, no busy-body, nor self-seeker; neither touchy, nor critical. . . . So meek, contented, modest, easy, steady, tender, it was a pleasure to be in his company. He exercised no authority but over evil, and that everywhere and in all; but with love, compassion, and long-suffering. A most merciful man, as ready to forgive as unapt to take or give an offence. Thousands can truly say, he was of an excellent spirit and savour amongst them, and because thereof the most excellent spirits loved him with an unfeigned and unfading love."[1]

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[1] Penn's Rise and Progress of the Quakers, 12th edit. p. 12; Sewel's History of the Quakers, 5th edit. i. 10; Gough's History of the Quakers, i. 53.

[2] Penn's Rise and Progress, p. 18.

[3] Sewel's History, 5th edit. i. 43.

[4] Sewel's History, i. 86.

Formation of the Society of Friends.

George Fox was born of humble parents, at Drayton, in Leicestershire. In the quaint language of Sewel, "his father was Christopher Fox, a weaver by trade, an honest man, and of such a virtuous life that his neighbours used to call him righteous Christer. His mother was Mary Lago, an upright woman, and of the stock of the martyrs."[2] George was put apprentice to "a shoemaker that dealt also in wool and in cattle;" but he became most attached to the agricultural part of his master's business. His humble origin and education have often been adverted to, as implying a stigma upon Quakerism; but it is unquestionably to this circumstance that Quakerism owes its most distinguishing features, and probably the greatest amount of good that it has done, or may yet do, in the world. As Fox grew up, pursuing his solitary occupations in the fields, his strong mind soon began to employ itself on the subject of the utmost moment to a mortal creature, the grounds of his hopes of a future existence, and the true understanding of the Scriptures. That which, at a first view, seemed to be a disadvantage to Fox, his want of learning, and his obscurity of station, have, through the native vigour of his intellect, become eminently advantageous. His mind was neither trammelled by creeds, nor directed by classical or other knowledge, nor misled by the glimmerings of school philosophy. He was thrown, by his absolute want of a higher education, on his Bible. The whole strength and earnestness of his understanding were concentrated on the inquiry into the doctrines it contained; and he seems, with a wonderful clearness and singleness of eye, to have at once comprehended the pure and simple system of the Christian faith. He embraced it heartily and for ever. No bias of selfishness, no hopes of honour or of gain, ever appeared to weigh with him for a moment; it was to Christianity for itself alone that he attached himself, and he set out to proclaim it in the face of the world, with that boldness which always distinguished him. At first his travels were principally through the midland counties, where he convinced great numbers of his principles. For four years he appears, as already stated, to have been the only preacher of those principles; and, what is singular, the second preacher of Quakerism was a woman, named Elizabeth Horton. In the fifth year of Quakerism there were, however, according to Sewel, no less than twenty-five preachers, and in the seventh year upwards of sixty. These, traversing the kingdom in all directions, excited an extraordinary commotion. But in order fully to understand the uproar which the preaching of Quakerism created, it is necessary to call to mind the features of that age, and to see what the doctrines of Fox really were.

The age of George Fox.

George Fox made his appearance just as the struggle between the crown and the people was drawing to a close. Charles I. was already in the hands of the parliament. The monarchy had been destroyed, and the public mind was full of new schemes of liberty and legislation. Then came the struggle between the parliament and the military power. Not only the monarchy and the parliament, but the church establishment itself, fell. Men soon began to grow weary of alternate tyranny and lawlessness, both in ecclesiastical and in political matters. They were disgusted, too, with the greediness of priests of different denominations, struggling shamelessly for power and wealth. The diffusion of the Scriptures during the respective reigns of Henry VIII., Edward VI., and Elizabeth, had now made them pretty common in the hands of the people. Thousands and tens of thousands were scattered throughout the country, who were become dissatisfied with the old institutions, and anxious to ally themselves with some body, the doctrines and practice of which were more consonant to their newly-awakened ideas. But they were not merely on the watch; they were in a state of high excitement. The novelty and animating nature of the doctrines of the gospel, and perhaps still more the splendour of eastern metaphor exhibited in the prophetical writings, had thrown them everywhere into a sort of spiritual intoxication. When, therefore, George Fox made his progress through the country, his voice was like a trumpet to collect around him hosts of inquirers. Priests, notwithstanding the opposition of their order, left their pulpits; officers in the army, judges, gentlemen, mechanics, and husbandmen; all classes, indeed, flocked round him, and found in his system of a free gospel, and renouncement of the vanities of the times, that which they had hitherto sought for in vain.

Doctrines of the Friends.

The doctrines which Fox taught, and which have been received and are still held as the true faith by the Society of Friends, are principally the following.

1*st*. The great foundation and corner-stone of Quakerism, as William Penn justly terms it, is the doctrine of the Inward Light, founded on various passages of Scripture, but especially on the words of the gospel according to St. John, that "Christ is the true Light which lighteth every man that cometh into the world." They believe in the words of a document, issued by themselves, that "every man coming into the world is endued with a measure of this light, grace, and spirit of Christ, by which, as it is attended to, he is enabled to distinguish good from evil, and to correct the disorderly passions and corrupt propensities of his nature; and that without the spirit inwardly revealed, man can do nothing to the glory of God, or to effect his own salvation."

2*d*. The spirituality of Christianity is a doctrine which flows directly from this root; and hence they believe in the non-essentiality of religious ceremonies. "We think," say they, "this influence (the influence of the Spirit of Christ) especially necessary to the performance of the highest act of which the human soul is capable, even the worship of the Father of lights and spirits, in spirit and in truth; therefore we consider as obstructions to pure worship all forms which divert the attention of the mind from the secret influence of this unction from the Holy One. (1 John, ii. 20–27.)" They cannot, therefore, admit of any fixed liturgy, any stated forms of prayer, or any regular preaching. "Yet, although true worship is not confined to time and place, we think it incumbent on Christians to meet often together,

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[1] Penn's Rise and Progress, pp. 53–56.

[2] Sewell's History, i. 11.

(Heb. x. 25), in testimony of their dependence on the heavenly Father, and for a renewal of their spiritual strength; nevertheless, in the performance of worship, we dare not depend for our acceptance with him on a formal repetition of the words and experiences of others; but we believe it to be our duty to cease from the activity of the imagination, and to wait in silence to have a true sight of our condition bestowed upon us." On this ground the sole outward act of worship amongst the Friends consists in meeting together and sitting down in silence, without any singing, or stated prayers or sermon.

3d. From the same great fundamental tenet of the society, it directly flows, that as this influence is absolutely necessary to the performance of individual worship, it is more especially so in the exercise of the ministry. There can be no preaching unless the preacher immediately feel himself moved to speak; therefore there can be no electing of particular individuals by the church, or education of them for the office of the ministry. It implies a ministry entirely of divine ordination, and without the participation of any human authority. According to this faith, there is and can be no paid priesthood. The gospel is a free gift to be freely exercised.

4th. The Friends do not hold the doctrine of the Trinity according to the common acceptation of the word. They think it safest in this mysterious subject to confine themselves to the terms of Scripture; and these are the words of their confession on this subject. "We agree with other professors of the Christian name in the belief in One Eternal God, the Creator and Preserver of the universe; and in Jesus Christ his Son, the Messiah and Mediator of the New Covenant (Heb. xii. 24)."

5th. The belief in the entire spirituality of the gospel system has led the Friends to consider some rites received and practised by other bodies of Christians as non-essential. "There are two ceremonies in use amongst most professors of the Christian name; water baptism, and what is termed the Lord's Supper. The first of these is generally considered as the essential means of initiation into the church of Christ, and the latter of maintaining communion with Him. But as we have been convinced that nothing short of his redeeming power, inwardly revealed, can set the soul free from the thraldom of sin, by this power alone we believe salvation to be effected. We hold, that as there is one Lord and one faith (Eph. iv. 5), so his baptism is one in nature and operation; that nothing short of it can make us living members of his mystical body; and that the baptism of water, administered by his forerunner John, belonged, as the latter confessed, to an inferior and decreasing dispensation (John iii. 30). With respect to the other rite, we believe that communion between Christ and his church is not maintained by that nor by any other external performance, but only by a real participation in his divine nature (2 Pet. i. 4) through faith; that this is the supper alluded to in the Revelations (Rev. iii. 20), 'Behold I stand at the door and knock; if any man hear my voice, and open the door, I will come in to him, and sup with him, and he with me;' and that where the substance is attained, it is unnecessary to attend to the shadow, which doth not confer grace, and concerning which, opinions so different, and animosities so violent, have arisen."

6th. Their great doctrine of the Inward Light necessarily implies the doctrine of repentance and a new life; in the words of Penn, "Repentance from dead works to serve the living God, which comprehends three operations. *First,* a sight of sin; *secondly,* a sense and godly sorrow for sin; *thirdly,* an amendment for the time to come. This was the repentance they (the first Quakers) preached and pressed, and a natural result of the principle they turned all people unto."[1]

7th. "From hence sprung another doctrine which they were led to declare. Perfection from sin, according to the Scriptures of truth, which testify it to be the end of Christ's coming, and the nature of his kingdom, and for which his Spirit was and is given, viz. to be perfect as our heavenly Father is perfect, and holy because God is holy. . . . But they never held a perfection of wisdom and glory in this life, or from natural infirmities, or death, as some have, with a weak and ill mind, imagined and insinuated against them."[2]

Such are the great and strictly religious doctrines of the Society of Friends. There are others which they hold in common with other Christians, and which need not be enumerated here; but there are others, again, constituting a great system of philosophy, of morals, and manners, which distinguished the faith of George Fox from that of his predecessors and contemporaries, and which, if permitted to operate freely throughout society, would unquestionably produce the most amazing and beneficent changes. In the gospel declarations, that "God made of one blood all the nations of the earth," and that "he is no respecter of persons," he perceived nothing less than a charter of the most perfect freedom and equality of right to the whole human race. He carried out this idea so liberally, that he extended it to the female part of the community. He declared the equality of the sexes; that there is no sex in souls, but all are one in Christ Jesus; and on this ground he gave the female Friends a participation in the civil economy of the society. He extended this doctrine to all nations and colours; one right and one law for all men, whether white or black. In the declaration of Christ, the heathen lorded it over one another, but it should not be so amongst his disciples, where he saw the law of brotherhood, and not of subjection. This law once recognised, he could no longer recognise the contrary law of bloodshed and revenge; he was bound to pronounce the anti-Christianity of war. He pronounced the anti-Christianity of all oaths, on the clear and unequivocal command of Christ, "Swear not at all."

Peculiar customs and practices.

He regarded Christianity as a heavenly dispensation, sent down to draw us from the follies and vanities of the world, and the very essence of which consisted in a renewed vitality of mind. This led him to resist, despise, and expose those assumptions of absurd titles, those demands of servile obeisance and empty flatteries by mere wealth and factitious rank, which degrade both givers and receivers, and fill the world with so much misery and heart-burnings, so much meanness and pride. On this principle he adopted the utmost simplicity of dress and manners. He resumed the original use of *thee* and *thou* to a single person, the more so as *you* was then used to a rich person, and *thou* to a poor one. He abandoned the practice of what he called "hat-homage," taking off the hat, and bowing, as marks of obeisance to superiors. He refused to address persons of rank by the titles of your Majesty, your Excellency, your Grace, &c., looking upon it as the basest flattery, where there happened to be neither majesty, excellency, nor grace. Believing in the authenticity of no ministry but such as depended alone upon the teaching of the Holy Ghost, he denied the right to tithes, church-rates, or any compulsory payments to the support of a priesthood. As he regarded the ceremony of marriage as requiring for its celebration no interference of a minister of the gospel, he refused the mode adopted at the altars of the Established Church, and introduced a simple form of marriage in the meetings of his own society. He rejected the common customs of mourning and burial, as not being in accordance with the simplicity of the Gospel. Regarding the names of the months and days of the week as originating in mythological idolatry, he substituted a mere numerical nomenclature. Various practices and social indulgences, as singing, dancing, music, the frequenting of theatres and other places of public amusement, playing at games of chance for money, drinking of healths, horse-racing, and field-sports, were renounced and discouraged by him, as incurring waste of time, or inconsistent with the serious hopes and duties of Christians. These innovations were all adopted by the Society of Friends, and have become fixed rules of practice.

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[1] Penn's Rise and Progress, p. 19.

[2] *Ibid.* p. 19.

The first preachers among the Friends.

It is obvious that a system like this could not be promulgated without setting in array against it an innumerable host of enemies. There was scarcely a custom of society, or a profession in it, at which it did not aim a severe blow. The church, the army, the law, each felt that it was menaced with decay or change. Royalty saw, that if this doctrine succeeded, it would lop off the right arm of arbitrary power, for it could not flatter the divine right of kings. The clergy saw that it did not object to this or that dogma, this or that ceremony, like the Puritans, but it assailed, root and branch, state-religion itself. If Quakerism succeeded, where would be the soldier and the marine; where the gainful trade of litigation? It was a system which aimed a death-blow at the flatteries of the world, and the self-gratulation and self-indulgent spirit of human nature; and it was accordingly speedily saluted with one general and furious tempest of hatred and vengeance. But, before turning to the persecutions of the Quakers, we must first notice the singular zeal, and as singular enterprises, of their first ministers. It has been stated, that, in the seventh year of Quakerism, these ministers amounted to upwards of sixty. These numbers continued for some years to increase rapidly; and they were animated with a surprising spirit of proselytism. Of these, Francis Howgill, John Audland, Samuel Fisher, had been clergymen; George Bishop, Richard Hubberthorn, William Ames, officers in the army; Anthony Pearson, John Crook, justices of peace. Of the rest, Edward Burrough, Robert Farnsworth, James Nayler, William Dewsbury, John Camm, Thomas Lowe, William Caton, and James Parnel, were amongst the most eminent. William Penn and Robert Barclay, two of their most celebrated members, did not join the society till about twenty years after its formation. There were also a considerable number of women-preachers, who displayed a spirit as bold and zealous as the men.

Firmly persuaded that they were actuated by the immediate influence and revelation of the Divine Spirit, and ordained to restore the primitive form and simplicity of the Christian faith, the Quaker-preachers traversed every quarter of the united kingdom, entering the churches of the establishment, denouncing their ceremonies and doctrines, telling the people that they were come to call them off from such things, from "the beggarly elements" of outward observances and outward teachers, to the great Inward Teacher; that the ground on which these churches stood was no more holy than any other ground;[1] and that sprinkling with water, putting on of surplices, and repeating ready-made prayers, were but relics of Popery. As these clergy and churches were maintained by the nation, they conceived that they had the clearest right to call upon the nation to look into them. They did not stop here; they believed it their duty to address solemn warnings to magistrates, to parliament, to the protector or the king as it might be, on what they regarded as their duty to the public. George Fox, Edward Burrough, Samuel Fisher, George Whitehead, and others of the Friends, had repeated interviews with Cromwell, Charles II., and other monarchs; and William Penn was a regular visitor at court during the short reign of James II.[2] Many of the preachers extended their travels to France, Germany, Holland, and America. George Fox himself visited Holland, America, and the West Indies. Penn and Barclay visited Holland and Germany, and were received with the most cordial sympathy by Elizabeth, the princess of the palatinate, who entered into a religious correspondence with them.

Their zeal and singular actions

Their success, and perhaps the very heat and opposition of the times, so stimulated their zeal and confirmed their opinions, that they now declared that they moved in the same spirit and power as the apostles. George Fox declared them little better than impostors who did not possess and act in that power and spirit. He believed, that by the Inward Light, not only the Scriptures, but both the intellectual and physical world, were opened to him. "He knew not only a renewing of the heart, and a restoration of the mind, but the *virtues of the creatures were also opened to him;* so that he began to deliberate whether he should practise physic for the good of mankind.... The three great professions in the world, physic, divinity, and law, were opened to him," &c.[3] He worked miracles, according to his own testimony and that of his friends. He cured a woman of a distracted mind, by merely telling her, in the name of the Lord, to be quiet.[4] He commanded a man at Arn-side to stretch out his withered arm, and it was restored.[5] But he believed himself not only endowed with the apostolic, but with the prophetic power. He foretold to Judge Fell, a fortnight before any body else dreamed of such a thing, the dissolution of the parliament by force.[6] He had a vision of an angel with a fiery sword, prophetic of the great fire in London.[7] Meeting Cromwell riding in Hampton-Court Park, as he drew near, "he perceived a shaft of death go forth from him." Cromwell invited him to come to the palace, but on going the next day he found him already on his death-bed.[8] He exercised the same gift on many other occasions, foretelling judgments on his persecutors. His coadjutors laid claim to the same revelations. They were zealous to the last to address warnings to magistrates and to governments; as Francis Howgill to Cromwell;[9] Samuel Fisher to the parliament;[10] Edward Burrough to Cromwell and his council, &c.[11] They foretold events. Thomas Aldam foretold the fall of Cromwell;[12] George Bishop, the great plague in London;[13] Thomas Ibbitt, Humphry Smith, George Fox the younger, and Thomas Briggs, the great fire of London;[14] Edward Burrough, the death of Cromwell, his own death, and various other events.[15] They exhibited signs, like the ancient prophets. A woman went into the parliament in 1658, with a pitcher in her hand, and breaking it, told them, so should they be broken to pieces.[16] Thomas Aldam took off his cap before the Protector, and tearing it to pieces, said, "so shall the government be rent from thee and thy house."[17] In 1660, Robert Huntingdon went into the church at Brough, near Carlisle, wrapped in a white sheet, and with a halter about his neck, to show the Independents and Presbyterians that the surplice would be introduced again, and that some of them would be hanged.[18] A woman appeared in a Protestant church at Dieppe, in sackcloth and ashes.[19] Thomas Ibbitt, two days before the fire of London, dismounted from his horse with his clothes hanging loosely about him, as though he had come in great haste, and went about the city denouncing judgment.[1] Solomon Eccles went into a Catholic chapel at Galloway, in Ireland, and, when the people were on their knees, appeared naked above his waist, with a chafing-dish of coals and burning brimstone on his head, and, crying "Woe to these idolatrous worshippers," declared that God had sent him to show them their portion, unless they repented. The same man went into a church in Aldermanbury in 1659, and, seating himself on the pulpit-cushion, in the face of the audience, began to sew.[2] In 1662, Daniel Baker, being in a ship becalmed opposite to Gibraltar, went ashore on Maunday Thursday, proceeded to the mass-house, and amid the people at high mass he rent his clothes, discovering sackcloth on his body; then taking his hat from his head, he threw it on the ground and stamped on it, and calling on them to repent, so passed away.[3]

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[1] Sewel's History, i. 79.

[2] *Ibid.* i. 273, 315–316; ii. 548, 559, 594, 613, 617.

[3] George Fox's Journal, 6th edit. i. 106; Sewel, i. 29.

[4] *Ibid.* i. 120; *Ibid.* i. 37.

[5] *Ibid.* i. 219.

[6] Sewel's History, i. 112, 113.

[7] *Ibid.* ii. 101.

[8] Sewel's History, i. 315, 316.

[9] *Ibid.* i. 139.

[10] *Ibid.* i. 226.

[11] *Ibid.* i. 210, 276.

[12] *Ibid.* i. 325.

[13] *Ibid.* i. 260.

[14] Sewel's History, ii. 175, 199, 388.

[15] *Ibid.* i. 315; ii. 50.

[16] *Ibid.* i. 312.

[17] *Ibid.* i. 313.

[18] *Ibid.* i. 436.

[19] *Ibid.* i. 191.

Zeal of the first Quakers.

But the zeal of the first Quakers could not expend itself even in these extraordinary demonstrations; many of them set out to the very ends of the earth, with what they believed to be commissions from on high. One young woman, Mary Fisher, proceeded to Adrianople (although once stopped at Venice, and sent back by the British consul) to convert the Grand Turk, who received her in the most courteous manner.[4] Two others, Catharine Evans and Sarah Cheevers, went to Malta to reclaim the Catholic inhabitants, but did not meet with so handsome a reception as their sister had done from the Sultan. They were clapped into the prison of the Inquisition, and only liberated after a four years' imprisonment, through the interference of Lord D'Aubigny.[5] John Love, John Perrot, Samuel Fisher, and John Stubbs, went to Rome, to testify, in the presence of the pope and cardinals, against their superstitions. Love died in the Inquisition, but the others escaped.[6] George Robinson travelled to Jerusalem to denounce the trade which the friars made of the holy sepulchre, and to convert the Mahommedans, and also returned safe.[7] Others crossed to New England, where we shall have occasion to speak of them immediately. This is a portion of the Quaker history, which suggests serious ideas. All these things were done under the conviction of immediate revelation; but the result of these strange signs and journeys did not justify the singular anomaly of the actions; and, what is remarkable, they have never, at any subsequent period, found imitators in the society. In the sober judgment of this age, such things will no doubt be estimated at their true value; and, from the present practice and character of the Friends, we presume they would not differ much in opinion from their neighbours.[8]

ersecu- ions suf- ered by ne Friends.

The persecutions which the Friends suffered forms another remarkable chapter in their history, and one in which they appear to great advantage. We have seen what were their doctrines, and that their promulgation was sure to plunge them into a sea of suffering. This was soon verified. Wherever they appeared, the clergy, who justly looked upon them as the most daring and determined enemies that ever appeared against them (for they everywhere declared to the people that their system was anti-Christian, and rotten to the very core), on all hands roused the civil and military powers against them. Wherever they preached they were hauled before the magistrates, fined or imprisoned; but though the persecution waxed hotter and fiercer every day, they never for a moment flinched, or remitted their activity in travelling and preaching all over the country. No persecution in modern times fell more heavily or savagely upon any people; and it must be said, to the honour of the society, that no people ever stood up more firmly for the rights of conscience and the liberty of the subject. The trials of the Friends, and especially that of John Crook in 1662,[9] and that of William Penn and William Mead in 1670,[10] at the Old Bailey, will for ever remain as noble monuments of their resistance to the arbitrary proceedings of the courts of judicature at that time, and their violent infringement of the privilege of jury. In the latter case there happened to be a noble jury, who, insensible to the most atrocious attempts made by the court to force a verdict, were shut up without "meat, drink, fire, or tobacco," for two nights and a day, and, still remaining immoveable, were conveyed with the prisoners to Newgate.

The enemies of the Quakers were furnished with abundant means of oppression, in the various acts which had been passed since the days of Henry VIII. till then, against the Popish recusants, and otherwise, to compel conformity to the established church. There was the 27th of Henry VIII.; the 1st of Elizabeth, for twelvepence a day; the 5th of Eliz. *De Excommunicato capiendo;* the 35th of Elizabeth, for abjuring the realm, on pain of death; the 3d of James I. for præmunire, imprisonment for life, and confiscation of estate; the 13th and 14th of Charles II. for transporting Quakers; the 17th of Charles II. against non-conformists; the 22d of Charles II. against seditious conventicles. They were so surrounded with snares that there existed not a chance of escape if there were the slightest desire to punish them. If all charges against them failed on any occasion, there was the oath of allegiance and supremacy always ready to present to them; and the Quakers could not take any oath whatever. But by the last act against conventicles, passed in 1670, they were completely given up as a prey to the informers. Any five persons convicted of being present in one house, over and above the ordinary family, were to be fined five shillings for the first offence, ten for a second, twenty pounds for preaching, forty for a second offence, and twenty pounds for the building in which the meeting was held, the whole to be levied by distress; and if any one person could not pay his fine, it was to be levied on any one or more who could, the informer receiving one third of the amount. Under such temptations to low cupidity, loss of their property and imprisonment of their persons spread throughout the whole country. Cromwell and Charles II. both professed a desire to stay this persecution, but they took few measures to effect this object; on the contrary, during the whole reign of Charles, persecution raged more and more vehemently. Their sufferings lasted thirty years, and the simple matter-of-fact relation of them fills two large folio volumes of more than one thousand four hundred closely printed pages. The prisons were full of them, and these prisons were pestilential dungeons, of which we can now hardly credit the description. In them there were at one time 4200 Quakers. The prisons of London had suffocating crowds in them, and the celebrated HOLE in Newgate was the death of numbers. Ellwood, the friend of Milton, and who had the honour to suggest the composition of Paradise Regained, was in Newgate amongst these numbers, and has left us, in his Life, some curious sketches of those scenes. The majority of the first preachers of Quakerism died in prison. In 1662 twenty Friends died in the London jails; in 1664 twenty-five more; in 1665 fifty-two others, besides seven who died after liberation, in consequence of their treatment during confinement. According to Besse, the historian of their sufferings, the total number of Friends who perished in prison during this period was 369. In Bristol at one time every adult was in prison. In London in 1670 Charles issued an order, signed by the archbishop of Canterbury and thirteen others, commanding Mr Christopher Wren to pull down their meeting-houses at Ratcliffe and Horsleydown, which was done, and the materials sold. Peal meeting-house was ransacked, and stripped of doors and windows. Their other meeting-houses were nailed up; and the Friends, who met on the ruins, or in the street, were driven away by soldiers, mercilessly beaten with the butt-ends of their muskets, and some of them killed. Throughout the severe winter of 1683, these steadfast people collected in the streets to worship, in spite of all pains and penalties, and suffered incredible hardships and insults. The dead were disinterred from their graves; women and children were dragged by the hair along the streets; some were pricked with needles and bodkins, and others were sold to the sugar plantations. Meantime their property was at the mercy of constables and informers, who wrenched open their doors with sledge-hammers and screws, and carried off everything, to the very children's food, often leaving not a tool to work with, or a horse to plough the land. In many instances these fellows, where the men were in prison, carried the keys of their houses in their pockets, went in and out as they pleased, declaring that they would "eat of the best and drink of the sweetest, and these rogues of Quakers should pay for all." There was levied at one time on the Friends at Bristol, for fines, L.16,400; and, from a careful examination of the records of the society, it clearly appears that property was taken or destroyed at that period to the amount of upwards of one million sterling.

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[1] Sewel's History, ii. 199.

[2] *Ibid.* ii. 241; State Trials, vi. 998.

[3] Sewel's History, i. 541.

[4] *Ibid.* i. 433.

[5] Sewel's History, i. 493.

[6] *Ibid.* i. 433.

[7] *Ibid.* i. 292.

[8] Nothing is here said of the actions of James Nayler, because they were condemned by the Friends at the time, and, after his punishment, thoroughly condemned by himself.

[9] Sewel, ii. 23; Gough, i. 518; Howell's State Trials, vi. 201.

[10] State Trials, vi. 951; Sewel, ii. 259; Gough, ii. 328.

This sketch of their persecutions would not be perfect if we omitted their treatment in New England. There, the colony of Independents, whose history is so well known from the circumstance of their having fled from persecution at home, and immediately become persecutors themselves, and whose cruelties to the Indians and to one another form so gloomy a passage in history, no sooner heard that two Quaker women were arrived in the harbour, than they seized on them before they could land, put them in prison, stripped them naked, and barbarously treated them. They ordered three other Quaker women to be stripped to the waist, and flogged through eleven towns, a distance of eighty miles, in all the severity of frost and snow. They then hanged three men and one woman, before a mandate from the king could arrest their bloody course.

The extent of persecution was much diminished by William Penn opening an asylum for his friends in his new state of Pennsylvania, whither great numbers emigrated; and a final stop was put to them by James II. He permitted the Friends to substitute an affirmation instead of an oath; then came the Toleration Act of William II., recognising more fully the rights of conscience; and subsequent acts legalized their marriages, and placed them at ease amongst their fellow-citizens. They still continue their conscientious refusal to pay tithes and church-rates, and these are taken by distraint, to the average annual amount of about L.11,000.

It would give an unfair view of the Society of Friends, if, after exhibiting the vehemence of their early zeal, we did not remind the reader of the peculiar spirit and circumstances of that age. Then all the elements of political and religious unrest were in a state of chaotic turbulence, and the whole style of language and of action amongst all denominations was such as would now be pronounced violent and fanatical. The Quakers, in this respect, only partook of the spirit of the age; and to understand them more truly, we must see them in their patient steadfastness under their dreadful misusage, in which they gave far higher evidence of the influence and support of the Divine Spirit, than by all their signs and wonders. It is to their everlasting honour that they never showed the least symptom of retaliation. Though often urged, when circumstances were in their favour, to denounce their enemies, they had on all such occasions but one answer, "We leave them to the Lord." They not only went on steadily, preaching and convincing thousands, but they set about and organized a system of discipline, or church-government, distinguished in a remarkable degree for its order and decorum. In the first place, they established a standing committee in London, called "The Meeting for Sufferings," for receiving the earliest accounts of the persecutions of their friends from all parts of the kingdom, and for taking the promptest measures for their mitigation. It was in this committee that George Fox was to be constantly found to the latest day of his life, whenever in London, anxiously engaged in endeavouring to alleviate the sufferings of the society. The system of discipline then organized, and which continues, in the main, as it was left by the first Quakers, we have now to describe.

Discipline of the society.

Wherever the Friends have a meeting-house, they hold, once a month, after the meeting for worship is over, a meeting for discipline; or, in other words, for all the civil and ecclesiastical affairs of the body. Though they do not pay their ministers, they deem it right to defray their expenses when they travel in the ministry. They hold it a Christian duty to support their own poor, and to educate their children. For these purposes they raise the necessary funds by voluntary contribution at these meetings, which are called Preparative Meetings, that is, meetings preparatory to the monthly meetings, which include several preparative meetings. Each preparative meeting appoints representatives to attend the monthly meeting.

The monthly meeting receives the funds for the poor, and appropriates to each meeting what is necessary. It also receives the funds for the public schools, and for what is called "the National Stock," that is, a fund placed at the disposal of the society at large for general charges; and hands them in by its representatives to the quarterly meeting. In these monthly meetings is chiefly vested the real property of the society, as its meeting-houses, lands, &c. They judge of the fitness of persons applying for membership; excite to due attention to religious and moral duties; and deal with disorderly members. They grant certificates of membership and conduct to those removing into other monthly meetings, without which they could not be received as members. They appoint two or more persons in each particular meeting, called overseers, to watch over the general conduct of the members, maintain the decorum of the meeting, and see the discipline enforced. They appoint also two or more persons, of high religious standing, as elders, to watch over the ministry, to judge of the fitness of such as offer themselves as preachers, and to sympathise with those already acknowledged. It is contrary to the rules of the society for any of its members to go to law with each other; all differences are to be settled by arbitration; and it is the duty of the monthly meetings to deal with such as violate this rule. Parties wishing to marry appear at these meetings and declare their intention; persons are appointed to inquire whether the parties are free from other engagements, and whether they have the consent of parents or guardians. These inquiries being answered in the affirmative, and the parties signifying to the following monthly meeting their continuance in the same mind, are permitted by it to proceed.

Several of these monthly meetings compose a quarterly meeting. A quarterly meeting, indeed, generally embraces one or two counties. At the quarterly meetings are produced, from the monthly meetings, written answers to certain standing queries respecting the conduct of the members, and the meetings' care over them. These accounts are digested into one, and sent on by representatives to the yearly meeting. The money contributions for the national stock, &c. are not forwarded by the representatives from the quarterly meetings to' the yearly meeting directly, but by appointed correspondents in each quarterly meeting to the Meeting for Sufferings, which is the fiscal and executive organ of the yearly meeting. Ministers wishing to travel in the ministry in Great Britain, must obtain a certificate from their own monthly meeting; and if they extend their views to Ireland, they must take one from the quarterly meeting. The quarterly meetings assist their monthly meetings in difficult cases, and hear any appeals from their judgment.

From the quarterly meetings in spring, representatives are sent to the yearly meeting in London; thus the affairs of the society coming into operation in every meeting in the kingdom, gradually concentrating themselves into one focus, concerns of a local nature being dropped in their own proper sphere, and the monthly or quarterly meetings, and those of a more general interest being carried on to the great annual assembly. To understand, however, the mechanism of the society, it must be explained that these meetings of discipline, monthly, quarterly, and yearly, are not restricted to the representatives only. All members may, and great numbers do, attend them; for not only has every member a right to give an opinion on all public questions, but these meetings offer points of pleasant reunion and acquaintanceship. It must, too, be understood that the women, simultaneously with the men, but in a separate apartment, hold their own monthly, quarterly, and yearly meetings of discipline, in which they watch over the interests, the moral conduct, and the religious consistency of the female portion of the community. There is also, previous to any meeting of discipline, a meeting of ministers and elders, to strengthen each others' hands. To their meeting in London, more commonly called "the Morning Meeting," is intrusted the revision of manuscripts which concern the principles of the society, and the granting of certificates to ministers wishing to travel abroad during the intervals of the yearly meeting. These ministers and elders afterwards take their places in the general meetings of discipline. The ministers are also members of the Meeting for Sufferings, which, as already stated, is the standing committee of the society.

These subordinate and preliminary meetings, then, having been held, the yearly meeting comes on in London in the month of May. There is but one yearly meeting for these united kingdoms, to which come representatives from Scotland and Ireland. But in America, where the great body of the Quakers is now to be found, there are eight yearly meetings, which correspond with the English yearly meeting, and with one another; besides five yearly meetings of what are called Liberal or Hicksite Quakers, with whom neither the English nor the other American Quakers hold any communication. The discipline in all is pretty much the same, and therefore the description of that in London may represent the rest. It elects a clerk, who officiates at once as chairman and secretary, and an assistant-clerk, to relieve him by reading long documents, &c. The meeting is held by adjournment from day to day, and generally continues about ten days. It receives epistles from Friends in Ireland, and the orthodox yearly meetings in America, and appoints committees to draw up answers. It receives and considers the answers to the standing queries on the moral and religious condition of the society, from all the quarterly meetings. Accounts are laid before it by the Meeting for Sufferings, of all the seizures for tithes, church-rates, &c. It has committees sitting on the state of the public schools, on the subject of slavery, and on other questions, in which the Friends take great interest, and on which they frequently feel bound to address the crown, petition parliament, or call upon the public for its attention. It has a committee to receive all appeals against the decision of the quarterly meetings. It alone has power to alter any of the established rules of the society, or to make new ones. It sometimes appoints committees to visit such quarterly meetings as appear in need of help; and it always addresses a general epistle to the society, which is read in every meeting in the kingdom; the women Friends issuing an epistle from their meeting, addressed to the female community exclusively.[1]

Peculiar mode of worship.

In their mode of worship the Friends differ from all other Christians. Believing all worship to depend upon the immediate operation of the Holy Spirit, and having, therefore, no paid ministers, no stated prayers, no singing even, they walk into their meeting-house, the men with their hats on, and sit down in silence. They keep on their hats because they do not believe that place to be holier than any other, or that worship is more acceptable at one time than another, but that it is enjoined on us, and is good for us, to assemble ourselves together before God. They have no separate pews, but all the men sit together on one row of benches, and all the women on another. They have no pulpit, because they have no fixed preacher; but as they may have several voluntary ones, they have a long raised gallery in front of the congregation, where the ministers sit, the men facing the men, and the women facing the women of the audience. The elders sit with them, or with the overseers, in a lower gallery, still facing the meeting. As the ministry is independent of human appointment, so is it of human choice in its distribution. There may be, and often are, half a dozen ministers or more resident, as in large towns, and there may be a succession of sermons and prayers, whilst in great numbers of other meetings there is no minister, nor a word spoken, for years together, except it be by travelling ministers, who occasionally visit, not only their meetings, but each family belonging to them.

Great change in the character of the society.

Such were the early Quakers, and such are the forms of polity and worship which they have left behind them. Those who now see the Friends as they are, would scarcely believe them to be descended from so fiery and innovating a race. The old Quakers were vehement in the promulgation of their principles, and aggressive in their attacks on the principles of others. The present Friends neither assail the religious doctrines of others, nor seem anxious to diffuse their own. The virtue of the first Quakers,was active, that of the present is passive to a miracle. They cling tenaciously to the outward forms of their system, and to their peculiarities of dress, speech, and renunciation of popular amusements; but the ancient fire which once lit up their body seems to have gone out. They profess to hold their great principles as sacred as their ancestors did, but they show little anxiety to make them known. Much of this remarkable change is plainly attributable to natural causes. The violence of a religious paroxysm determines the length of its duration. When persecution ceased, the Friends found themselves thrown, by their abandonment of the ordinary amusements and tastes of the world, on trade for occupation, and led home for relaxation. They became busy, domestic, and of consequence wealthy. These causes will explain much, but there is another cause which will explain more of the present circumstances of the society; their great tenet, and corner-stone of their faith, the Inward Light. Carrying this doctrine to the extent which they do, that it is the all-sufficient guide; that its guidance is to be sought and waited for; that we must put down before it our own imaginations and reason, and without its impulse we must make no religious movement, it has had this effect; it has acted as a blight upon the ministry. Those who might feel disposed to address their meetings from a simple feeling of love, and desire for the salvation of their fellows, and from a belief that every good motive must come from the source of all good, and would be blessed by Him; these, perhaps the most able members of the body, have yet shrunk from the task, because they felt that they should be restrained by the elders, as persons running in their own strength, and in their own natural reason. Those who have not been so sensitive, and have been adopted as ministers, have entered upon a process of putting down every motion and faculty of their own minds, and of waiting for a direct and palpable revelation from heaven. The consequence need not be stated. It is a fact, that since the first days of Quakerism they have had few preachers of extraordinary eloquence or originality of mind. The ministry is now confessedly low, and the sermons heard in their meetings are most frequently common-place and rambling. The experiment of an unpaid ministry in their hands has been by no means a splendid one. No spread or prevalence of their doctrines has followed, at all answerable to the ground of inspiration assumed. With the exception of two preachers who have lately paid a visit to Australia and the South Sea Islands, they have sent out no missionaries, nor contributed to the funds of those societies which did, because they were not moved to it; as if the evidence of success were not sufficient warrant. In their meetings of discipline the same principle has produced the same effects. Though all profess to live under the influence of the spiritual guide, some are supposed to live under it more habitually. These have acquired the name of Weighty Friends, that is, Friends of weight of character and consequent influence. Instead, therefore, of deciding all questions in these meetings by the ordinary mode of voting, or by a show of hands, a mode, one would have imagined, particularly consonant to their views of natural right, they have adopted the singular one of deciding by weight; that is, by the dicta of the Weighty Friends, who, for the most part, are men of weighty purses too. These Friends have only to say, "I am of this or that opinion," without assigning any reason, and this is taken as the sense of the meeting, and decides the question. Thus is the government of the society thrown into the hands of an oligarchy of the most dangerous kind; for none can be more dangerous than that of an assumed sanctity; and thus are the advantages of their otherwise popular system curiously neutralized.

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[1] For all that relates to the civil and religious economy of the society, see its statute-book, The Book of the Rules of Discipline, &c.

The same principle has operated still further. It has damped religious inquiry and discussion. In the common affairs of life and trade, where the Friends have used their understandings, they have shown themselves shrewd and successful; in matters of religion they thought it right to renounce their natural faculties, and wait. When the young have expressed to ministers, or any of their elder Friends, their doubts or uneasiness on any religious point, they have replied, "they did not feel free to discuss such matters;" they advised them to "centre down into their own minds, to turn inward to the infallible guide." The consequence became apparent in a dearth of religious intelligence. There was not the same inquiry into and clear recognition of religious doctrines amongst them as amongst other communities of Christians; and when the spirit of research burst upon them from without, they were startled. Many felt themselves like mere children in theology, and were scattered different ways.

Modern schisms among the Friends.

These divisions first showed themselves in America in 1827. They originated in objections to the doctrines of a very popular and aged minister, Elias Hicks; but at the yearly meeting in Philadelphia that year, it was found that great numbers were of his opinions, and the parties came to an open rupture. The schism soon spread to New York, and the feud raged for some years with great violence, ending eventually in the total disruption of the society in America. It is difficult to state the numbers of the society, because there has always been a reluctance to take a regular census of the body. In the year 1659, from the number of females who signed petitions to parliament, it was calculated that the number altogether in England was about 30,000. At present, from calculations made by private individuals, there does not appear to be quite 20,000; but in America they have been variously estimated at from 100,000 to 160,000, and may very safely be rated at more than 100,000. The section of the American Quakers calling themselves orthodox state the numbers who avowed the opinions of Elias Hicks at 30,000; the Hicksites themselves claim 60,000. It may, therefore, be fairly taken for granted that the body there is pretty equally rent in two. The English Quakers renounced the Hicksite Quakers, though these people protested that they held, and had always held, the doctrines of the first Friends in their integrity. Scarcely was this schism effected when the Quakers in England found themselves assailed on the opposite side by a party which had been most urgent with them to disown the Hicksites. This attack appeared in the shape of a publication called "A Beacon to the Society of Friends," warning them against the errors of Hicks, and advocating water-baptism, the taking of the Lord's Supper, and other opinions which the Quakers from the first had abandoned. The heats and contentions incident to religious disputes have, on this ground, distracted the society here; some few have withdrawn from the body, and several individuals have been dismissed for adopting ceremonies which Quakerism rejects; but the body itself has hitherto remained entire. It is not necessary here to enter into the points in dispute. It may suffice to say, that the Hicksites are charged with setting the Inward Light above the Scriptures, and the Beaconites with setting the Scriptures above the Inward Light; the Hicksites with running too far into mysticism, and the Beaconites into the "beggarly elements" of outward form. Both parties appeal to Scripture against each other, and the English Friends appeal to it against them both. The circumstance to be regretted is, that this society, which has always boasted that it "has no creed," and which says, "We require no formal subscription to any articles, either as to the condition of membership, or to qualify for the services of the church; we prefer judging of men by their fruits;" should thus rend itself to pieces about "articles of faith," and the very stuff of which "creeds" are made.

Their high philanthropic character.

If, however, the Society of Friends, having an "infallible guide," has not avoided wandering different ways; if, being "a Society of Friends," they have not avoided bickerings and divisions; they have the honour of being amongst the noblest and most unwearied philanthropists which the world has ever seen. In this character they have proudly maintained their testimonies. If George Fox was not untouched with the extravagances of his age, he outstripped that age two hundred years in his clear perception of the highest requirements of Christianity. He was amongst the first, if not the first, to call public attention to the dreadful state of our prisons; to the injustice of capital punishments for mere stealing; and to the atrocious system of confining fresh prisoners with the most thoroughly debased.[1] He declared the anti-christianity of war, oaths, and slavery. In the maintenance of all these great truths, to the recognition of which the world is now but tardily coming, his followers have nobly emulated him. William Penn, by his just treatment of the Indians, and the full liberty of conscience granted in his new state of Pennsylvania, showed the noble lessons he had learned in this school. It was amongst the Friends that the great crusade against negro slavery commenced in the person of John Woolman, an American minister.[1] From that time to the present the Quakers have never ceased their efforts in that cause. They were the first in England to form an association for the abolition of the slave-trade. Thomas Clarkson, on setting out on his career, found them everywhere ready to co-operate with him, and to the last day of the struggle their purses and personal exertions were never spared. They have not been less zealous in spreading their opinions of the crime and impolicy of war; and in prison discipline, Elizabeth Pryor, a name not enough known or honoured, and her more known but not more deserving coadjutor Elizabeth Fry, have merited largely of the public. It is in this point of view, in thus early and steadily, theoretically and practically, exhibiting Christianity in its highest and most beneficent form, "peace on earth, and good-will towards men," that the Friends have conferred on society the greatest good of which men can be made the instruments, and deserve from it the most grateful esteem.

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[1] Sewel, i. 67; Fox's Journal, i. 143.

For a full account of the schism amongst the American Friends, we must refer to The Friend, and The Herald of Truth, journals published by the opposite parties; The Beacon, and Christian Enquirer; all published in America. In The Christian Reformer, a London Journal, a narrative may also be found, vols. xiii. xiv. xv. xvii. and xviii., old series. The English discussion has occasioned a host of pamphlets, but the chief facts regarding it are contained in The Beacon, by Isaac Crewdson; Truth Vindicated; The Crisis of the Quaker Controversy; Quakerism Examined, by John Wilkinson; An Examination of the Principles and Practices of the Quakers, by Elisha Bates; Luke Howard's Yorkshireman; Reports of the Proceedings in the Yearly Meetings of 1835 and 1836, in the Christian Advocate and Patriot newspapers; and defensive pamphlets by S. Tuke, Dr Hancocke, and others.

The history and doctrines of the early Friends will be found in George Fox's Journal; Barclay's Apology for the True Christian Divinity; The Histories of the Society, by Sewel and Gough; The History of the Sufferings of the Quakers, by Besse; The History of the Friends in Ireland, by Rutty; Ellwood's Life, written by himself; and the works of William Penn, Richard Claridge, and others. (B. E.)

The word *quality* cannot be explained. It is treated by Aristotle as a general conception.

QUALITY is a word which, as used in philosophical disquisitions, cannot be explained by any periphrasis. That which is expressed by it must be brought into the immediate view of the senses or intellect, and the name properly applied, or he who is a stranger to the word will never be made to comprehend its meaning. Aristotle, who treated it as a general conception, second in order amongst the ten predicaments or categories, gives several characters of it; but though they are all in some respects just, no man could from them, without other assistance, learn what quality is.

When a man comprehends, by means of his senses and intellect, what it is that the word *quality* denotes, he will indeed perceive that the first of these characters is applicable to some qualities and not to others; that the second is more applicable to quantity than to quality; and that it is only the third which can with propriety be considered as the general characteristic of this predicament. Thus, when we have learned by our sense of sight that whiteness is a quality of snow, and blackness of coal; and, by means of observation and reflection, that wisdom is a quality of one man, and folly of another; we must admit that the sensible quality of the snow is contrary to that of the coal, and that the intellectual quality of wisdom is contrary to that of folly. There is, however, no contrariety between wisdom and whiteness or blackness, nor between hardness or softness and any particular colour; for sensible and intellectual qualities can never be compared, and it is not easy, if indeed it be possible, to make a comparison between qualities perceptible only by different senses. Nay, amongst qualities perceptible by the same sense, we often meet with a difference where there is no contrariety; for though the figure of a cube is different from that of a sphere, and the figure of a square from that of a circle, the sphere is not contrary to the cube, nor the circle to the square.

His second characteristic of this genus is still less proper than the first. It is indeed true that some qualities admit of intension and remission; for snow is whiter than paper, and one woman is handsomer than another; but of the species of quality called figure we cannot predicate either more or less. A crown-piece may have as much of the circular quality in it as the plane of the equator, and a musket-bullet as much of the spherical quality as the orb of the sun. It is indeed a property of all quantity to admit of intension and remission; and therefore this ought to have been given as the character, not of the second, but of the third category.

That it is only from a comparison of their qualities that things are denominated like or unlike, or that one thing cannot resemble another but in some quality, is indeed a just observation. We know nothing directly except qualities sensible and intellectual (see METAPHYSICS); and as these have no resemblance to each other, we conclude that body or matter, the subject of the former, is a being unlike mind, the subject of the latter. Even of bodies themselves we can say that one is like or unlike another only by virtue of their qualities. A ball of ivory resembles a ball of snow in its figure and colour, but not in its coldness or hardness; a ball of lead may resemble a ball of snow in its figure and coldness, but not in its colour; and a cube of ivory resembles not a ball of lead either in figure, colour, or coldness. The mind of a brute resembles that of a man in its powers of sensation and perception, but does not resemble it in the powers of volition and reasoning; or at least the resemblance, in this latter instance, is very slight. All bodies resemble one another in being solid and extended, and all minds in being more or less active. Likeness or unlikeness, therefore, is the universal characteristic of the category *quality*.

Other speculations of Aristotle.

Aristotle has other speculations respecting quality which are worthy of notice. He distinguishes between qualities which are essential and those which are accidental, between qualities which are natural and those which are acquired; and he speaks of the qualities of capacity and those of completion. Extension and figure in general are qualities essential to all bodies; but a particular extension, such as an inch or an ell, and a particular figure, such as a cube or a sphere, are qualities accidental to bodies. Amongst the natural qualities of glass it is one to transmit objects of vision; but to enlarge these objects is an adventitious or acquired quality. The same quality may be natural in one substance, as attraction in the magnet; and acquired in another, as the same attraction in the magnetic bar. Docility may be called a quality natural to the mind of man, science an acquired one. To understand what he means by qualities of capacity and completion, it may be sufficient to observe, that every piece of iron has the qualities of a razor in capacity, because it may be converted into steel, and formed into a razor; and when it is so formed, it has, in the language of this sage, the quality of a razor in completion. Amongst the qualities of capacity and completion, the most important, and what may lead to interesting speculations, is the reasoning faculty of man. A capacity of reasoning is essential to the human mind; but the completion of this capacity or actual reasoning is not, otherwise infants and persons asleep would be excluded from the human species.

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[1] Journal of John Woolman; also Woolman's Considerations on the Keeping of Negroes, Philadelphia, 1754; Dublin, 1776.

Locke's doctrine.

Mr Locke has puzzled his readers with a question respecting the species of an idiot or a changeling, whom he pronounces to be something between a man and a brute.[1] It is not often that we feel ourselves inclined to regret Locke's ignorance of Aristotle's distinctions; but we cannot help thinking, that had the British philosopher attended to the Stagyrite's account of qualities in capacity and qualities in completion, this perplexing question would never have been started. It is justly observed in the Essay upon Human Understanding, that of real essences we know nothing, but that every man selects a certain number of qualities which he has always perceived united in certain beings, and, forming these into one complex conception, gives to this conception a specific name, which he applies to every being in which he finds those qualities united. This is undoubtedly the process of the mind in forming genera and species; and as the excellent author refuses the name of man to the changeling, it is obvious that the complex conception, to which he gives that name, must imply rationality, or the actual exercise of reason. But this limitation will exclude many beings from the species man, whom Mr Locke certainly considered as men and women. Not to mention infants and persons in sound sleep, how shall we class those who, after having lived thirty or forty years in the full exercise of reason, have been suddenly or by degrees deprived of it by some disorder in the brain?

> From Marlborough's eyes the streams of dotage flow,
> And Swift expires a driveller and a show.

But were the hero and the wit in those deplorable circumstances excluded from the human species, and classed between men and brutes? No, surely; they were both acknowledged to be men, because they were known to have the quality of reason in what Aristotle would have called capacity. Their dotage and drivelling originated from some disorder in their bodies, probably in the region of the brain; and Locke himself contends that no defect in body is sufficient to degrade a person from the rank of manhood. Again, lunatics have the exercise of reason, except at new and full moon. Are these unhappy beings sometimes men and sometimes a species by themselves between men and brutes?

Fallacy thereof.

It appears, therefore, that not the actual exercise of reason, but reason in capacity, ought to be included in the complex conception to which we give the specific name of man, as some of the greatest men that ever lived have been during parts of their lives deprived of the power of actual reasoning. This, however, it will be said, does not remove the difficulty; for the occasional exercise of reason in lunatics, and the great exertions of it in such men as Swift and Marlborough, show that they had it in capacity at all times; whereas we have no evidence that changelings have even a capacity of reasoning at any time, since they never do a rational action, nor ever utter a sentence to the purpose. That we have no direct and positive evidence of the minds of changelings being capable of reasoning, were they supplied with proper organs, must be granted; but the probabilities of their being so are many and great. We know by experience that the actual exercise of reason may be interrupted by an occasional and accidental pressure on the brain; and therefore we cannot doubt but that if this pressure were rendered permanent by any wrong configuration of the skull given to it in the womb, or in the act of being born into the world, an infant, with a mind capable of reasoning by means of proper organs, would by this accident be rendered, throughout the whole of life, an idiot or changeling. That idiotism is caused by such accidents, and is not the quality of an inferior mind occasionally given to a human body, will at least seem probable from the following considerations.

True doctrine.

It does not appear that an animal body can live and move except whilst it is actuated by some mind. Whence, then, does the unborn infant derive its mind? It must be either immediately from God, or *ex traduce* from its parents; but if the mind of man be immaterial, it cannot be *ex traduce*. Now, as idiots are very few in number when compared with the rational part of the human species, and as God in the government of this world acts not by partial but by general laws, we must conclude that the law which he has established respecting the union of mind and matter is, that human bodies shall be animated with minds endowed with a capacity of reasoning, and that those who never exert this capacity are prevented by some such accident as we have assigned.

QUALLA MOORBA, a river and port situated on the western coast of Malacca. The river is a large one; but the entrance into it is interrupted by a heavy surge, which breaks during the south-west monsoon, and has raised a dangerous sand-bank at the mouth, which extends three miles out to sea. This river is, however, frequented by vessels, which come here on account of the tin-mines in its vicinity. It is 18 miles south of Queda.

QUANG-PING, a city of China, of the first rank, in the southern part of Petchelee, agreeably situated in a fertile and well-watered territory. Long. 114. 29. E. Lat. 36. 47. N.

QUANGSEE, a province of China, situated on the south-western frontier, and bordering on Tonquin. The country is flat in the eastern districts, which are fertile, and yield rice not only for internal consumption, but also for export to the neighbouring provinces. The remaining part of the province consists of lofty mountains covered with extensive forests. These mountains are rich in mineral wealth, containing mines of gold, silver, copper, and tin, the working of which, according to the narrow maxims of Chinese policy, was for a long time prohibited, but at last permitted under the burden of paying forty per cent. to the emperor. This, however, was with the exception of the gold-mines, which the emperor retained in his own hands. The population is estimated by Sir George Staunton at 10,000,000. The capital is Queyling or Koueiling.

QUANGTONG, a large and populous province in the south of China, bounded on the east and south by the China Sea. Along the sea-coast the country is flat and extremely fertile, producing every species of grain, of which it yields two crops in the year. The northern frontier, by which it is separated from the province of Quangsee, consists of a range of high mountains, which produce gold, copper, and iron; and also a remarkable species of timber called iron-wood, from its resemblance in its properties, namely, its colour, weight, and hardness, to that metal. A beautiful species of rosewood is also found here; and in many parts an osier, the shoots of which spread along the ground, resembling twisted cords, and are so tough and pliable that they may be formed into baskets, chairs, and other pieces of furniture, and even serve for cables and ropes. Quangtong is considered as one of the most important provinces of the empire; it is well situated for trade, and, amongst numerous other ports, contains Canton, by which all the commerce between China and Europe is now carried on. The mountains on the northern frontier form the only interruption to the navigable communication between Pekin and Canton. The goods being transported across the mountains by land-carriage, are embarked upon the river of Canton, and thus conveyed by water to this great emporium. The population of this province is estimated by Sir George Staunton at 21,000,000. The governor maintains a respectable naval and military force for the suppression of piracy, as well as for overawing the rude tribes of the adjacent mountains.

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[1] Book iv. chap. 4, § 13, &c.

QUANGTONG, a town of the Birman empire, in the province of Ava, being situated on the Irrawaddy River, twenty-five miles from the frontiers of China. The meaning of the word Quangtong, or Canton, being a port or mart, numerous towns of this name are found in the vicinity of the Chinese empire; and it is likely that the town in question was either named or built by them. It is frequented by Chinese merchants, who bring thither tea, porcelain, silks, rubies, iron, and cotton. One of the staple commodities is the brown cotton of which nankeens are made. Under a liberal commercial policy it might become a mart for European goods. Long. 96. 55. E. Lat. 24. 2. N.

QUANTITY, as explained by the great English lexicographer, is that property of any thing which may be increased or diminished. This interpretation of the word is certainly just, and for the purposes of common conversation it is sufficiently determinate; but the man of science may expect to find in a work like ours a definition of the thing signified. This, however, cannot be given. A logical definition consists of the *genus* under which the thing defined is ranked, and the *specific* difference; but quantity is ranked under no genus.

Quantity characterized by Aristotle.

In that school where such definitions were most valued, it was considered as one of the ten categories, or general conceptions, under which all the objects of human apprehension were mustered, like soldiers in an army. On this account, even Aristotle himself, who delighted in definitions, and was not easily deterred from a favourite pursuit, could not, consistently with his own rules, attempt to define quantity. He characterises it, however, in several parts of his works, and particularly in the 15th chapter of the fourth book of his Metaphysics: "Things are the *same* of which the SUBSTANCE is one; *similar*, of which the QUALITY is one; *equal*, of which the QUANTITY is one." Again, he tells us,[1] that the chief characteristic of quantity is, that it may be denominated equal and unequal.

That any man can become wiser by reading such descriptions as these, none but an idolater of Aristotle will suppose. There is, indeed, no periphrasis by which we can explain what is meant by quantity to those who have not previously formed such a notion. All that can be done by making the attempt is only to settle language, by stating exactly the cases in which we use this word in the greatest conformity to general custom; for there is a laxness or carelessness of expression in the language of most men, and our notions are frequently communicated by speech in a way by no means precise; so that it is often a great chance that the notions excited in the mind of the hearer are not exact counterparts of those in the mind of the speaker.

The understandings of men differ in nothing more remarkably than in their power of abstraction, and of rapidly forming conceptions so general and simple as not to be clogged with distinguishing circumstances, which may be different in different minds whilst uttering and hearing the same words: and it is of great consequence to a man of scientific habits, either to cultivate, if possible, this talent, or to supersede its use by studiously forming to himself notions of the most important universals in his own course of contemplation, by careful abstraction of everything extraneous. His language by this means becomes doubly instructive by its extreme precision; and he will even judge with greater certainty of notions intended to be communicated by the more slovenly language of another person.

We cannot say that there is much ambiguity in the general use of the term quantity. But here, as in all other cases, a love of refinement, of novelty, and frequently of vanity, and the wish of appearing ingenious and original, have made men take advantage of even the small latitude with which the careless use of the word will furnish them, in order to amuse themselves and the public by giving the appearance of science to empty sounds.

The subject of mathematical reasoning.

Mathematics is undoubtedly employed in discovering and stating many relations of quantity; and it is in this category alone that any thing is contemplated by the mathematician, whether in geometry, arithmetic, or algebra. Hence mathematics have been called the science of quantity. The simplicity of the object of the mathematician's contemplation, and the unparaleled distinctiveness with which he can perceive its modifications, have enabled him to erect a body of science, eminent not only for its certainty, but also for the great length to which he can carry his reasonings without danger of error; whilst the intimate connection which this science has with the arts of life, and the important services which it has performed, have procured for it a most respectable place in the circle of the sciences. Ingenious men have availed themselves of this pre-eminence of mathematics, and have endeavoured to procure respect for their disquisitions on other subjects, by presenting them to the public as branches of mathematical science, and therefore susceptible of that accuracy and certainty which form its peculiar boast. Our moral affections, our sensations, our intellectual powers, are all susceptible of augmentation and diminution, are conceivable as greater and less when stated together, and are familiarly spoken of as admitting degrees of comparison. We are perfectly well understood when we say that one pain, heat, grief, kindness, is greater than another; and as this is the distinguishing characteristic of quantity, and as quantity is the subject of mathematical discussion, we suppose that these subjects may be treated mathematically. Accordingly, Dr Francis Hutchinson has said, amongst many things of the same kind, that the greatness of a favour is in the direct compound ratio of the service performed and the dignity of the performer, and in the inverse ratio of the merit and rank of the receiver; that the value of a character is in the compound ratio of the talents and virtue of the possessor; and he has delivered a number of formal propositions on the most interesting questions in morals, couched in this mathematical language, and even expressed by algebraic formulæ. But this is merely play on terms, and conveys no instruction. We understand the words; they contain no absurdity; and, in as far as they have a sense, we believe the propositions to be true. But they give no greater precision to our sentiments than the more usual expressions would do. If we attend closely to the meaning of any one of such propositions, we shall find that it only expresses some vague and indistinct notions of degrees of those emotions, sentiments, or qualities, which would be just as well conceived by means of the expressions of ordinary language; and that it is only by a sort of analogy or resemblance that this mathematical language conveys any notions whatever of the subjects.

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[1] *Præd.* p. 34, edit. Sylb.

The mathematician contemplates only measureable quantities.

The object of contemplation to the mathematician is not whatever is susceptible of greater and less, but what is measurable; and geometry is not the science of magnitude, in its most abstracted and general acceptation, but of magnitude which can be measured. It is, indeed, the Science of Measure, and whatever is treated in the way of mensuration is treated mathematically. Now, in the discourse of ordinary life and of ordinary men, many things are called quantities which we cannot or do not measure. This is the case in the instances already given of the affections of the mind, pleasure, pain, beauty, wisdom, honour, and the like. We do not say that they are incapable of measure; but we have not yet been able to measure them, nor do we think of measuring them when we speak rationally and usefully about them. We therefore do not consider them mathematically; nor can we introduce mathematical precision into our discussions of these subjects until we can, and actually do, measure them. Persons who are precise in their expression will even avoid such phrases on these subjects as suppose, or strictly express, such measurement. We should be much embarrassed how to answer the question, How much pain does the toothach give you just now; and how much is it easier since yesterday? Yet the answer, if we had a measure of pain, would be as easy as to the question, How many guineas did you win at cards? or how much land have you bought? Nay, although we say familiarly, "I know well how much such a misfortune would affect you," and are understood when we say it; it would be awkward language to say, "I know well the quantity of your grief." It is in vain, therefore, to expect mathematical precision in our discourse or conceptions of quantities in the most abstracted sense. Such precision is confined to quantity which may be and is measured.[1] It is only trifling with the imagination when we employ mathematical language upon subjects which have not this property. It will therefore be of some service in science to discriminate quantities in this view; to point out what are susceptible of measure, and what are not.

Measuring explained.

What is measuring? It is one of these two things: It is either finding out some known magnitude of the thing measured, which we can demonstrate to be equal to it; or it is finding a known magnitude of it, which being taken so many times, shall be equal to it. The geometer measures the contents of a parabolic space when he exhibits a parallelogram of known dimensions, and demonstrates that this parallelogram is equal to the parabolic space. In like manner, he measures the solid contents of an infinitely extended hyperbolic spindle, when he exhibits a cone of known dimensions, and demonstrates that three of these cones are equal to the spindle.

In this process it will be found that he actually subdivides the quantity to be measured into parts of which it consists, and states these parts as actually making up the quantity, specifying each, and assigning its boundaries. He goes on with it, piece by piece, demonstrating the respective equalities as he goes along, till he has exhausted the figure, or considered all its parts. When he measures by means of a submultiple, as when he shows the surface of a sphere to be equal to four of its great circles, he stops, after having demonstrated the equality of one of these circles to one part of the surface; and then he demonstrates that there are other three parts, each of which is precisely equal to the one he has minutely considered. In this part of the process he expressly assigns the whole surface into its distinct portions, of which he demonstrates the equality.

But there is another kind of geometrical measurement, which proceeds on a very different principle. The geometer conceives a certain individual portion of his figure, whether line, angle, surface, or solid, as known in respect to its dimensions. He conceives this to be lifted from its place, and again laid down on the adjoining part of the figure, and that it is equal to the part which it now covers; and therefore that this part, together with the first, is double of the first. He lifts it again, and lays it down on the next adjoining part, and affirms that this, added to the two former, make up a quantity triple of the first. He goes on in this way, making similar inferences, till he can demonstrate that he has in this manner covered the whole figure by twenty applications, and that his moveable figure will cover no more; and he affirms that the figure is twenty times the part employed.

Euclid's fourth proposition.

This mode is precisely similar to the manner of practical measurement in common life. We apply a foot-rule successively to two lines, and find that thirty applications exhaust the one, whilst it requires thirty-five to exhaust the other. We say, therefore, that the one line is thirty and the other thirty-five feet long; and that these two lines are to each other in the ratio of thirty to thirty-five. Having measured two shorter lines by a similar application of a stick an inch in length, thirty times to the one and thirty-five to the other, we say that the ratio of the two first lines is the same with that of the two last. Euclid has taken this method of demonstrating the fourth proposition of the first book of his celebrated Elements.

But all this process is a fiction of the mind, and it is the fiction of an impossibility: It is even inconceivable, that is, we cannot in imagination make this application of one figure to another; and we presume to say, that if the elements of geometry cannot be demonstrated in some other way, the science has not that title to pure, abstract, and infallible knowledge which is usually allowed it. We cannot suppose one of the triangles lifted and laid on the other, without supposing it something different from a triangle *in abstracto.* The individuality of such a triangle consists solely in its being in the precise place where it is, and in occupying that portion of space. If we could distinctly conceive otherwise, we should perceive that, when we have lifted the triangle from its place, and applied it to the other, it is gone from its former place, and that there is no longer a triangle there. This is inconceivable, and space has always been acknowledged to be immoveable. There is, therefore, some logical defect in Euclid's demonstration.[2] We apprehend that he is labouring to demonstrate, or rather illustrate, a simple apprehension. This indeed is the utmost that can be done in any demonstration; but the mode by which he guides the mind to the apprehension of the truth of his fourth proposition is not consistent either with pure mathematics or with the laws of corporeal nature. The real process, as laid down by him, seems to be this. We suppose something different from the abstract triangle; something that, in conjunction with other properties, has the property of being triangular, with certain dimensions of two of its sides and the included angle. It has avowedly another property, not essential to, and not contained in, the abstract notion of a triangle, namely, mobility. We also suppose it permanent in shape and dimensions, or that although, during its motion, it does not occupy the same space, it continues, and so do all its parts, to occupy an equal space. In short, our conception is very mixed, and does not perceptibly differ from our conception of a triangular piece of matter, where the triangle is not the subject, but an adjunct, a quality. And when we suppose the application made, we are not, in fact, supposing two abstract triangles to coincide. This we cannot do with anything like distinctness; for our distinct conception now is, not that of two triangles coinciding, but of one triangle being now exactly occupied by that moveable thing which formerly occupied the other. In short, it is a vulgar measurement, restricted by suppositions which are inadmissible in all actual measurements in the present universe, in which no moveable material thing is known to be permanent, either in shape or magnitude.

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[1] To talk intelligibly of the quantity of a pain, we should have some standard by which to measure it; some known degree of it so well ascertained, that all men, when talking of it, should mean the same thing. And we should be able to compare other degrees of pain with this, so as to perceive distinctly, not only whether they exceed or fall short of it, but also how much, or in what proportion; whether by an half, or a fifth, or a tenth.

[2] We do not think so. The demonstration of this and of several other propositions, which form the basis of all the subsequent reasonings of Euclid, rests upon, and, in fact, is nothing more than an appeal to observation, though of the simplest kind; and hence there is no radical or essential distinction between mathematical evidence, and that which we have in the physical sciences, the only difference being that the former proceeds on observations so simple as almost to escape our notice.

This is an undeniable consequence of the principle of universal gravitation, and the compressibility of every kind of tangible matter with which we are acquainted. Remove the brass rule but one inch from its place; its gravitation to the earth and to the rest of the universe is immediately changed, and its dimensions change of consequence. A change of temperature will produce a similar effect; and this is attended to and considered in all nice mensurations. We do the best we can to assure ourselves that our rule always occupies a sensibly equal space; and we must be contented with chances of error which we can neither perceive nor remove.

Were this a proper place, we might take notice of some other logical defects in the reasoning of this celebrated proposition. But they are beside our present purpose of explaining the different modes of mathematical measurement, with the view of discovering that circumstance in which they all agree, and which, if the only one, must therefore be the characteristic of mensuration.

The characteristic notion of mensuration.

We think that the only circumstance in which all modes of mensuration agree, or the only notion that is found in them all, is, that the quantity is conceived as consisting of parts, distinguishable from each other, and separated by assignable boundaries; so that they are at once conceived separately and jointly. We venture to assert that no quantity is directly measured which we cannot conceive in this way, and that such quantities only are the immediate objects of mathematical contemplation, and should be distinguished by a generic name. Let them be called mathematical quantities. Extension, duration, number, and proportion, have this characteristic, and they are the only quantities which have it. Any person will be convinced of the first assertion by attending to his own thoughts when contemplating these notions. He will find that he conceives every one of them as made up of its own parts, which are distinguishable from each other, and have assignable boundaries, and that it is only in consequence of involving this conception that they can be added to or subtracted from each other; that they can be multiplied, divided, and conceived, in any proportion to each other.

He may perhaps find considerable difficulty in acquiring perfectly distinct notions of the mensurability, and the accuracy of the modes of mensuration. He will find that the way in which he measures duration is very similar to that in which he measures space or extension. He does not know, or does not attend to, anything which hinders the brass foot-rule in his hand from continuing to occupy equal spaces during his use of it in measuring the distance of two bodies. In like manner, he selects an event which nature or art can repeat continually, and in which the circumstances which contribute to its accomplishment are invariably the same, or their variations and their effects are insensible. He concludes that it will always occupy an equal portion of time for its accomplishment, or always last an equal time. Then, observing that, during the event whose duration he wishes to measure, this standard event is accomplished twenty-nine and a half times, and that it is repeated 365¼ times during the accomplishment of another event, he affirms that the durations of these are in the ratio of twenty-nine and a half to 365¼. It is thus, and with the same logical defect as in the measuring a line by means of a brass rod, that the astronomer measures the celestial revolutions by means of the rotation of the earth round its axis, or by the vibrations of a pendulum.

For most of the preceding observations we have been indebted to Dr Reid, who published a dissertation on this subject in the forty-fifth volume of the Philosophical Transactions, which we recommend to our philosophical readers as a performance eminent for precision and acuteness. If we presume to differ from him in any trivial circumstance, it is with that deference and respect which all must consider as due to his talents and his fame.

Characters of mathematical quantity.

Dr Reid justly observes, that as nothing has proportion which has not either extension, duration, or number, so the characters of mathematical quantity may be restricted to these three. He calls them *proper* quantities, and all others he calls *improper*. We believe that, in the utmost precision of the English language, this denomination is very apposite, and that the word *quantity*, derived from *quantum*, always supposes measurement. But the word is frequently used in cases where its original sense is not kept in view, and we use other words as synonymous with it, when all mensuration, whether possible or not, is out of our thoughts. According to practice, therefore, the *jus et norma loquendi*, there seems to be no impropriety in giving this name, in our language at least, to whatever can be conceived as great or as little. There is no impropriety in saying that the pain occasioned by the stone is greater than that of the toothach; and when we search for the category to which the assertion may be referred, we cannot find any other than quantity. We may be allowed therefore to say, with almost all our scientific countrymen, that everything is conceivable in respect of quantity which we can think or speak of as greater and less; and that this notion is the characteristic of quantity as a genus, whilst measurableness is the characteristic of mathematical quantity as a species.

But do we not measure many quantities, and consider them mathematically, which have not this characteristic of being made up of their own distinguishable parts? What else is the employment of the mechanician, when speaking of velocities, forces, attractions, repulsions, magnetical influence, chemical affinity, and the like? Are not these mathematical sciences? And if the precision and certainty of mathematics arise from the nature of their specific object, are not all the claims of the mechanician and physical astronomer ill-founded pretensions? These questions require and deserve a serious answer.

Velocity, force, density; how measured.

It is most certain that we consider the notions which are expressed by these terms, velocity, force, density, and the like, as susceptible of measure, and we consider them mathematically. Some of these terms are nothing but names for relations of measurable quantity, and only require a little reflection to show themselves such. *Velocity* is one of these. It is only a name expressing a relation between the space described by a moving body and the time which elapses during its description. Certain moderate rates of motion are familiar to us. But what greatly exceeds this, such as the flight of a bird when compared with our walking, excites our attention, and this excess gets a name. A motion not so rapid as we are familiar with, or as we wish, also gets a name, because in this the excess or defect may interest us. We wish for the flight of the hawk; we chide the tardy pace of our messenger; but it is scientific curiosity which first considers this relation as a separate object of contemplation, and the philosopher must have a name for it. He has not formed a new one, but he makes use of a word of common language, the natural meaning of which is the combination of a great space with a short time. The philosopher having once appropriated it, in his scientific vocabulary, to this very general use, it loses with him its true signification. Tardiness would have done just as well, though its true meaning is diametrically opposite; and there is no greater impropriety in saying the slowness of a cannon-bullet than in saying the velocity of the hour-hand of a watch. Velocity is a quality or affection of motion, the notion of which includes the notions of space and duration, two mathematical quantities, and no other. It does not therefore express a mathematical quantity itself, but a relation, a combination of two mathematical quantities of different kinds; and as it is measurable in the quantities so combined, its measure must be an unit of its own kind, that is, an unit of space as combined with an unit of time.

Density is another word of the same kind, expressing a combination of space with number. *Densæ arbores* mean trees standing at a small distance from each other; and the word is used in the same sense when we say that quicksilver is denser than water. The expression always suggests to the reflecting mind the notions of particles and their distances. We are indeed so habituated to complicated views of things, that we can see remote connections with astonishing rapidity; and a very few circumstances are sufficient for leading forward the mind in a train of investigation. Common discourse is a most wonderful instance of this. In this way we say, that we found by actually weighing them that inflammable air had not the sixth part of the density of common air. Supposing all matter to consist of equal atoms equally heavy, and knowing that the weight of a bladder of air is the sum of the weights of all the atoms, and also knowing that the vicinity of the atoms is in a certain proportion of the number contained in a given bulk, we affirm that common air is more than six times denser than inflammable air; but this rapid decision is entirely the effect of habit, which renders us familiar with certain groups of conceptions, and we instantaneously distinguish them from others, and thus think and discourse rationally. The Latin language employs the word *frequens* to express both the combination of space and number, and that of time and number.

There are perhaps a few more words which express combinations of mathematical quantities of different kinds; and the corresponding ideas or notions are therefore the proper and immediate subjects of mathematical discussion. But there are many words which are expressive of things, or at least of notions, to which this way of considering them will not apply. All those affections or qualities of external bodies, by which they are conceived to act on each other, are of this kind; impulsive force, weight, centripetal and centrifugal force, magnetical, electrical, chemical attractions and repulsions, in short, all that we consider as the immediate causes of natural phenomena. These we familiarly measure, and consider mathematically.

Forces measured in the phenomena.

What was said on this subject in the article PHYSICS will give us clear conceptions of this process of the mind. These forces or causes are not immediate objects of contemplation, and are known only by and in the phenomena which we consider as their effects. The phenomenon is not only the indication of the agency of any cause, and the characteristic of its kind, but the measure of its degree. The necessary circumstances in this train of human thought are, 1st, The notion of the force as something susceptible of augmentation and diminution; and, 2d, The notion of an inseparable connection of the force with the effect produced, and of every degree of the one with a corresponding degree of the other. From these is formed the notion that the phenomenon or effect is the proper measure of the force or cause. All this is strictly logical.

But when we are considering these subjects mathematically, the immediate objects of our contemplation are not the forces which we are thus treating. It is not their relations which we perceive, and which we combine with such complication of circumstances and certainty of inference as are known in all other sciences. By no means; they are the phenomena only, which are subjects of purely mathematical discussion. They are motions which involve only the notions of space and time; and when we have finished an accurate mathematical investigation, and make our affirmation concerning the forces, we are certain of its truth, because we suppose the forces to have the proportions and relations, and no other, which we observe in the phenomena. Thus, after having demonstrated, by the geometrical comparison of the lines and angles and surfaces of an ellipse, that the momentary deflection of the moon from the tangent of her orbit is the 3600th part of the simultaneous deflection of a stone from the tangent of its parabolic path, Newton affirms, that the force by which a particle of the moon is retained in her orbit is the 3600th part of the weight of a particle of the stone; and having further shown, from fact and observation, that these momentary deflections are inversely as the squares of the distances from the centre of the earth, he affirms that all this is produced by a force which varies its intensity in this manner.

Now all this investigation proceeds upon the two suppositions mentioned above, and the measures of the forces are in fact the measures of the phenomena. The whole of physical astronomy, and indeed the whole of mechanical philosophy, might be taught and understood, without ever introducing the word force, or the notion which it is supposed to express; for our mathematical reasonings are really about the phenomena, which are subjects purely mathematical.

The precision, therefore, which we presume to affirm must attend these investigations, arises entirely from the measurable nature of the quantities that are the real objects of our contemplation, and the suitableness and propriety of the measures which we adopt in our comparisons.

Since, then, the phenomena are the immediate subjects of our discussion, and the operating powers are only inferences from the phenomena considered as effects, the quantity ascribed to them must also be an inference from the quantity of the effect, or of some circumstance in the effect. The measure, therefore, of the cause, or natural power or force, cannot be one of its own parts; for the whole and the part are equally unperceived by us. Our measure, accordingly, must be a measure of some interesting part, or of the only interesting part of the phenomenon. It is therefore in a manner arbitrary, and depends chiefly on the interest we take in the phenomenon. It must, however, be settled with precision, so that all men in using it may mean the same thing. It must be settled, therefore, by the description of that part or circumstance of the phenomenon which is characteristic of the natural power. This description is the definition of the measure.

Measures of centripetal force.

Thus Newton assumes as the measure of his centripetal force, the momentary deviation from uniform rectilineal motion. Others, and sometimes Newton himself, assume the momentary change of velocity, which again is measured by twice this deviation. These measures, being thus selected, are always proper in a mathematical sense, and, if strictly adhered to, can never lead us into any paralogism. They may, however, be physically wrong. There may not be that indissoluble connection between the phenomenon and the supposed cause. But this is no mathematical error, nor does it invalidate any of our mathematical inferences. It only makes them useless for explaining the phenomenon by the principle which we adopted; but it prepares a modification of the phenomenon for some more fortunate application of physical principles.

All that can be desired in the definitions or descriptions of these measures is, that they may not deviate from the ordinary use of the terms, because this would always create confusion and occasion mistakes. Dr Reid has given an example of an impropriety of this kind, which has been the subject of much debate amongst the writers on natural philosophy; we mean the measure of the force inherent in a body in motion.

Controversy between the Cartesians and Leibnitzians.

Descartes, and all the writers of his time, assumed the velocity produced in a body as the measure of the force which produces it; and observing that a body, in consequence of its being in motion, produces changes in the state or motion of other bodies, and that these changes are in the proportion of the velocity of the changing body, they asserted that there is in a moving body a *vis insita*, an *inherent force*, and that this is proportional to its velocity; saying that its force is twice or thrice as great, when it moves twice or thrice as fast at one time as at another. But Leibnitz observed, that a body which moves twice as fast rises four times as high, against the uniform action of gravity; that it penetrates four times as deep into a piece of uniform clay; that it bends four times as many springs, or a spring four times as strong, to the same degree; and produces a great many effects which are four times greater than those produced by a body which has but half the initial velocity. If the velocity be triple, quadruple, &c. the effects are nine times, sixteen times, &c. greater; and, in short, are proportional, not to the velocity, but to its square. This observation had been made before by Dr Hooke, who enumerated a prodigious variety of important cases in which this proportion of effect is observed. Leibnitz, therefore, affirmed that the force inherent in a moving body is proportional to the square of the velocity.

It is evident that a body, moving with the same velocity, has the same inherent force, whether this be employed to move another body, to bend springs, to rise in opposition to gravity, or to penetrate a mass of soft matter. Therefore these measures, which are so widely different, whilst each is agreeable to a numerous class of facts, are not measures of this something inherent in the moving body which we call its force, but are the measures of its exertions when modified according to the circumstances of the case; or, to speak still more cautiously and securely, they are the measures of certain classes of phenomena consequent upon the action of a moving body. It is in vain, therefore, to attempt to support either of them by a demonstration. The measure itself is nothing but a definition. The Cartesian calls that a double force which produces a double velocity in the body upon which it acts. The Leibnitzian calls that a quadruple force which makes a quadruple penetration. The reasonings of both in the demonstration of a proposition in dynamics may be the same, as also the result, though expressed in different numbers.

But the two measures are far from being equally proper; for the Leibnitzian measure obliges us to do continual violence to the ordinary use of words. When two bodies moving in opposite directions meet, strike each other, and stop, all men will say that their forces are equal, because they have the best test of equality which we can devise. Or when two bodies in motion strike the parts of a machine, such as the opposite arms of a lever, and are thus brought completely to rest, we and all men will pronounce their mutual energies by the intervention of the machine to be equal. Now, in all these cases, it is well known that a perfect equality is found in the products of the quantities of matter and velocity. Thus a ball of two pounds, moving with the velocity of four feet in a second, will stop a ball of eight pounds moving with the velocity of one foot per second. But the followers of Leibnitz say that the force of the first ball is four times that of the second.

All parties are agreed in calling gravity an uniform or invariable accelerating force; and the definition which they give of such a force is, that it always produces the same acceleration, that is, equal accelerations in equal times, and therefore produces augmentations of velocity proportional to the times in which they are produced. The only effect ascribed to this force, and consequently the only thing which indicates, characterises, and measures it, is the augmentation of velocity. What is this velocity, considered not merely as a mathematical term, but as a phenomenon, or as an event produced by the operation of a natural cause? It cannot be conceived any other way than as a determination to move on for ever at a certain rate, if nothing shall change it. We cannot conceive this very clearly. We feel ourselves forced to animate, as it were, the body, and give it not only a will and intention to move in this manner, but a real exertion of some faculty in consequence of this determination of mind. We are conscious of such a train of operations in ourselves; and the last step of this train is the exertion or energy of some natural faculty, which we, in the utmost propriety of language, call force. By such analogical conception, we suppose a something, an energy, inherent in the moving body; and its only office is the production and continuation of this motion, as in our own case. Scientific curiosity was amongst our latest wants, and language was formed long before its appearance. As we formed analogical conceptions, we contented ourselves with the words already familiar to us, and to this something we gave the name *force*, which expressed that energy in ourselves which bears some resemblance, in office at least, to the determination of a body to move on at a certain rate. This sort of allegory pervades the whole of our conceptions of natural operations, and we can hardly think or speak of any operation without a language, which supposes the animation of matter. And in the present case there are so many points of resemblance between the effects of our exertions and the operations of nature, that the language is most expressive, and has the strongest appearance of propriety. By exerting our force we not only move and keep in motion, but we move other bodies. In like manner, a ball not only moves, but puts other bodies in motion, or penetrates them. This is the origin of that conception which so forcibly intrudes itself into our thoughts, that there is inherent in a moving body a force by which it produces changes in other bodies. No such thing appears in the same body if it be not in motion. We therefore conclude that it is the production of the moving force, whatever that has been. If so, it must be conceived as proportional to its producing cause. Now this force, thus produced or exerted in the moving body, is only another way of conceiving that determination which we call velocity, when it is conceived as a natural event. We can form no other notion of it. The *vis insita*, the determination to move at a certain rate, and the velocity, are one and the same thing, considered in different relations.

Vis insita.

Therefore the *vis insita corpori moventi*, the determination to move at a certain rate, and the velocity, should have one and the same measure, or any one of them may be taken as the measure of the other. The velocity being an object of perception, is therefore a proper measure of the inherent force; and the propriety is more evident by the perfect agreement of this use of the words with common language. For we conceive and express the action of gravity as uniform, when we think and say that its effects are proportional to the times of its action. Now all agree that the velocity produced by gravity is proportional to the time of its action. And thus the measure of force, in reference to its producing cause, perfectly agrees with its measure, independent of this consideration. But this agreement is totally lost in the Leibnitzian doctrine; for the body which has fallen four times as far, and has sustained the action of gravity twice as long, is said to have four times the force.

The quaintness and the continued paradox of expression

Conservatio virium vivarum.

which this measure of inherent force leads us into, would have quickly exploded it, had it not been that its chief abettors were leagued in a keen and acrimonious warfare with the British mathematicians who supported the claim of Sir Isaac Newton to the invention of fluxions. They rejoiced to find in the elegant writings of Huygens a physical principle of great extent, such as this, which could be set in comparison with some of the wonderful discoveries in Newton's *Principia*. The fact, that in the mutual action of bodies on each other the product of the masses and the squares of the velocities remain always the same, which they call the *conservatio virium vivarum*, is of almost universal extent; and the knowledge of it enabled them to give ready and elegant solutions of the most abstruse and intricate problems, by which they acquired a great and deserved celebrity. Dr Robert Hooke, whose observation hardly anything escaped, was the first who remarked,[1] long before Huygens, that in all the cases of the gradual production and extinction of motion, the sensible phenomenon is proportional to the square of the produced or extinguished velocity.

Law of continuity.

John Bernoulli brought all these facts together, and systematized them according to the principle advanced by Huygens in his treatise on the centre of oscillation. He and Daniel Bernoulli gave most beautiful specimens of the prodigious use of this principle for the solution of difficult physical problems, in their dissertations on the motion and impulse of fluids, and on the communication of motion. It was, however, very early objected to them, that in the collision of bodies perfectly hard there was no such *conservatio virium vivarum;* and that in this case the forces must be acknowledged to be proportional to the velocities. The objections were unanswerable. But John Bernoulli evaded their force, by affirming that there were not and could not be bodies perfectly hard. This was the origin of another celebrated doctrine, on which Leibnitz greatly plumed himself; namely, the law of continuity, that nothing is observed to change abruptly, or *per saltum*. But no one will pretend to say that a perfectly hard body is an inconceivable thing; on the contrary, all will allow that softness and compressibility are adjunct ideas, and not in the least necessary to the conception of a particle of matter, nay totally incompatible with our notion of an ultimate atom.

Great superiority of Newton.

Sir Isaac Newton never could be provoked to engage in this dispute. He always considered it as a wilful abuse of words, and unworthy of his attention. He guarded against all possibility of cavil, by giving the most precise and perspicuous definitions of those measures of forces, and of all other quantities which he had occasion to consider, and by carefully adhering to them. And in one proposition of about twenty lines, namely, the thirty-ninth of the first book of the *Principia*, he explained every phenomenon adduced in support of the Leibnitzian doctrine, showing them to be the immediate consequences of the action of a force measured by the velocity which it produces or extinguishes. There it appears that the heights to which bodies will rise in opposition to the uniform action of gravity are as the squares of the initial velocities; so are the depths to which they will penetrate uniformly resisting matter, and so is the number of equal springs which they will bend to the same degree. We have had frequent occasion to mention this proposition as the most extensively useful of all Newton's discoveries. It is that which gives the immediate application of mechanical principles to the explanation of natural phenomena. It is incessantly employed in every problem by the very persons who hold by the other measure of forces, although such conduct is virtually giving up that measure. They all adopt, in every investigation, the two theorems $f\dot{t}=\dot{v}$, and $f\dot{s}=v\dot{v}$; both of which suppose an accelerating force f proportional to the velocity v which it produces by its uniform action during the time t; and the theorem $\int f\dot{s}=v^2$ is the thirty-ninth of the first book of the *Principia*, and is the *conservatio virium vivarum.*

This famous dispute, the only one in the circle of mathematical science, has led us somewhat aside. But we have little more to remark with respect to measurable quantity. We cannot say what varieties of quantity are susceptible of strict measure, or that it is impossible to give accurate measures of everything susceptible of augmentation and diminution. We affirm, however, with confidence, that pain, pleasure, joy, and the like, are not made up of their own parts, which can be contemplated separately; but they may chance to be associated by nature with something that is measurable, and we may one day be able to assign their degrees with as much precision as we now ascertain the degrees of warmth by the expansion of the fluid in the thermometer. There is one sense in which they may all be measured, viz. numerically, as Newton measures density, *vis motrix*, and so forth. We can conceive the pain of each of a dozen of men to be the same. Then it is evident that the pain of eight of these men is to that of the remaining four as two to one; but from such mensuration we do not foresee that any benefit is likely to arise.

QUANTITY, in *Grammar*, is an affection of a syllable, by which its measure, or the time it occupies in pronunciation, is ascertained; or that which determines the syllable to be long or short.

Quantity is also the object of prosody, and distinguishes verse from prose; whilst the economy and arrangement of quantities, that is, the distribution of long and short syllables, constitutes what is called *number*.

Quantities are usually distinguished amongst grammarians by the characters of short and long. There is also a common, variable, or dubious quantity; that is, syllables which are at one time taken for short, and at another time for long ones.

QUARANTINE is a trial which ships must undergo when suspected of pestilential infection. It may be ordered by the king, with advice of the privy-council, at such times, and under such regulations, as he judges proper. Ships ordered on quarantine must repair to the place appointed, and continue there during the time prescribed; and they must have no intercourse with the shore, except for necessary provisions, which are conveyed with every possible precaution. When the time is expired, and the goods have been opened and exposed to the air as directed, if there be no appearance of infection, they are admitted to port. See PLAGUE.

QUARLES, FRANCIS, the son of James Quarles, clerk to the board of green cloth, and purveyor to Queen Elizabeth, was born in 1592. He was educated at Cambridge, became a member of Lincoln's Inn, and was for some time cup-bearer to the queen of Bohemia, and chronologer to the city of London. It was probably on the ruin of the queen's affairs that he went to Ireland as secretary to Archbishop Usher; but the troubles in that kingdom forced him to return; and not finding affairs more settled in England, some disquiets he met with were thought to have hastened his death, which happened in 1644. His works, both in prose and in verse, are numerous, and were formerly in great esteem, particularly his Divine Emblems; but the obsolete quaintness of his style has caused them to fall into neglect, excepting amongst particular classes of readers. "The memory of Quarles," says Headley, "has been branded with more than common abuse, and he seems to have been censured merely from the want of being read. If his poetry failed to gain him friends and readers, his piety should at least have secured him peace and good will. He too often, no doubt, mistook the enthusiasm of devotion for the inspiration of fancy. To mix the waters of Jordan and Helicon in the same cup, was reserved for the hand of Milton; and for him, and him only, to find the bays of Mount Olivet equally verdant with those of Parnassus. Yet, as the effusions of a real poetical mind, however thwarted by untowardness of subject, will seldom be rendered totally abortive, we find in Quarles original imagery, striking sentiment, fertility of expression, and happy combinations; together with a compression of style that merits the observation of the writers of verse. Gross deficiencies of judgment, and the infelicity of his subjects, concurred in ruining him."

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[1] *Micrographia, vis restitutiva*, &c. in his Posthumous Works.

QUARNARO, the collective name of some islands situated on the coast of Austrian Dalmatia, in a gulf near to Istria, which is secure as a harbour. The whole of these islands are fertile and well cultivated. The largest of them, Arbe, contains 3000 inhabitants; the next in size, Pago, has 4000. One important product, salt, is made in many lagunes by the power of the sun. The inhabitants of these islands are a mixed race, consisting of Italians and Sclavonians, and not too much civilized.

QUARRY, a place under ground, from which are extracted marble, freestone, slate, limestone, or other matters proper for building.

Quarry, or *Quarrel*, amongst glaziers, means a pane of glass cut in the form of a diamond.

Quarries are of two kinds, square and long, each of which is of a different size, and expressed by the number of the pieces that make a foot of glass, viz. eighths, tenths, eighteenths, and twentieths; but all the sizes are cut to the same angles, the acute angle in the square quarrels being 77° 19′, and in the long ones 67° 21′.

Quarry, amongst hunters, is sometimes used for a part of the entrails of the beast taken, which is given by way of reward to the hounds.

Quarry, in falconry, is the game which the hawk is in pursuit of, or has killed.

QUART, a measure of capacity, being the fourth part of some other measure. The English quart is the fourth part of the gallon, and contains two pints.

QUARTAN, a measure containing the fourth part of some other measure.

Quartan, a species of intermitting fever.

QUARTATION is an operation by which the quantity of one thing is made equal to a fourth part of the quantity of another thing. Thus when gold alloyed with silver is to be parted, we are obliged to facilitate the action of the aquafortis, by reducing the quantity of the former of these metals to one fourth part of the whole mass; which is done by sufficiently increasing the quantity of the silver, if it be necessary. This operation is called quartation, and is preparatory to the parting; and many authors even extend this name to the operation of parting.

QUARTER, the fourth part of any thing, the fractional expression for which is $\frac{1}{4}$.

Quarter, in weights, is generally used to signify the fourth part of an hundredweight avoirdupois, or twenty-eight pounds. Quarter, used as the name of a dry measure, is the fourth part of a ton in weight, or eight bushels.

Quarter, a term in the manège. To work from quarter to quarter, is to ride a horse three times in upon the first of the four lines of a square, then changing your hand, to ride him three times upon the second, and so to the third and fourth, always changing hands, and observing the same order.

Quarters, with respect to the parts of a horse, is employed in various senses. Thus the shoulders and fore-legs are called the *fore-quarters*, and the hips and hinder-legs the *hind-quarters*. The quarters of a horse's foot are the sides of the coffin, comprehending between the toe and the heel; the *inner* quarters are those opposite to one another, facing from one foot to the other, and these are always weaker than the *outside* quarters, which lie on the external sides of the coffin. *False-quarters* are a cleft in the horn of a horse's hoof, extending from the coronet to the shoe. A horse is said to be a *quarter-cast* when, for any disorder in the coffin, we are obliged to cut one of the quarters of the hoof.

Quarter, in *Astronomy*, the fourth part of the moon's period. Thus, from the new moon to the quadrature is the first quarter; from this to full moon, the second quarter; and so on.

Quarter, in *Heraldry*, is applied to the parts or members of the first division of a coat that is quartered, or divided into quarters.

Franc Quarter, in *Heraldry*, is a quarter single or alone, which possesses one-fourth part of the field. It forms one of the honourable ordinaries of a coat.

Quarter of a Ship, that part of a ship's side which lies towards the stern, or which is comprehended between the aftmost end of the main chains and the sides of the stern, where it is terminated by the quarter-pieces.

Quarter-Master, an officer whose principal business it is to look after the quarters of the soldiers, their clothing, bread, ammunition, firing, and the like.

Quarter-Master-General is an important officer in the army, and should not only be a man of great judgment and experience, but well skilled in geography. His duty is to mark out the marches and encampments of an army; and therefore he should know the country perfectly well, with its rivers, plains, marshes, woods, mountains, defiles, and passages, nay, even the smallest accident of the ground. Prior to a march, he receives the order and route from the general commanding, and appoints a place for the quarter-masters of the army to meet him next morning, with whom he marches to the next camp, where, having viewed the ground, he marks out to the regimental quarter-masters the ground allowed each regiment for their camp; he chooses the head-quarters, and appoints the villages for the generals of the army's quarters; he appoints a proper place for the encampment of the train of artillery; he conducts foraging parties, as likewise the troops to cover them against assaults, and has a share in regulating the winter-quarters and cantonments. See Army.

Quarter-Sessions, a general court which is held quarterly by the justices of peace of each county.

QUARTERS, a name given at sea to the several stations where the officers and crew of a ship of war are posted in action.

Quarters, at a siege, the encampment upon one of the principal passages round a place besieged, to prevent relief and convoys.

Head-Quarters of an Army, the place where the commander-in-chief has his quarters.

Intrenched Quarters, a place fortified with a ditch and parapet, to secure a body of troops.

Winter Quarters sometimes means the space of time included between leaving the camp and taking the field; but more properly the places where the troops are quartered during the winter.

QUARTETTO, *Quartet*, in music, a composition for four voices, or for four instruments, in which the parts are all *obbligati*; that is, in which no one of the parts can be omitted without injuring the proper effect of the composition. To understand the structure of instrumental quartettos of this kind, those of Haydn, Mozart, Beethoven, Spohr, Onslow, and a very few others, must be examined. Vocal quartettos are generally accompanied by instruments, to sustain the voices. A mere interchange of melody between one part and another, where the parts alternately become principal and subordinate, without any interweaving of them by means of imitations, double counterpoint, &c. does not constitute a regular quartetto. Neither is a regular quartetto found in a composition that consists of one principal part, accompanied from beginning to end by three other parts, which are merely harmonic supports to the principal part. See Music and Principal.

QUARTILE, an aspect of the planets when they are at the distance of ninety degrees from each other, and which is denoted by the character □.

QUARTERING, in *Heraldry*, is dividing a coat into four or more quarters or quarterings, by parting, couping, and otherwise, that is, by perpendicular and horizontal lines.

QUARTO-Decimans, an ancient sect in the Christian church, who taught that Easter should always be celebrated according to the custom of the Jews, on the fourteenth day of the moon in the month of March, whensoever that day might fall out; and hence they derived their name, *quartodecimani*, or fourteenth-men. The Asiatics were mightily attached to this opinion, pretending that it was built on the authority of St John, their apostle; and Pope Victor could never bring them to obedience in this article, though he was upon the point of excommunicating them.

QUARTU, a city of the island of Sardinia, in the diocese of Cagliani. It stands on a bay of the same name. Though many of the houses are respectable, they are all built of bricks dried by the sun. The walls of the church-yard are strangely decorated with skulls and thigh-bones. The situation is tolerably healthy. The inhabitants amount to 5129.

QUATRE-BRAS, a village of the Netherlands, in the circle of Nivelles, receiving its name from two great roads crossing each other at this point, where there is a direction-post with four arms. It is worthy of remark as the spot where the first meeting took place between the British and French troops two days before the decisive battle of Waterloo. This contest was obstinate and bloody, and the loss on both sides heavy, whilst the success was doubtful. The British received there the intelligence of the defeat of the Prussians at Ligny; and their artillery not being come up, they retreated the next day to the field of Waterloo, where they completed the work of the campaign. The reigning duke, Frederick William of Brunswick, fell in the attack of the French on his troops.

QUATUORVIR, in *Antiquity*, formerly written IIII. Vir, a Roman magistrate, who had three colleagues joined with him in the same administration, and had the care of conducting and settling the colonies sent into the provinces. There were also quatuorviri appointed to inspect and take care of repairs.

QUAVER, in *Music*, a measure of time equal to half a crotchet, or an eighth part of a semibreve.

QUEBEC, the capital of Lower Canada, is situated upon the north-eastern extremity of a promontory called Cape Diamond, three hundred and fifty feet above the water level, on the left bank of the river St Lawrence. The rocky ridge upon which the city stands is formed by the St Lawrence and the St Charles, the former river flowing to the southward of Quebec, and the latter to the northward, and the junction taking place in front of the town, where they expand into a considerable basin forming the harbour of Quebec. The distance from the one river to the other, across the ridge, is rather more than a mile. It is divided into two parts, Upper and Lower Quebec. The latter is built at the base of the promontory, nearly on a level with high-water mark. The communication from this to the upper town is by a long, narrow, winding, and extremely steep street, which terminates close to the city walls, at an elevation of two hundred feet above the river. Here Upper Quebec commences, extending its limits considerably to the westward along the slope of the ridge, and up the promontory towards the cape, within fifty or sixty yards of its summit, which is crowned by the citadel. This part of the town contains the government buildings, the residence of the governor, the military, and the most opulent of the inhabitants, with the best and handsomest streets, and the most agreeable mansions. The lower town is much more crowded and mean in appearance, and is very filthy and inconvenient. The streets are narrow, the foot-pavement being barely sufficient for a single passenger; the houses have a gloomy and monotonous aspect, and many of them are said to be built of wood, although there exists a statute forbidding the use of this material in the construction of the main part of buildings, as a security against the dreadful conflagrations which have so often desolated the cities of the west. The warehouses are built of stone; and this ill-favoured portion of Quebec is the chief seat of the commerce and traffic by which the city is enriched. Amongst the public buildings may be mentioned the castle of St Louis, a huge vice-regal chateau, supported by piers, and overhanging the precipice; the Hotel Dieu, the Protestant and Catholic cathedrals, and a number of other religious edifices; the exchange, bank, court-house, hospitals, barracks, gaol, and others. There is a French seminary or college, containing usually about two hundred pupils, and other establishments connected with education. In the district of Quebec there are five public or free schools, in the district of Montreal twenty-four, and in the district of Three Rivers six public schools, under the superintendence of the Board of Royal Institution for the Advancement of Learning, incorporated by the provincial act 41st Geo. III. cap. 17. To this board the legislature makes an annual grant. Each teacher is bound to instruct one third of the number of pupils gratuitously, and in no case to charge more than three shillings and fourpence per month. The visitors may vary the rate according to the number of children in each family who attend school, and the circumstances of the parents. There are also two grammar-schools, one at Quebec and another at Montreal, supported by an annual grant of L.200 each from the Jesuit Estates Fund, with L.90 and L.50 respectively for house-rent. These are also under the superintendence of the Royal Institution. The system of instruction is that of the public grammar schools of England. Twenty-six free scholars are admitted into each of them. The rate of tuition for others is L.12 per annum. There are also upwards of a thousand schools established under the provincial act 9 Geo. IV. cap. 46, attended by about 45,600 scholars of both sexes. L.20 are allowed to each teacher having at least twenty children under his care. These schools are under the direction of trustees annually elected by the inhabitants. No particular system of tuition is followed, but the Lancasterian is pursued in a few of them. There are also several Roman Catholic colleges in the province, and a number of private seminaries for the higher branches of education. Besides these, there were in Lower Canada, in 1835, 1170 elementary schools, attended by 21,014 boys and 16,654 girls, of whom 12,495 were taught gratis, and 25,173 were paid for. The houses were mostly roofed with shingles, but many of those of a better sort, and the public buildings and great warehouses, are covered with tin or iron plates. There are several distilleries, breweries, tobacco, soap, candle, and other manufactories. Excellent ships are built here, and every variety of tradesmen may be found in the upper or lower town. Many of the shops, or stores as they are called in America, are elegantly fitted up, and well supplied with every commodity in demand. There are suburbs attached to each town.

One of the leading features of Quebec is its fortifications, it being the strongest place in America. "As a fortress," says Mr Montgomery Martin, "Quebec may now be ranked in the first class, the citadel, on the highest point of

Cape Diamond, together with a formidable combination of strongly constructed works, extending over an area of forty acres. Small batteries, connected by ramparts, are continued from the edge of the precipice to the gateway leading to the lower town, which is defended by cannon of a large calibre, and the approach to it up Mountain Street (which connects the upper and lower town) enfiladed and flanked by many large guns. A line of defence connects with the grand battery a redoubt of great strength, armed with twenty-four pounders, entirely commanding the basin and passage of the river. Other lines add to the impregnability of Quebec if properly defended, the possession of which may be said to give the mastery of Upper as well as of Lower Canada." To the west, and in front of the citadel, are the celebrated plains of Abraham, where was achieved the victory which wrested Canada from France, and annexed it to the British empire. An obelisk marks the field where Wolf and Montcalm fought and perished. The basin or harbour of Quebec is very beautiful, safe, and spacious, being sufficient to contain a hundred sail of the line. The river St Lawrence is twelve miles broad above the city, but is here contracted to one mile in breadth. The commerce of Quebec is considerable, indeed nine tenths of the trade of Canada is carried on from this city. The imports consist of British manufactures, wine, rum, and other spirits, sugar, coffee, tea, salt, and tobacco. The exports, the produce of the Canadas, are ships' masts, spars, timber, various kinds of prepared wood, pot and pearl ash, fish, oil, seal-skins, pork, beef, butter, lard, live-stock, hides, castoreum, capillaire, natural curiosities, wheat, Indian corn, and the like, as also furs; and there is likewise a re-exportation of British fabrics, West India produce, and teas. The imports into Lower Canada, during the year 1835, amounted to L.1,496,376, and the exports to L.896,847, of which L.7750 was for fish, L.30,590 for corn, and L.620,182 for wood. The amount of the paper currency in 1835 was L.268,881, of which L.52,535 was in notes of the Quebec bank, and L.216,346 in notes of the Montreal bank. The following table shows the amount of shipping in 1835.

Countries.	Inwards.					
	Quebec.		Montreal.		St John's.	
	Ships.	Tons.	Ships.	Tons.	Ships.	Tons.
Great Britain.....	869	277,125	78	19,984	...	...
British colonies...	186	21,158	27	2,524	4	340
United States.....	24	6,507	1	155	1324	69,086
Foreign states....	26	6,700	2	210	...	...
Total...........	1105	311,490	108	22,873	1328	69,426
Men employed...	13,425		1134		3422	
	Outwards.					
Great Britain.....	946	300,097	69	17,893	...	...
British colonies...	186	14,003	28	2,767	4	320
United States.....	4	397	8	1,678	820	68,607
Foreign states....	8	1,477	1	263	...	...
Total...........	1144	315,974	106	22,601	824	68,927
Men employed...	13,614		1103		2909	

Emigration to Quebec was for many years carried on to a great extent; the number of arrivals in the year 1832 being 51,746. The recent disturbances in Canada, and the opening up of a new field for emigration in Australasia, have combined to check the influx of Europeans, so that in the year 1836 they had diminished to 27,728, in 1837 to 22,500, and in 1838 to only 4992. The seasons of Quebec may be briefly noticed. Winter sets in towards the close of November, and for several weeks heavy falls of snow, hail, and sleet, follow each other in rapid succession. The snow falls very deep, and it is often a difficult matter to keep even a narrow pathway open. Towards the end of December the weather clears, and the solid sheet of snow which covers the surrounding country becomes enlivened by multitudes of citizens, who now sally forth with horse, sledge, and carriole, and drive along the smooth and shining plain. In March the weather gets mild, and even hot, and in April the ice of the St Lawrence breaks with a mighty crash. May and June are generally wet; but July and August are marked by intense heat and the plague of insects. September is the most agreeable month; but, in October, winter returns "to rule the inverted year." Quebec was settled by the French in the year 1608; taken by the English, first in 1629, and afterwards in 1759; and finally ceded to us by the treaty of Paris in 1766. In 1776 an unsuccessful attack was made upon it by the Americans under General Montgomery, who fell, together with about 7000 men. The population of Quebec in 1825 amounted to 20,396, and in 1831 to 25,916. Long. 70. 72. W. from Greenwich, Lat. 46. 48. N.

Since the article Canada in this work made its appearance, a revolution has broken out in that part of the British empire, and proved of so serious a nature as to cause a considerable loss of life both in the field and upon the scaffold. It is not our purpose to enter into minute details regarding either the origin of the revolt or the course of events. A brief statement of the leading facts is all that can be given here. Since this colony was annexed to the British crown, two parties have existed in it, the French, the original settlers, or their descendants; and the British, or their descendants, who were the subjugators of the province. The two races have never amalgamated, but, on the contrary, their animosity to each other has been aggravated by recent circumstances to such a degree, that it is constantly in danger of breaking out in acts of open hostility. Although the British race are possessed of the greatest wealth, intelligence, and enterprise, the French Canadians have always been by far the most numerous class, and, on the ground of their numerical superiority, they aspire to have the leading sway in the affairs of the province. But, as the government of Canada is constituted, this has been found impossible; for although they may preponderate in the lower house or house of assembly, they are checked by the legislative council, the members of which are not popularly elected, but chosen by the governor in the name of the sovereign of Great Britain. It is alleged by the house of assembly that abuse of power has resulted from this mode of election; that extreme partiality to the British, and neglect of the French, has been shown, not only in the formation of the legislative council itself, but in the distribution of government appointments. Amongst the grievances of which they complained were, the tenures act, the want of control over the public revenue of the province, and others, which were embodied in a document transmitted to the imperial government in 1832–33. This memorial consisted of ninety-two resolutions, and was drawn up by the leading men of the house of assembly. The substance of them was as follows: 1*st*, That the legislative council should be elective; 2*dly*, that the executive council should be converted into a ministry, responsible to the assembly; 3*dly*, that the tenures act and land company's act should be repealed; 4*thly*, that the crown revenues should be surrendered unconditionally; 5*thly*, that the management of the waste lands should be given up to them. And they further declared, that they would pay no arrears, nor vote any civil list, until these demands should be complied with. The arrears spoken of were the salaries of public functionaries, which for several years had remained unpaid, being stopped by the members of assembly. The delegates from Canada met with a patient hearing from the committee appointed to investigate the subject; but the British government refused to accede to the propositions, and a series of resolutions were carried in parliament, the substance of which is as follows: 1*st*, That whilst no change could be made in the mode of electing the legislative council, it was expedient to adopt measures for securing to it a higher degree of public confidence; 2*dly*, that whilst it was expedient to improve the composition of the executive council, it was unadvisable to render it responsible to the assembly; 3*dly*, that the title of the land company was to remain inviolate; 4*thly*, " that as soon as the legislative shall make provisions by law for discharging lands from feudal dues and services, and for removing any doubts as to the incidents of the tenure of land, in free and common soccage, it is expedient to repeal the Canada tenures act, and the Canada trade act, so far as the latter relates to the tenures of land in this province, saving, nevertheless, to all persons the rights vested in them under or in virtue of those acts;" 5*thly*, that provision should be made for paying arrears due; and, lastly, " that it is expedient that the legislatures of Lower and Upper Canada respectively be authorized to make provision for the joint regulation and adjustment of questions respecting their trade and commerce, and of other questions wherein they have a common interest.[1]

On the 18th of August 1837, an extraordinary session of the parliament of Lower Canada was called together by Lord Gosford, the governor-in-chief; but the assembly again refused all supplies, and continued to decline exercising any legislative functions. Confusion and disorganization now began to spread throughout the whole social as well as political system of Canada. On the 23d of October, a meeting of delegates, named by the different parishes in five counties, was held at St Charles, in Lower Canada. The persons assembled were addressed by Papineau, speaker of the house of assembly, and other individuals, and a series of resolutions were passed expressing dissatisfaction with the manner in which Canada was governed. That same day a meeting of the friends of the constitution was held at Montreal, and resolutions were passed in favour of supporting the government, and condemnatory of the revolutionary movements. Disaffection now assumed the shape of insurrection, and anarchy was immediately followed by bloodshed. The insurrection was suppressed without much difficulty; but the country still remains in a very unsettled condition. (R. R. R.)

QUECKNI, a town of the Birman empire, in the province of Martaban, and situated between the sea and a range of mountains to which it gives name. Long. 97. 45. E. Lat. 15. 35. N.

QUEDA, or QUEDAH, a country of Asia, and a Malay principality, situated on the west coast, between the fifth and eighth degrees of north latitude, immediately opposite to Prince of Wales Island. It extends about 150 miles along the coast, between 5° 10′ and 7° 30′ of north latitude, and stretches inland from twenty to twenty-five miles. Along the shore, for a distance of about twenty-four leagues, there are numerous islands, that shelter the coast, which is low and covered with woods. The water, to a great distance from the shore, is extremely shallow, with sand-banks, so that ships are obliged to anchor at a great distance from the shore. Twenty-three rivers, all deep enough for prows, and some for larger vessels, empty themselves into the sea. The town is called Queda by strangers. It is situated in latitude 6° north, upon one of the largest rivers, which is navigable for vessels of 300 tons burden, and is 300 yards in width at the mouth, where was formerly a brick fort, now in ruins. The entrance into this river is choked up by a flat mud-bank, over which, at spring tides, there is only nine feet water. The road where the ships anchor is about two leagues from the shore. The town of Queda formerly contained about 300 houses, inhabited by Chinese, Chulias, and Malays; and it enjoyed a considerable trade; but since the establishment of Pulo Pinang, the Malay prows have chiefly resorted to the latter place. Allistar, seven miles up the river, is the residence of the king, to which place all vessels can ascend when their draught enables them to pass the bar. The river here is narrow, but deep; and both shores are muddy, swampy, and covered with jungle. A little above Allistar the ground rises, and the river is then only navigable for prows. There are in the interior tin-mines, the produce of which is conveyed to the coast by the Qualla Moorba, a rapid and shallow stream, yet navigable for small craft. The exports of this district consist of elephants' teeth, wax, &c., but principally tin, which are chiefly exchanged for opium and Spanish dollars. The king, as in most of these eastern countries, engrosses the chief share of the trade. In 1786 an agreement was made with the king of Queda for the cession of Pulo Pinang or Prince of Wales Island; and in 1792 a regular treaty was concluded on the subject, by which the East India Company agreed to pay 6000 dollars annually whilst they retained possession of the island. A new treaty was made in 1802, for the cession of additional territory, which tract of country the company engaged to protect from all enemies, robbers, and pirates. The free exportation of provisions and other articles to Prince of Wales Island was also agreed on, besides a clause for the apprehension and delivery of insurgents, felons, debtors, and slaves; in consideration of which the company agreed to pay 10,000 dollars annually, as long as they held possession of the island and the coast.

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[1] Nothing has given rise to greater discontent and heart-burnings than the provision made for the support of the church by means of portions of land set apart for this purpose. The grants of land, as a reward for public services, have likewise been considered as very injurious. This cannot be better explained than in the words of Lord Durham, in his Report on the affairs of British North America.

" The system of clergy reserves was established by the act of 1791, commonly called the Constitutional Act, which directed that, in respect of all grants made by the crown, a quantity equal to one seventh of the land so granted should be reserved for the clergy. A quantity equal to one seventh of all grants would be one eighth of each township, or of all the public land. Instead of this proportion, the practice has been, ever since the act passed, and in the clearest violation of its provisions, to set apart for the clergy in Upper Canada a seventh of all the land, which is a quantity equal to a sixth of the land granted. There have been appropriated for this purpose 300,000 acres, which, legally, it is manifest, belong to the public. And of the amount for which clergy reserves have been sold in that province, namely, L.317,000 (of which about L.100,000 have been already received and invested in the English funds), the sum of about L.45,000 should belong to the public.

" In Lower Canada the same violation of the law has taken place, with this difference, that upon every sale of crown and clergy reserves, a fresh reserve for the clergy has been made, equal to a fifth of such reserves. The result has been the appropriation for the clergy of 673,567 acres, instead of 446,000, being an excess of 227,559 acres, or half as much again as they ought to have received. The Lower Canada fund already produced by sales amounts to L.50,000, of which, therefore, a third, or about L.16,000, belong to the public. If, without any reform of this abuse, the whole of the unsold clergy reserves in both provinces should fetch the average price at which such lands have hitherto sold, the public would be wronged to the amount of about L.280,000; and the reform of this abuse will produce a certain and almost immediate gain to the public of L.60,000. In referring, for further explanation of this subject, to a paper in the appendix, which has been drawn up by Mr Hanson, a member of the commission of inquiry which I appointed for all the colonies, I am desirous of stating my own conviction that the clergy have had no part in this great misappropriation of the public property, but that it has arisen entirely from heedless misconception, or some other error, of the civil government of both provinces.

" The great objection to reserves for the clergy is, that those for whom the land is set apart never have attempted, and never could successfully attempt, to cultivate or settle the property, and that, by that special appropriation, so much land is withheld from settlers, and kept in a state of waste, to the serious injury of all settlers in its neighbourhood. But it would be a great mistake to suppose that this is the only practice by which such injury has been, and still is, inflicted on actual settlers. In the two Canadas especially, the practice of rewarding, or attempting to reward, public services by grants of public land, has produced, and is still producing, a degree of injury to actual settlers which it is difficult to conceive without having witnessed it. The very principle of such grants is bad, inasmuch as, under any circumstances, they must lead to an amount of appropriation beyond the wants of the community, and greatly beyond the proprietor's means of cultivation and settlement. In both the Canadas, not only has this principle been pursued with reckless profusion, but the local executive governments have managed, by violating or evading the instructions which they received from the secretary of state, to add incalculably to the mischiefs that would have arisen at all events.

" In Upper Canada, 3,200,000 acres have been granted to ' U. E. Loyalists,' being refugees from the United States, who settled in the province before 1787, and their children; 730,000 acres to militiamen, 450,000 acres to discharged soldiers and sailors, 255,000 acres to magistrates and barristers, 136,000 acres to executive councillors and their families, 50,000 acres to five legislative councillors and their families, 36,900 acres to clergymen as private property, 264,000 acres to persons contracting to make surveys, 92,526 acres to officers of the army and navy, 500,000 acres for the endowment of schools, 48,520 acres to Colonel Talbot, 12,000 acres to the heirs of General Brock, and 12,000 acres to Doctor Mountain, a former bishop of Quebec; making altogether, with the clergy reserves, nearly half of all the surveyed land in the province. In Lower Canada, exclusively of grants to refugee loyalists, as to the amount of which the crown lands' department could furnish me with no information, 450,000 acres have been granted to militiamen, to executive councillors 72,000 acres, to Governor Milne about 48,000 acres, to Mr Cushing and another upwards of 100,000 acres (as a reward for giving information in a case of high treason), to officers and soldiers 200,000 acres, and to ' leaders of townships' 1,457,209 acres; making altogether, with the clergy reserves, rather more than half of the surveyed lands originally at the disposal of the crown."

QUEDLINBURG, a city of the Prussian province of Saxony, situated on the river Bode, which was formerly the capital of an independent ecclesiastical state, under the abbess of that name. It contains eight Catholic churches, is surrounded with walls, and has an ancient palace, with an extensive library, 1720 houses, and 11,500 inhabitants. There are extensive breweries and distilleries, and various manufactures of woollen and linen goods. Long. 11. 32. 39. E. Lat. 51. 47. 48. N.

QUEEN, a woman who holds a crown singly in her own right. The title of queen is also given by way of courtesy to her who is married to a king, and called by way of distinction queen-consort, the former being termed queen-regent. The widow of a king is also called queen, but with the addition of dowager.

QUEEN CHARLOTTE'S ISLANDS, a group of islands lying in front of that part of the north-western coast of America called New Hanover, between the fiftieth and fifty-fourth parallels of north latitude. Cook observed these islands, but supposed that they formed portions of the continental shore. They were discovered by La Pérouse, who named them the Fleurieu Islands, an appellation of which they were unintentionally deprived by Vancouver, who called them after the princess-royal of England. The largest island is of a triangular form, about one hundred and seventy miles in length, and in some parts sixty miles in breadth, and is separated from the main land by a broad channel or arm of the sea. The southern promontory of this island was named Cape Hector by La Pérouse, and Cape St James by Vancouver. The latter navigator coasted along the shore, and found that near the sea the land was moderately elevated, but that towards the interior it rose into rugged and uneven mountains. Of the Indians who inhabit it little is known, and that little is significant of their being pretty low in the scale of intelligence.

QUEEN CHARLOTTE'S *Island*, in the Pacific, six miles in length and one in breadth, was discovered in 1767 by Captain Wallis. Long. 138. 4. W. Lat. 19. 18. S.

QUEEN CHARLOTTE'S *Sound*, a bay at the north end of the southern island of New Zealand, where Captain Cook erected a post with an union flag. The entrance is situated in long. 184. 45. W. and lat. 41. S.

QUEEN'S COUNTY, an inland county in the province of Leinster, in Ireland, is bounded on the north by the King's County, on the east by those of Kildare and Carlow, on the south by those of Carlow and Kilkenny, and on the west by Tipperary and the King's County. It extends over a surface of 396,810 acres, of which 335,838 are cultivated, and 60,972 are uncultivated mountain and bog.

No notice of the inhabitants of this part of Ireland is to be found in Ptolemy's account of the island; but Whitaker supposes it to have been peopled, together with all the other interior parts, by the Scots. It was afterwards known by the names of Ossory and Leix; the former consisting of the north-western districts, the latter of the remainder of the county, and the Barrow constituting the boundary between them. Ossory, of which the Macgillypatricks or Fitzpatricks were the toparchs, ranked as a subordinate kingdom at the landing of the English, and for some time afterwards. Leix was made a county palatine, which fell into the possession of Roger Mortimer through the female line, and afterwards was seized on by the O'Mores, who retained possession of it, and proved persevering and troublesome enemies to the English government, until the reign of Philip and Mary, when the territory was made shire-ground, under the name of the Queen's County, in honour of the sovereign; and the place chosen for the county town was named Maryborough, for the same reason. This county, when brought under British law, was gradually peopled by English settlers. During the subsequent reigns several of these families have become extinct in the male line, and others were expelled or extinguished by the confiscations arising out of the civil wars in 1641 and 1689, whilst the descendants of others, the principal of whom are the Veseys, Cootes, Parnells, Dawsons, and Burrowes, still retain the whole or some portion of their ancestral possessions. It is now divided into the baronies of Ballyadams, Cullinagh, Maryborough East, Maryborough West, Partnehinch, Slievemarigue or Slievemargy, Stradbally, Tinnehinch, and Upper Ossory. These are subdivided into thirty-eight parishes, and six parts of parishes the remaining parts of which are in the adjoining counties. According to the ecclesiastical arrangements of the country, the county contains fifty-one parishes, of which twenty-seven are in the diocese of Leighlin, fifteen in that of Ossory, seven in Kildare, and one each in Killaloe and Dublin.

The general face of the country is level, but it rises into heights of considerable elevation in the Slieve-Bloom Mountains, which, taking a direction nearly north and south along the western verge of the county, rise to a considerable height, their most elevated point being 1689 feet above the level of the sea, and with an acclivity so abrupt that the only practicable road across them is through the pass of Glandine. In the southern extremity the Slievemarigue Hills, of considerably inferior elevation, separate the county from that of Kilkenny. But the general surface of the country is not, strictly speaking, level; the monotony of a perfect plain is relieved by a range of low hills, which traverse it in a direction from north to south, and the most remarkable of which are the Rock of Dunamase and the Dun of Clopoke; as also by eskars, a singular species of low hills, or rather slight elevations of the surface, formed of rounded pebbles, apparently forced together by the operation of contending currents of water. The most remarkable of these is the Ridge of Maryborough, which, entering from the King's County, proceeds for a considerable distance by Maryborough, and, after having been deranged and broken, resumes again the form of a continuous ridge, branching out in the southern part of the county in two divisions. The Slieve-Bloom Mountains give rise to some of the great rivers of Ireland. The Barrow rises at their northern extremity, and, after passing through the north of the county, forms its north-eastern boundary; then, turning southwards, it forms its boundary to the east, separating it from Kildare and Carlow, and falls into the Suir some miles below New Ross, forming with that river the estuary called Waterford Harbour. The source of the Nore is southward of that of the Barrow, in the same mountains. It passes through the south-western part of the county by Abbeyleix and Ballynakill, enters the county of Kilkenny near Ballyragget, and, after flowing by the city of Kilkenny, joins the Barrow about two miles above New Ross. The portion of the Barrow between its junction with the Nore and Suir is generally called the Ross River. The Suir, which also rises in the Slieve-Bloom Mountains at their southern extremity, does not belong to this county. The smaller rivers are the Ownas, Trihogue, and Blackwater, tributaries of the Barrow; and the Tonnet, Dolore, Old Forge River, Cloncoose, Cromoge, Corbally, Trumry, Colt, and Erkin, tributaries of the Nore. The Barrow is navigable for barges from Athy, where it is connected with the Grand Canal from Dublin to New Ross, and thence to the sea for vessels of 500 tons. The Nore is not navigable until after it has quitted the county. There is no lake except that of Anagh on its northern boundary, which partly belongs to the King's County, the line of demarcation between the two counties being drawn through the middle of it.

The amount of the population, according to the calculations made at different periods, some founded on conjectural estimates, others on actual enumeration under legislative authority, is as follows:—

Year.	Authority.	No. of Souls.
1760	De Burgo	53,604
1792	Beaufort	82,000
1812	Parliamentary return	113,857
1821	Ditto	134,275
1831	Ditto	145,843

The return of 1831 gives an average of one inhabitant to every 2·72 acres, or of one to every 2·30 cultivated acres. The returns of the Commissioners of Public Instruction in 1834, being made up in dioceses, do not give the population of counties with strict accuracy; yet they afford data sufficient to show the comparative numbers of the three great divisions of the people with respect to their several religious persuasions. If the entire population of the county be estimated at 150,000, the number of Episcopalian Protestants would amount to 20,000, of Protestant dissenters to 1000, and of Roman Catholics to 129,000; according to which calculation, the Protestants would be to the Catholics as one to six nearly.

The county returned eight members to the Irish parliament; two for the county at large, and two each for the boroughs of Portarlington, Maryborough, and Ballynakill. This number was reduced to three by the act of union, by which the boroughs were disfranchised, with the exception of the first named, which still continues to return one member. The number of registered electors for the county, according to the latest return, was 2150, that of the borough of Portarlington 156. The election for the county takes place at Maryborough. The local government consists of a lieutenant, eighteen deputy-lieutenants, all appointed by the crown during pleasure, and ninety magistrates (including the lieutenants) appointed by the lord-chancellor, and holding office during good behaviour. The constabulary force consists of a sub-inspector, eight chief constables, ten head-constables, thirty-seven constables, and two hundred and seventy-six sub-constables; in all, 332.

The state of education, according to the parliamentary returns in 1821 and 1824–26, was as follows:

Year.	Boys.	Girls.	Sex not ascertained.	Total.
1821	4825	1998		6,823
1824–6	6624	4908	231	11,763

Of the numbers stated in the latter of these returns, 2074 were Episcopalian Protestants, 104 Protestant dissenters, and 9426 Roman Catholics; the religious persuasion of the remaining 305 not having been ascertained. The total number of schools was 275; of which thirty-five, containing 2150 pupils, were maintained by grants of public money; twenty-four, containing 1625 pupils, by the voluntary contributions of societies or individuals; and the remaining 216 schools, which afforded the means of education to 7988 pupils, wholly by the fees of the pupils. The Report of the Commissioners of National Education in 1837 (the latest published), states the number of schools, teachers, and pupils connected with their board as follows: Schools, 18; teachers, 20; boys, 1323; girls, 1045; total of pupils, 2368.

The level part of the county forms the southern portion of the great flœtz limestone field which traverses Ireland across its centre. The peculiar flatness of the interior appears to have caused those accumulations of alluvial matter, composed of clay and limestone gravel, which, in the form of low but steep ridges of hills, occur so frequently throughout the midland districts, and are known by the name of eskars. Some very striking specimens of this formation in the county have already been noticed. That the surface of the country was exposed to the action of rapid currents of water, is evidenced by the deep parallel indentations or furrows frequently observable on the surface of rocks from which the alluvial soil has been removed. It is also probable that the gravel hills were rapidly deposited from water in violent action; an inference which is confirmed by the fact, that they mostly consist of large masses of rock partially rounded, intermixed with small gravel, and even with clay and sand. The sandstone shows itself in the Slieve-Bloom Mountains, which are almost wholly of that formation. The south-eastern extremity forms a small part of the Leinster coal-field, the mineral in it being, like that of Kilkenny, which adjoins it, of the carbonaceous or stone-coal formation, the slaty glantz-coal of Werner, burning dully with little flame, emitting an offensive and unwholesome vapour, and therefore disagreeable for domestic use, but excellent for malting or for the forge, for both which purposes it is in such demand that its high price, were there no other objection to it, prevents it being much used for family purposes even in the neighbourhood. Iron was raised here, and the works were carried on as long as the forests afforded materials for fuel. Potters' earth is also raised, and applied, in the neighbourhood of Mountmellick, to the manufacture of the coarser kinds of earthen wares.

The soil varies greatly in different parts. Where it rests on the limestone substratum, it consists mostly of a stiff clay loam, well adapted for the growth of wheat; in other parts it is light and sandy, and produces good crops of oats and barley. The mountain district is wet and boggy even in the higher parts, the clayey sub-soil not admitting free passage for the water, which therefore accumulates on the surface; and it is also much encumbered with rock. The low hills that traverse the middle of the county from north to south are capable of culture mostly to their summits, and, where not deemed suitable for the plough, afford rich pasturage for sheep. The tracts on the sides of the rivers, being annually flooded by the overflowings of the stream during winter, form rich meadow-land. Bogs are frequent in most parts, supplying ample material of fuel for domestic purposes. The county was once so thickly wooded as to be al-

Queen's County.

most impenetrable for the passage of large bodies of men; and thence, as well as from the bogs, which, from a different cause, were also difficult to be crossed by those not well acquainted with their peculiarities, the natives were enabled to hold out long against the attempts of the English settlers. But the old woods have long since been cleared away, the only proof of their former existence being discoverable in the numerous remains of timber-trees lying in the bottom of Lough Annagh. A new growth, however, the offspring, not of the unaided efforts of nature, but of the hand of modern improvement, has in a great measure restored one of its most beautiful and useful features. Large plantations, chiefly around the demesnes of the gentry, vary the prospects, and tend much to relieve the monotony of the level surface. Most parts present the mansions and seats of resident proprietors; comfortable farm-houses are numerous, and much attention has been paid by many landlords to excite amongst their tenantry a laudable emulation in the neatness of their cottages, and in the judicious cultivation of their little farms. The coal district must, however, form an exception to this general description. In it, notwithstanding the superior means of procuring domestic comforts, through the high wages and constant employment afforded by the collieries, the appearance of the peasantry, both in their persons and dwellings, exhibits too frequent instances of the destitution consequent on confirmed habits of reckless improvidence. With the exception of the lands held by wealthy proprietors in their own hands, and those in the mountainous parts, where grazing is the chief object, the farms are not large, seldom more than from ten to fifteen acres. Wheat is very extensively grown, its culture being more and more attended to even on those soils which, during the more confined state of agricultural knowledge, were thought to be unfit for it. The lighter soils answer well for barley and oats. Potatoes are everywhere raised, both for family use and for feeding cattle; forming also an essential part of the improved rotation system, which is generally practised. Green crops, particularly turnips, are not unusual, and the value of every kind of clover seems to be duly appreciated. Much attention is given to the introduction of implements and machines of the best description; the clumsy and inartificial vehicles, ploughs, and harrows, formerly in use, being scarcely to be met with except in districts little capable of being brought into profitable agricultural production. The breed of every kind of cattle has been improved during the last twenty or thirty years, to a degree that scarcely could have been anticipated at the commencement of the period. Dairies are numerous and highly productive. Butter is the produce chiefly attended to; and large quantities of it are prepared for export. Cheese is seldom made. The rich low lands graze black cattle of large size. In a word, the county, with the exception already noticed, appears to be rapidly advancing in improvement throughout every department of rural economy, from the nobleman's demesne to the humble garden of the cottier tenant.

From the preceding statement it may easily be inferred that the character of the population is almost exclusively agricultural. The only place in which manufactures have at all succeeded is Mountmellick. Several branches of the woollen, linen, and cotton trade have been undertaken there, but without much success; coarse woollens and cottons for the supply of the surrounding districts being the only kinds fabricated. Tanning is carried on to some extent; flour-mills are large and numerous; and there are some extensive distilleries and breweries. The Grand Canal, a branch of which has been carried from Monasterevin to Mountmellick, conveys much of the produce of the county to Dublin, either for sale there or for export. The Barrow serves the same purpose with respect to Waterford. The mail-coach roads from Dublin to Cork and Limerick traverse the county.

Queenborough
||
Queensferry.

There are many remains of ancient edifices, both ecclesiastical and military. Amongst the most remarkable of the former is that of Aghaboe, once the seat of the bishopric of Ossory; the ruins of Aghmacart, and of several others of lesser note, are still visible. The site of the abbey of Timahoe can be ascertained only by the pillar-tower there, which is supposed to have stood in its immediate vicinity. Of the military antiquities the most ancient is a fortress placed upon the summit of a hill in the south-west of the county, and called Bawnachra; it consists of a circular enclosure surrounded by a rampart and fosse. The ancient fortress of Dunamase, situated on the summit of a precipitous hill rising abruptly from the middle of a large plain, and once the chief residence of the O'Mores, presents a very picturesque appearance. Lea Castle, a few miles distant, on the Barrow, a place of considerable strength, was taken and dismantled by Cromwell. Burros-in-Ossory on the Nore, and Castlecuffe in Tinnehinch, built by the celebrated republican leader Sir Charles Coote, were also places of considerable strength. Amongst the modern mansions, that of the Earl of Portarlington, at Ems, is the most splendid.

Maryborough, the county town, situated nearly in the centre of the county, on one of the small feeders of the Barrow, presents few features to arrest attention, beyond those public edifices to which the transaction of county business and the claims of religion give rise. It was a borough entitled to send representatives to parliament; but this, the only important privilege to a small town, having been abolished at the union, the other corporate functions became paralyzed, and are now virtually extinct. The county court-house is a neat building; and the prison, on the radiating plan, lately built at an expense of L.19,000, affords accommodation for 121 prisoners. The state of crime, as far as it is deducible from the number of convictions, is not favourable. In 1837 the convictions were 214, of which five were capital, but commuted into a lesser punishment; eight were for transportation for life, and fifteen for seven years. The district lunatic asylum for the King's, Queen's, Westmeath, and Longford counties is fixed here; and it affords accommodation for 156 patients, who are maintained in it at an average expense of L.19 per head. The flour trade is the only manufacture of any extent. The population in 1831 was 3220. That of the other towns having upwards of 1000 inhabitants each was in the same year respectively as follows:—Mountellick, 4577; Portarlington, originally a settlement of French refugees, and till lately of some note as a place of elementary education, 3091; Mountrath, 2593; Graige, which is, strictly speaking, a suburb of Carlow, though in a different county, 1976; Ballynakill, 1927; Stradbally, near which is the Dun of Clopoke, an isolated rock, perforated by subterraneous cavities, 1799; Ballycollinbeg, 1381; Rathdowney, 1214; and Abbeyleix, which, though amongst the smallest, is the neatest in external appearance, 1009.

QUEENBOROUGH, a town of the county of Kent, in the Isle of Sheppey, at the mouth of the river Medway, forty-five miles from London. It was an ancient borough, and returned two members to the House of Commons till 1832, when it was disfranchised. It is governed by a mayor and jurats. The chief employment is the oyster fishery. The population amounted in 1801 to 545, in 1811 to 805, in 1821 to 881, and in 1831 to 786.

QUEENSFERRY, South, a royal burgh and parish in the county of Linlithgow, Scotland. It is situated on the south side of the Frith of Forth, nine miles west from Edinburgh, and consists of one irregular street of a mean appearance, from which branch various narrow alleys. The town is a place of considerable antiquity, having been in early times a burgh of regality, held under the abbey of Dunfermline. It obtained the privileges of a burgh of regality from Malcolm IV., which were confirmed by David II. and afterwards by Charles I.; and in the year

1633 the burgh sent its first commissioner to the Scottish parliament. In 1641, by act of parliament, it was dismembered from the parish of Dalmeny, and erected into a separate parish. Before the union it possessed a considerable trade, but what it now has depends on a soap-work, a brewery, and a distillery. The regular ferry is at Newhall, a little to the east of the town, where the frith contracts to one and a half mile in breadth. It is under the direction of trustees; and, in addition to the sail-boats, a steam-vessel, carrying the mail, plies regularly at all times of the tide. There are at both sides low-water piers, on which the passengers are landed, and excellent inns for their accommodation. The revenue of the burgh is about L.88, arising from customs, anchorages, shore-dues, and other small items; and its permanent expenditure is L.70. 2s. The revenue for 1837-38 amounted to L.135. It is governed by a provost, three bailies, a treasurer, a dean of guild, and fifteen councillors, and, with Culross, Dunfermline, Inverkeithing, and Stirling, returns a member to parliament. The population in the year 1821 amounted to 690, and in 1831 to 684.

QUEILING, or Koueling, a city of China, of the first rank, and capital of the province of Quangsec. It is situated on the banks of a rapid river. Long. 109. 51. E. Lat. 25. 12. N.

QUELPAERT, an island in the Eastern Seas, to the north of the peninsula of Corea. A Dutch vessel was wrecked here in 1635, called the Sparrow-Hawk, commanded by Henry Hamel, by whom the knowledge of this island was first brought to Europe. Long. 126. 35. E. Lat. 33. 14. N.

QUENTIN, St, an arrondissement of the department of the Aisne, in France. It extends over 430 square miles, comprising ten cantons, divided into 121 communes, with 91,200 inhabitants. The capital is a city of the same name, situated on a hill, at the foot of which flows the Somme, which is joined by two inland canals. It is strongly fortified, and has a fine old cathedral and good market-place, 1650 houses, and 10,740 inhabitants, who have been long celebrated for their fabrics of fine linens, especially cambrics and lawns, and thread-lace. These trades have, however, of late years declined, the manufactures of cotton have been substituted, and, now that spinning-mills have been at work, many muslins and fine calicoes are produced. Near this city was fought, in 1557, a great battle between the French and Spaniards. Long. 3. 12. 18. E. Lat. 49. 50. 51. N.

QUESAN, a cluster of small islands situated off the eastern coast of China, and attached to the province Tchekiang. The most southerly, called by the British sailors Patchcock, is situated in long. 120. 52. E. and lat. 29. 22. N.

QUESNAY, François, a physician of considerable eminence, but who is chiefly known in the history of philosophy as a profound and ingenious inquirer into the constitution of society, and as the founder of the sect of the Economists.

The accounts of the life of this distinguished person, which, unlike that of most literary men, abounded in incident and adventure, are exceedingly meagre and contradictory. Neither the place of his birth nor the condition of his parents has been well ascertained; but the accounts apparently most entitled to credit state that he was born at the village of Ecquivilly, in the Isle de France, in 1694; and that his father was either a common labourer, or a small proprietor who cultivated his own little property.[1] His humble origin is indeed evident from the fact mentioned by all his biographers, of his early education having been almost entirely neglected, and of his being constantly occupied, until his fourteenth or sixteenth year, in the sports or labours of the fields, without being either sent to school or taught to read. But although placed in such unfavourable circumstances, young Quesnay was imbued with an ardent love of knowledge, and with a strong desire to emerge from the obscure station in which he had been brought up. The *Maison Rustique* of Liebaut was the first book that came into his hands; and he is said to have learned to read it by the assistance of lessons given him by a gardener of the village. The perusal of this book, which seems to have had a material influence over his future studies, awakened his latent powers, and stimulated him to make further efforts to extend his information. Having acquired a competent knowledge of his vernacular tongue, by the eager reading of such French books as came into his hands, he next applied himself to the study of the dead languages; and speedily attained, partly by the slender assistance of a self-dubbed surgeon of the village, but chiefly by his own extraordinary industry and sagacity, to a tolerable proficiency in Latin and Greek.

Quesnay now resolved, in opposition to the wishes of his parents, and especially of his mother, to devote himself to the profession of surgery, and received the rudiments of his instruction in that art from the village-doctor who had assisted him in his philological studies. But the pupil very soon surpassed the master; and when the latter applied to be admitted into the *Maitrise*, or Corporation of Surgeons, he presented, as testimonials of his skill in his profession, and of his capacity to practise it with advantage, some Essays written by Quesnay, and which were received with very great applause. Quesnay was not privy to this *ruse;* but soon after its occurrence he left his paternal village, and set out to prosecute his studies at Paris. We are not informed by what means he supported himself in that city, nor how long he remained there; but his indefatigable industry and zeal enabled him to make great progress in his studies, whilst his merit and modesty procured him several friends. Besides attending prelections on the various branches of surgery, and the different hospitals, he found leisure to devote some portion of his time to metaphysical researches, and the study of philosophy, for which the perusal of the *Recherche de la Vérité* of Malebranche had given him a very decided taste. Nay, such was the almost unparalleled activity and vigour of his mind, that having accidentally met, during his stay in Paris, with the celebrated M. Cochin, of the Royal Academy of Painting, he put himself under his tuition; and we are told, that he profited so well by the few lessons he received, as to be able not only to take remarkably good likenesses, but to design and *engrave*, with his own hand, the various bones of the human skeleton, in a manner which would not have disgraced the most skilful artists.

On finishing his studies at Paris, Quesnay formed the design of establishing himself as a surgeon in Mantes, a considerable town of his native province, and presented himself to the surgeons of its *Maitrise* for examination. But they refused, from jealousy, as is alleged, of his talents, to admit him to trial. He was thus laid under the necessity of returning to Paris, where he passed his examinations with éclat; and in 1718 received letters ordering him to be admitted into the *Maitrise* of Mantes.

Having established himself at Mantes, his reputation soon extended itself. He was employed by some of the first families of the neighbourhood, and, amongst others, by that of the Marshal de Noailles, Duc de Villeroi, who persuaded him to leave his residence in the country, and to accompany him to Paris as his surgeon, as nearly as we can collect in 1729 or 1730. An incident not long afterwards occurred, which had the most material influence over his future prospects and life. Having accompanied the Duc de Villeroi to the house of the Comtesse d'Estrades, Quesnay remained behind in the carriage whilst the duke went in to visit that lady, who, during the interview, was suddenly seized with an epileptic fit. Quesnay being called in, and perceiving the nature of the attack, with singular presence of mind ordered the duke and the other attendants out of the room, and managed so well as to succeed in concealing the nature of the malady. The comtesse was so much pleased with this dexterity and address, that she lost no time in recommending Quesnay to her all-powerful friend, Madame d'Estioles, afterwards Madame de Pompadour, who made him her physician; and, besides obtaining for him apartments at Versailles, procured him, in 1737, the place of surgeon in ordinary to the king.[1]

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[1] It is stated in the *Eloge Historique* of Quesnay, in the *Mémoires de l'Académie des Sciences* for 1774, that he was the son of an *advocat en Parlement* at Montfort, and that he was born at Merey. But it is difficult to suppose, had his father been in such a station, that his education should have been so entirely neglected. In the brief but interesting notice of Quesnay, given by Mr Crawfurd in a note to the *Journal* of Madame du Hausset, femme de-chambre of Madame de Pompadour, et *l'amie* de Quesnay, in the *Mélanges d'Histoire et de Littérature* (p. 276), he is stated to have been the son of a labourer. This also is the statement of the *Encyclopédie Méthodique*. According to the *notice* prefixed by Dupont to the *Eloge* of M. Gournay, in the third volume of the *Œuvres de Turgot*, Quesnay was the son *d'un propriétaire cultivateur*.

Quesnay was shortly afterwards appointed secretary to the Royal Academy of Surgery, established in 1731; and, besides several articles on particular branches of surgéry, he contributed the preface to the first volume of its *Mémoires*, which has always been reckoned peculiarly valuable for its profound and discriminating observations on the respective uses of theory and observation in the physical sciences, and on the assistance they reciprocally lend to each other.

Having from an early period been much subject to the gout, and becoming in consequence less able to discharge his duties as surgeon, Quesnay took the degree of doctor of medicine in 1744; and was soon afterwards appointed, through the influence of his powerful patroness, to the important place of consulting physician to the king. In this capacity he attended Louis in the campaigns of 1744 and 1745, and, amid the distractions of a camp, collected and prepared the greater part of the materials for his *Traité de Fièvres*, published in 1753.

His appointment as physician to the king was preceded by the grant of letters of nobility, issued on the recovery of the dauphin from an attack of small-pox. Louis, who was much struck with the justice and solidity of Quesnay's remarks, familiarly called him *son penseur*, and gave him, in allusion to this title, three pansey flowers (in French, *pensées*), for his arms, with the motto *Propter cogitationem mentis*.

The leisure Quesnay now enjoyed enabled him to prosecute his studies with greater assiduity. In 1747 he republished an enlarged edition, in three tomes 12mo, of his *Essai Physique sur l'Economie Animale*, originally published in 1736; in 1748 he published an *Examen Impartiel des Contestations des Médecins et des Chirurgiens de Paris*; in 1749 he published a *Mémoire sur la Sagesse de l'Ancienne Législation de la Chirurgie en France*, and two separate treatises in 12mo, the one on Suppuration, and the other *De la Gangrène*; in 1750 he republished his *Traité des Effets et de l'Usage de la Saigné*, written during his residence at Mantes, and originally published in 1730; and in 1753 he published his *Traité des Fièvres Continués*, two tomes 12mo.

These works have all been held in very high estimation; and an excellent judge has given it as his opinion, that "the *Traité de la Gangrène* is by far the most valuable publication which we yet possess upon this subject." Every page of this work, he adds, "is distinguished by the same talent for accurate observation and perspicuous arrangement, which are so remarkable in all the other writings of this celebrated author." (Thomson's *Lectures on Inflammation*, p. 502.)

The *Traité des Fièvres* was the last of Quesnay's professional works. He appears to have thenceforth comparatively abandoned his medical studies. At no period, indeed, had he allowed them to occupy exclusively his attention; and he now devoted himself, in preference, to other, and, if possible, still more interesting inquiries. He had always entertained a strong predilection for agricultural pursuits, the effect, perhaps, of his situation in early life; and this, combined with the speculative and metaphysical cast of his mind, seems to have led him to those peculiar notions respecting the paramount importance of agriculture as a source of wealth, and the constitution of society, which have rendered his name so justly celebrated in the history of economical science. The articles *Fermier* and *Grains* in the *Encyclopédie*, published in 1756 and 1757, contain the earliest development of his views on this subject. They are both written with great ability, and display an intimate acquaintance with the subject, considerable reading, and great powers of analysis. In the article *Grains* the distinction between the *produit total* and the *produit net*; between the productiveness of agriculture and the supposed unproductiveness of other employments, with the doctrine of the unrestricted freedom of commerce, and most of the other leading principles in the theory of the economists; are distinctly stated, and illustrated with much ingenuity. The *Tableau Economique*, and the *Maximes Générales du Gouvernement Economique*, annexed to it under the title of *Extraits des Economies Royales de M. de Sully*, were printed, by command of the king, at Versailles, in the year 1758, with the following very remarkable epigraph for a work brought forth under such auspices, *Pauvres paysans, pauvre royaume; pauvre royaume, pauvre souverain.* The Maxims, which contain a short but comprehensive abstract of Quesnay's system, were reprinted, together with an analysis of the *Tableau*, and a selection from various articles contributed by Quesnay, in explanation and defence of his peculiar doctrines, to the *Journal d'Agriculture*, and the *Ephémérides du Citoyen*,[2] in the collection of Quesnay's economical works, entitled *Physiocratie, ou Constitution Naturelle du Gouvernement le plus Avantageux au Genre Humain*, edited by his friend and scholar Dupont in 1767.

We have elsewhere entered at considerable length into an examination of the speculations of Quesnay and his followers, with respect to the constitution of political societies and the sources of public wealth. (See ECONOMISTS and POLITICAL ECONOMY.) That there is a good deal of error in them must be allowed; but this is far more than countervailed by the many just, discriminating, and original views and important discoveries which they contain. Perhaps, however, the principal merit of Quesnay and his followers does not consist so much in the discoveries they made, as in their having been the first philosophers who distinctly perceived that the institutions of society should always harmonize with the natural principles on which it is founded, or, as they termed it, with the *ordre naturel et essentiel des sociétés politiques*. According to them, economical science is "*L'étude et la démonstration des loix de la nature rélatives à la subsistence et la multiplication du genre humain.* L'observation universelle de ces loix est l'intérêt commun et général de tous les hommes. La connaissance universelle de ces loix est donc le préliminaire indispensable et le moyen nécessaire du bonheur de tous." (*Ephémérides du Citoyen*, 1769, No. II. p. 13.) It is to be regretted that, in investigating these laws, they proceeded too much upon abstract and speculative principles, without sufficiently attending to the effects of particular institutions, and to the various phenomena manifested in the progress of society. But notwithstanding the defective mode in which they conducted their researches, they succeeded in establishing and elucidating many important principles; and there is certainly much more reason to wonder at the general correctness of their conclusions, than to feel surprised at the errors into which they fell. Quesnay and his disciples established, that society either is or should be formed to secure the greatest possible advantage to its members; that the security of property and the freedom of industry are its essential bases; and that, instead of interfering to regulate the pursuits of individuals, the proper business of the politician is to protect the equal rights and liberties of all, and to secure the utmost freedom of competition in every department of industry. And though it be undoubtedly true that most of these principles had been pointed out by previous writers, Quesnay and his school have the merit of being the first who showed their dependence on each other, and who, by presenting them in a systematic and consecutive form, were enabled to give a scientific demonstration of the injustice and impolicy of such institutions as ignorance or mistaken views of national interest had established in opposition to them.

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[1] This incident is related by Mr Crawford, *Mélanges*, p. 276, and is referred to by Marmontel.

[2] The *Ephémérides du Citoyen*, begun in 1767, was, for a few months, conducted by the Abbé Baudeau, and then by Dupont. It appeared monthly, and two numbers make a considerable 12mo volume. The authors were disciples of Quesnay, and zealous economists. Their discussions embraced the moral and political sciences, many branches of which they have treated with much ability and acuteness. There is a valuable *Eloge* of Quesnay in one of the numbers for 1775, written by Count d'Albon. The following extract from the *approbation* given by the *Censeur* to the third number for 1770 is curious: "J'exhorte de nouveau les auteurs de ce *Journal*, à résister à la tentation de critiquer. Le bonheur du citoyen tient à sa confiance. On peut et l'on doit quelquefois avertir en secret ceux qui sont préposés à l'administration. *Mais on ne doit prêcher aux particuliers que leur propre réforme, et non celle de l'état.*"

In the article Political Economy an attempt has been made to show the fallacy of Quesnay's opinion with respect to agriculture being the only source of wealth; and the experience of all ages sufficiently proves that the *despotisme légal*, in the hands of an hereditary monarch, without *contreforces* of any kind, which he strangely supposed was the best of all possible governments, is about the very worst.[1]

Notwithstanding his great age, and the sufferings he experienced from almost incessant attacks of the gout, the activity of Quesnay's mind continued unimpaired. "*Il a*," said one of his friends, "*une tête de trente ans sur un corps de quatre-vingts.*" He contributed subsequently to the publication of the *Physiocratie*, many acute and able articles to the *Ephémérides du Citoyen*, and continued wholly occupied with these studies, and with mathematics, to which he latterly began to pay considerable attention, until his death, which took place at Versailles in December 1774, in the eightieth year of his age.

Quesnay possessed inflexible integrity, a nice sense of honour, and great prudence and discretion. Though highly esteemed by the king, and long resident at court, he never intermixed in the intrigues of which it was the constant theatre. No one ever scrupled to express himself freely in his presence; nor was this confidence ever betrayed. "Il recevoit chez lui des personnes de tous les partis, mais en petit nombre, et qui toutes avoient une grande confiance en lui. *On y parloit très hardiment de tout; et ce qui fait leur éloge et le sien, jamais on n'a rien répété.*"[2] To the utmost frankness and sincerity he added the easy address and polish of a courtier, and the intelligence of a philosopher. No man could be less solicitous of distinguishing himself, or more careful not to offend the self-esteem of others. His conversation was animated, without the least effort at brilliancy. So much indeed was he averse from every appearance of pretension, that he was in the habit of veiling the most profound remarks and observations under the form of apologues, which generally referred to some subject connected with rural affairs, to which he was always particularly attached. He was most indulgent to the faults and errors of others, provided they were unalloyed by any taint of artifice or baseness, for which he never hesitated, whatever might be the rank of the party, to express the utmost contempt. Quesnay was truly a patriot and a philosopher; and it would be difficult to produce another instance of one who, having lived long in a profligate and luxurious court, unsullied by its vices, and aloof from its contentions, preserved to an extreme old age all those generous and kindly feelings, with that unobtrusive but ardent zeal in the cause of humanity, and that love of speculation and profound inquiry, which distinguished his earlier years.

"Quesnay," says Madame du Hausset, "étoit un grand génie, suivant l'opinion de tous ceux qui l'avoit connu, et de plus un homme fort gai. Il aimoit causer avec moi de la campagne; j'y avois été élevée, et il me faisoit parler des herbages de Normandie et du Poitou, de la richesse des fermiers, et de la manière de cultiver. C'étoit le meilleur homme du monde, et la plus éloigné de la plus petit intrigue. Il étoit bien plus occupé à la cour de la meilleure manière de cultiver la terre que de tout ce que s'y passoit." (*Mélanges*, p. 343.)

"Tandis," says Marmontel, "que les orages se formoient et se dissipoient au-dessous de l'entresol de Quesnay, il griffonnoit ses axiomes et ses calculs d'économie rustique, aussi tranquille, aussi indifférent à ces mouvemens de la cour, que s'il en eût été à cent lieues de distance. Là bas, on décidoit de la paix, de la guerre, du choix des généraux, du renvoi des ministres; et nous, dans l'entresol, nous raisonnions d'agriculture; nous calculions le *produit net*, ou quelquefois nous dînions gaiement avec Diderot, d'Alembert, Duclos, Helvétius, Turgot, Buffon; et Madame de Pompadour, ne pouvant pas engager cette troupe de philosophes à descendre dans son salon, venoit elle-même les voir à table, et causer avec eux."

Dr Smith was well acquainted with Quesnay. He frequently met him during his residence at Paris in 1766; and whilst he bears the most honourable testimony to the "modesty and simplicity" of his character, he has pronounced his system to be, "with all its imperfections, the nearest approximation to the truth that has yet been published on the subject of political economy." (Wealth of Nations, p. 307.) So highly, indeed, was Smith impressed with a sense of his merits as a man and a philosopher, that it was his intention, had he not been prevented by Quesnay's death, to have inscribed to him the Wealth of Nations. (Dugald Stewart's Account of the Life and Writings of Dr Smith.)

Quesnay had a son by his wife, to whom he was united when at Mantes. He gave him an excellent education; and exhibited a striking proof of his disinterestedness, by constantly refusing to solicit for him any place or situation under government. This son ultimately settled in the country, on an estate near Beauvoir. Turgot gave one of Quesnay's grandsons a place in the administration; and another entered the army, and acted as captain of infantry at the battle of Jemmappes.

Few men have been more esteemed by their friends than Quesnay, or more ready to do all in their power to advance their interests. Mercier de la Rivière, the author of the work *Sur l'Ordre Naturel et Essentiel des Sociétés Politiques*, seems to have occupied the chief place in his esteem, and was looked upon by him as the only person in France qualified to conduct the administration of the finances. He was also much attached to the Marquis de Mirabeau, Turgot, Dupont, the Abbé Baudeau, St Péravy, and other leading economists, who willingly acknowledged him for their master, and enthusiastically exerted themselves to defend and to propagate his doctrines. "The economists were in reality, and not merely in appearance, a sect of philosophers.

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[1] We are at a loss to conjecture the grounds on which Mr Chalmers has affirmed (Biographical Dictionary, vol. xxv. art. *Quesnay*) that the "economists abused their influence by circulating democratical principles." It would be quite as correct to say that Locke and his followers abused their influence by circulating *despotical* principles.

[2] *Journal de Madame du Hausset*, in the *Mélanges*, &c. p. 277. A striking instance of the confidence placed by the most opposite parties in Quesnay is given in the second volume of Marmontel's Memoirs.

> Secta fuit servare modum, finemque tueri
> Naturamque sequi, patriæque impendere vitam,
> Nec sibi sed toti genitum se credere mundo.

They acted from an honest zeal for the truth, and not from fashion, eccentric tastes, or the love of singularity; their sole object was to enlighten and improve mankind; and to them, amongst political inquirers, belongs the rare praise of having first pointed out the natural order of things, or the observed course of nature in the conduct of the world, as the example and guide of human policy." (C. C.)

QUESNE, Marquis du Quesne, admiral of the naval forces of France, and one of the greatest men of the seventeenth century, was born in Normandy in the year 1610. He contributed to the defeat of the naval power of Spain at Gattari; he was dangerously wounded before Barcelona in 1642, and on other occasions; and having entered into the service of the Swedes, he became vice-admiral, and entirely defeated the Danes, killing their admiral, and taking his ship. He was recalled into France in 1647, and commanded the squadron sent to Naples. The naval affairs of France being much decayed, he fitted out divers ships for the relief of the royal army that blockaded Bordeaux, which was the principal cause of the surrender of the town. He was very fortunate in the wars of Sicily, where he defeated the Dutch thrice, and De Ruyter was killed. He also obliged the Algerines to sue in a very humble manner for peace from France. In short, Asia, Africa, and Europe, felt the effects of his valour. He was a Protestant; yet the king bestowed on him the land of Bouchet, and, to immortalize his memory, gave it the name of that great man. He died in 1688.

QUESTOR, or Quæstor, in Roman antiquity, an officer who had the management of the public treasure. The questorship was the first office which any person could hold in the commonwealth, and have a right to sit in the senate. At first there were only two; but afterwards two more were created to take care of the payment of the armies abroad, and to sell the plunder, for which purpose they generally accompanied the consuls in their expeditions. On this account the latter were called *peregrini*, as the former were called *urbani*. The number of questors was afterwards greatly increased. They had the keeping of the decrees of the senate; and hence came the two offices of *quæstor principis*, or *augusti*, sometimes called *candidatus principis*, whose office resembled in most respects that of our secretaries of state, and the *quæstor palatii*, answering in a great measure to our lord-chancellor.

QUEUE, in *Heraldry*, signifies the tail of a beast. Thus, if a lion be borne with a forked tail, he is blazoned double-queued.

QUEVEDO de Villegas, Francisco, a celebrated Spanish poet, born at Madrid in the year 1570. He was descended from a noble family, and was made a knight of St James; but he was thrown into prison by order of Count Olivarez, whose administration he satirized in his verses, and was not set at liberty until after that minister's disgrace. Quevedo wrote some heroic, lyric, and facetious poems. He also composed several treatises on religious subjects, and translated some authors into Spanish. He died in 1644. The best known of his works are, 1. The Spanish Parnassus; 2. The Adventurer Buscon; 3. Visions of Hell Reformed. Quevedo was one of the greatest scholars and most eminent poets of his time. His youth was spent in the service of his country in Italy, where he distinguished himself by the utmost sagacity and prudence. His moral discourses prove the soundness of his doctrine and his religious sentiments, whilst the correctness of his literary pieces display his accurate judgment and refined taste. His great knowledge of Hebrew is apparent from the report of the historian Mariana to the king, requesting that Quevedo might revise the new edition of the Bible of Arias Montanus. His translations of Epictetus and Phocylides, with his imitations of Anacreon and other Greek authors, show how well he was versed in that language; that he was a Latin scholar, his constant correspondence, from the age of twenty, with Lipsius, Chifflet, and Scioppius, sufficiently illustrates. As a poet, he excelled both in the serious and burlesque style, and was singularly happy in that particular turn which we have since admired in Butler and Swift.

QUIBERON, a market-town of France, in the department of Morbihan, and arrondissement of L'Orient. It is situated on a peninsula, in a bay of the same name, and contains 1850 inhabitants. It is defended by the fort Penthièvre, on the same peninsula, and is remarkable for the unsuccessful attempt made in 1795, by a body of royalist emigrants, under the brave Sombreuil.

QUICK or Quickset *Hedge*, amongst gardeners, denotes all live hedges, of whatever sort of plants they are composed, to distinguish them from dead hedges; but in a more limited sense of the word, it is restricted to those planted with the hawthorn, under which name the young plants or sets are sold by the nursery-gardeners, who raise them for sale.

QUICKLIME, a general name for all calcareous substances when deprived of their fixed air; such as chalk, limestone, and oyster-shells, calcined.

QUICKSILVER, or Mercury, one of the metals, and so fusible that it cannot be reduced to a solid state but at a degree of cold equal to forty below zero of Fahrenheit's thermometer. See Chemistry.

QUICK-MATCH, amongst artillerymen, a kind of combustible preparation, formed of three cotton strands, drawn into length, and dipped in a boiling composition of white-wine vinegar, saltpetre, and mealed powder. After this immersion it is taken out hot, and laid in a trough, where some mealed powder, moistened with spirits of wine, is thoroughly incorporated into the twists of the cotton, by rolling it about therein. Thus prepared, they are taken out separately, and drawn through mealed powder; then hung upon a line and dried, after which they are fit for immediate service.

QUID pro Quo, in *Law*, denotes the giving one thing of value for another; or the mutual consideration and performance of both parties to a contract.

Quid *pro Quo*, or Qui *pro Quo*, is also used in physic to express a mistake in the physician's bill, where *quid* is written for *quo*, that is, one thing for another; or of the apothecary in reading *quid* for *quo*, and giving the patient the wrong medicine. Hence the term is in general extended to all blunders or mistakes committed in medicine, either in the prescription, the preparation, or the application of remedies.

QUIDDITY, Quidditas, a barbarous term, used in the schools for *essence*. The name is derived from this, that it is by the essence of a thing that it is a *tale quid*, such a *quid*, or thing, and not another. Hence what is essential to a thing is said to be *quiddative*.

QUIETISTS, a religious sect, famous towards the close of the seventeenth century. They were so called from a kind of absolute rest and inaction which they supposed the soul to be in when arrived at that state of perfection they called the *unitive life;* in which state they imagined the soul wholly employed in contemplating its God, to whose influence it was entirely submissive, so that he could turn and drive it whither and how he would. In this state, the soul no longer needs prayers, hymns, and the like, being laid, as it were, in the bosom and between the arms of its God, in whom it is in a manner swallowed up.

Molinos, a Spanish priest, is the reputed author of Quietism, though the Illuminati in Spain had certainly taught something like it before. The sentiments of Molinos were contained in a book which he published at Rome in the year 1681, under the title of the Spiritual Guide. For this he was cast into prison in 1685; but he afterwards publicly renounced the errors of which he was accused. This solemn recantation, however, proved unavailing, inasmuch as it was followed by a sentence of perpetual imprisonment, and he died in prison in the year 1696. Molinos had numerous disciples in Italy, Spain, France, and the Netherlands. One of the principal patrons and propagators of Quietism in France was Marie Bouvières de la Mothe Guyon, a woman of fashion, remarkable for goodness of heart and regularity of manners, but of an unsettled temper, and subject to be drawn away by the seduction of a warm and unbridled fancy. She derived all ideas of religion from the feelings of her own heart, and described its nature to others as she felt it herself. Accordingly her religious sentiments made a great noise in the year 1687; and, after accurate investigation, they were declared unsound by several men of eminent piety and learning, and professedly confuted in the year 1697, by the celebrated Bossuet. Hence arose a controversy of greater moment between the prelate last mentioned, and Fénélon, archbishop of Cambray, who seemed disposed to favour the system of Madame Guyon, and who, in 1697, published a book containing several of her tenets. Fénélon's book was, by means of Bossuet, condemned in the year 1699, by Innocent XII.; and the sentence of condemnation was read by Fénélon himself at Cambray, where he exhorted the people to respect and obey the papal decree.

A sect similar to this had appeared at Mount Athos in Thessaly, near the end of the fourteenth century; it was called *Hesychasts*, meaning the same with Quietists. They were a branch of the mystics, or those more perfect monks who, by long and intense contemplation, endeavoured to arrive at a tranquillity of mind free from every degree of tumult and perturbation. In conformity to an ancient opinion of their principal doctors, who thought there was a celestial light concealed in the deepest retirements of the mind, they used to sit every day, during a certain space of time, in a solitary corner, with their eyes eagerly and immoveably fixed upon the middle regions of the belly, or navel; and boasted, that whilst they remained in this posture, they found, in effect, a divine light beaming forth from their soul, which diffused through their hearts inexpressible sensations of pleasure and delight. To such as inquired what kind of light this was, they replied, by way of illustration, that it was the glory of God, the same celestial radiance that surrounded Christ during his transfiguration on the Mount. Barlaam, a monk of Calabria, from whom the Barlaamites derived their denomination, styled the monks who adhered to this institution Massalians and Euchites; and he gave them also the new name of *Umbilicani*. Gregory Palamas, archbishop of Thessalonica, defended their cause against Barlaam, who was condemned in a council held at Constantinople in the year 1341.

The Mahommedans seem to be no strangers to Quietism. They expound a passage in the seventeenth chapter of the Koran, "O thou soul which art at rest, return unto the Lord," of a soul which, having, by pursuing the concatenation of natural causes, raised itself to the knowledge of that being which produced them and exists of necessity, rests fully contented, and acquiesces in the knowledge of Him, and in the contemplation of his perfection.

QUILLET, Claude, an eminent Latin poet of the seventeenth century, was born at Chinon, in Touraine, and practised physic there with reputation; but having declared against the pretended possession of the nuns of Loudun, in a manuscript treatise, the original of which was deposited in the library of the Sorbonne, he was obliged to retire into Italy, where he became secretary to the Marshal d'Estrées, the French ambassador at Rome. In 1655, Quillet having published in Holland a Latin poem, entitled *Callipædia*, under the name of *Galvidius Lætus*, he there inserted some verses against the Cardinal Mazarin and his family; but that cardinal making him some gentle reproaches, he retrenched what related to the cardinal in another edition, and dedicated it to him, Mazarin having, before it was printed, given him an abbey. He died in 1661, aged fifty-nine, after having given Ménage all his writings, and five hundred crowns to pay the expense of printing them; but the Abbé took the money and papers, and published none of them. His *Callipædia* has been translated into English verse.

QUILLOTA, a province of the republic of Chili, in South America, about twenty-five leagues in length from north to south, and nearly twenty-one leagues in breadth from east to west. It is rich in metallic ores, and also very productive in an agricultural point of view. All kinds of grain and vines are here cultivated, and the hemp and honey of the province are much esteemed. The capital, St Martin de la Coucha, or Quillota, is built upon a fertile valley on the banks of the Acoucagua, one of the rivers which descend from the western declivities of the Andes, and flow into the ocean. It contains about 8000 inhabitants, and is situated about one hundred miles north-west from Santiago. The population of the whole province is estimated at between forty and fifty thousand.

QUILOA is the name of a kingdom of Eastern Africa, situated to the north of Mozambique. The island of Quiloa, which appears to constitute the principal part of the sovereignty, lies opposite a peninsula formed by two great rivers, the most important of which is called Coavo. This situation confers on it the accommodation of three safe and spacious ports. It is accessible at all times, and forms the mart for the trade of slaves of the whole coast of Zanguebar; but the king is compelled to yield half of the profits to the powerful scheik of the island of Zanzibar, who appoints a vizier to look after his rights. Indeed the negro monarch enjoys little more than a nominal sovereignty; for the viceroy of Zanzibar, generally a Moor, keeps him in a state of tutelage, and rules supremely in his name. The continent produces a species of teak-wood, as durable as that from Surat, of the greatest beauty, and well adapted for ship-building. The sugar-cane, cotton-tree, and indigo, are indigenous to the soil. The gigantic baobab, the tamarind, the cedar, the tree which yields gum-copal, and the coffee-plant of Madagascar, are also found here. Game, and herds of every species of wild animal, particularly the wild ox, as well as river and sea-fish, are abundant. Lions, panthers, elephants, and other formidable tenants of the forest or the desert, often visit the banks of the two rivers for the purpose of quenching their thirst. These banks are ornamented by large trees, interspersed with villages subject to the authority of the king of Quiloa. Fruits and vegetables are scarce, and millet forms the principal food of the natives. The women cultivate millet and potatoes from custom and necessity; and some also make mats and coarse stuffs for their own use. Hunting or fishing forms the chief employment of the male part of the population. The chief town of the island, which bears the same name, was the capital of Eastern Africa, when first visited by the Portuguese in the beginning of the sixteenth century. They succeeded in establishing themselves, but were at last driven out by the Imam of Muscat. There are but few traces of its ancient splendour and power now remaining. Long. 39. 47. E. Lat. 8. 41. S.

QUIMPER, an arrondissement of the department of Finisterre, in France. It is six hundred and forty-one square miles in extent, is composed of nine cantons, divided into sixty-five communes, and contains 82,800 inhabitants. The capital is the city of the same name. It is on the acclivity of a hill, about ten miles from the sea, at the junction of the rivers Odet and Benaud. The harbour is accessible for vessels of two hundred tons burden, and in the road of Benaudet the largest ship can ride in security. It is the see of a bishop, and contains a cathedral, four other churches, 1010 houses, with 6750 inhabitants, who carry on a considerable coasting trade and some fisheries. Near this place an attempt was made to land a body of royalists under Puysaye during the revolution, but it totally failed, and the greater part of them were executed. This was the birthplace of the celebrated Hardouin. Long. 4. 12. 30. W. Lat. 47. 58. 24. N.

QUIMPERLE, an arrondissement of the department of Finisterre, in France, extending over three hundred and sixteen square miles. It is divided into five cantons and twenty communes, and contains 37,200 inhabitants. The capital is the city of the same name. It stands in a rich valley, where the rivers Isolle and Elle unite their waters, and form a small and shallow harbour. It is an ill-built place, and much scattered, but contains 800 houses and 5800 inhabitants. Long. 3. 39. W. Lat. 47. 51. 53. N.

QUIN, James, a celebrated performer on the English stage, was born at London in 1693. He was intended for the bar; but preferring Shakspeare to the statutes at large, he, on the death of his father, when it became necessary for him to do something for himself, appeared on the stage at Drury Lane. In 1720 he first displayed his comic powers in the character of Falstaff, and soon afterwards appeared to as great advantage in Sir John Brute; but it was upon Booth's quitting the stage that Quin showed to most advantage, in the part of Cato. He continued a favourite performer until the year 1748, when, on some disgust between him and Mr Rich the manager, he retired to Bath, and only came up annually to act for the benefit of his friend Ryan, until the loss of two front teeth spoiled his utterance for the stage. Whilst Mr Quin continued upon the stage, he constantly kept company with the greatest geniuses of the age. He was well known to Pope and Swift; and the Earl of Chesterfield frequently invited him to his table; but there was none for whom he entertained a higher esteem than for the poet Thomson, the author of the Seasons, to whom he made himself known by an act of generosity that does the greatest honour to his character. Mr Quin's judgment in the English language recommended him to Frederick prince of Wales, who appointed him to instruct his children in speaking and reading with a graceful propriety; and Quin being informed of the elegant manner in which his majesty delivered his first speech from the throne, he cried out in a kind of ecstasy, "Ay, I taught the boy to speak." Nor did his majesty forget his old tutor; for, soon after his accession to the throne, he gave orders, without any application being made to him, that a pension should be paid to Mr Quin during his life. Mr Quin, indeed, was not in absolute need of this royal benefaction; for, as he was never married, and had none but distant relations, he sunk L.2000, which was half his fortune, in an annuity, for which he obtained L.200 a year, and, with about L.2000 more in the funds, lived in a decent manner during the latter part of his life at Bath, whence he carried on a regular correspondence with Mr Garrick, and generally paid a visit to his friends in the metropolis once a year, when he constantly passed a week or two at Mr Garrick's villa at Hampton. He died of a fever in 1766.

QUINARIUS was a small Roman coin, equal to half the denarius, and consequently worth about threepence three farthings of our money. It was called *quinarius*, because it contained the value of five asses, in the same manner as the denarius was named from its containing ten.

QUINAUT, Philip, a celebrated French poet, born of a good family, at Paris, in 1635. He cultivated poetry from his infancy, and sixteen dramatic pieces of his were acted between the years 1653 and 1666. In the mean time, Quinaut was not so much devoted to poetry but that he applied himself to the study of the law, and made his fortune by marrying the widow of a rich merchant to whom he had been useful in his profession. Quinaut afterwards turned his attention to the composing of operas, which were set to music by Lully, who was charmed with a poet whose verses were not too nervous to yield to the capricious airs of music. He died in 1688, after having for many years enjoyed a handsome pension from Louis XIV.; and he was extremely penitent in his last illness for all those of his compositions which tended to inspire love and pleasure.

QUINCUNX, in Roman antiquity, any thing that consists of five twelfths of another, but particularly of the *as*.

Quincunx *Order*, in *Gardening*, is a plantation of trees, disposed originally in a square consisting of five trees, one at each corner, and a fifth in the middle; which disposition, repeated again and again, forms a regular grove, wood, or wilderness.

QUINDECAGON, in *Geometry*, a plain figure with fifteen sides and fifteen angles.

QUINDECEMVIRI, in Roman antiquity, a college of fourteen magistrates, whose business it was to preside over the sacrifices. They were also the interpreters of the Sybil's books, which, however, they never consulted except by an express order of the senate.

QUINHONE, an excellent harbour in Cochin-China, where vessels are sheltered from every wind. The entrance is narrow, and it is only at high water that vessels of great burden can enter. Lat. 13. 52. N.

QUINQUAGENARIUS, in Roman antiquity, an officer who had the command of fifty men.

QUINQUAGESIMA Sunday, Shrove Sunday, so called as being about the fiftieth day after Easter.

QUINQUATRIA, or Quinquatrus, was a festival celebrated at Rome in honour of Minerva, and which began on the 18th of March, or, as others will have it, on the 19th, and lasted five days. On the first day they offered sacrifices and oblations without the effusion of blood; the second, third, and fourth, were spent in shows of gladiators; and on the fifth day they went in procession through the city. Scholars had a vacation during the solemnity, and at this time presented their masters with a gift or fee, called *Minerval*. Boys and girls used to pray to the goddess Minerva for wisdom and learning, of which she had the patronage. Plays were acted, and disputations held, at this feast, on subjects of polite literature. The quinquatria were so called, because they lasted for five days. There seems to be a strong resemblance between this festival and the panathenæa of the Greeks.

QUINQUENNALIS, in Roman antiquity, a magistrate in the colonies and municipal cities of that empire, who had much the same office as the ædile at Rome.

QUINQUEREMIS, in the naval architecture of the ancients, is a name given to a galley which had five rows of oars. They in general divided their vessels into *monocrota* and *polycrota*. The former had only one tier of rowers; the latter had several tiers of them, from two or three, up to twenty, thirty, or even forty; for in the time of Philopater we have an account of such a vessel, which required no less than four thousand men to row it.

Meibomius has diminished the imaginary improbability of there ever having been such a vessel, by reducing the enormous height supposed to be necessary for such a number of rows of oars, and men to work them, and finding a better way of placing the men than others had thought of. The quinqueremes of the ancients had 420 men in each, 300 of whom were rowers, and the rest soldiers. The Roman fleet at Messina consisted of 330 of these ships; and the Carthaginian, at Lilybœum, of 350 of the same size. Each vessel was 150 feet in length. Thus, 130,000 men were contained in the one, and 150,000 in the other, with the apparatus and provisions necessary for such expeditions as they were intended for. This gives so grand an idea of the ancient naval armaments, that some have questioned the truth of the statement; but we find it related by Polybius, an historian too authentic to be questioned, and who expresses his wonder at the circumstance whilst he relates it.

QUINQUEVIRI, in Roman antiquity, an order of five priests, peculiarly appointed for the sacrifices to the dead, or celebrating the rites of Erebus.

QUINTESSENCE, in *Chemistry*, a preparation consisting of the essential oil of some vegetable substance, mixed and incorporated with spirit of wine.

QUINTESSENCE, in *Alchemy*, is a mysterious term, signifying the fifth or last and highest essence of power in a natural body. Or, when divested of its alchemical signification, and employed to express something that is intelligible, the word denotes merely the highest state of purification in which any body can be exhibited.

QUINTAL, the weight of 100 lbs. in most countries, but in England it is the cwt. or 112 lbs. Quintal was formerly used for a weight of lead, iron, or other common metal, usually equal to 100 lbs. at six scores to the hundred.

QUINTETTO (English, *Quintet*), in music, a composition for five voices, or for five instruments, each of which is *obbligato*. The remarks that have been made upon the construction of the quartetto apply generally to that of the quintetto. Amongst the finest instrumental quintettos are those of Boccherini, Mozart, Beethoven, and Onslow. The best that have been composed for wind-instruments only, are A. Reicha's for flute, oboe, clarinet, horn, and bassoon.

QUINTILE, in *Astronomy*, an aspect of the planets when they are seventy-two degrees distant from one another, or a fifth part of a zodiac.

QUINTILIAN (MARCUS FABIUS QUINTILIANUS), a celebrated rhetorician and critic, who flourished in the first century of the Christian era. His life, written by an unknown author, is prefixed to several editions of his works. From it we learn that he was born at Rome, though under what consuls, or in what reign, is unknown; and that no credit is due to the tradition which makes him a native of Calagurris or Calahorra, in Spain, since he is not amongst the number of the Iberians whom Martial has celebrated. In fact, that poet names him apart from any others, and, in the homage which he pays, clearly intimates that he was a Roman.

> Quintiliane vagæ moderator summe juventæ,
> Gloria Romanæ, Quintiliane, togæ.

Quintilian calls himself the son of an advocate, and informs us besides that, in his youth, he was acquainted with Domitius Afer and Seneca, who both perished under Nero. Seneca speaks of Quintilian, a declaimer, the grandfather of him who so long taught rhetoric at Rome. Domitian intrusted the instruction of his grand-nephews to Quintilian; and another pupil of his, C. Cælius, became the best orator of the time. Having married a lady of a noble family, Quintilian had the grief to lose her, as well as one of the sons she had brought him; an affliction which he experienced soon after he had composed his book on the causes of the corruption of eloquence. He then wrote his books of rhetoric, but whilst engaged in the composition of the work, he lost his other son. His daughter, whom he had by a second wife, married Novius Celer, a man of distinction. The anonymous author concludes by stating that he does not know in what year Quintilian died.

According to the calculations of Dodwell, he must have been born in the year 42 of our era, and must have died under Hadrian, some time between the years 117 and 138. Those who hold him to have been a Spaniard, say that he was brought to Rome by Galba; and the same thing is stated in the chronicle of Eusebius. But Quintilian himself assures us that at Rome he was acquainted with Domitius Afer; and the death of this orator took place in the year 55 of our era. Dodwell, therefore, conjectures that in 61 Quintilian followed Galba into Spain, where he taught rhetoric pleaded causes, and in the year 68 returned to Rome with the same emperor. From this time until the year 88 he gave lessons in rhetoric, a public provision having been attached to this function by Galba, according to Dodwell; by Domitian, according to the chronicle of Eusebius; by Vespasian, according to Suetonius. At the same time, Quintilian shone at the bar, where his pleadings attracted so much notice that they were written out and sold. He enjoyed an honourable degree of credit, and, according to Juvenal, a considerable fortune; which, however, accords but indifferently with the present that he received from Pliny the younger, as a portion to his daughter. It is possible, indeed, that Pliny, in mentioning this fact, may be speaking of a different Quintilian; but it may be observed, that no other rhetorician of the name is known at the time here referred to. Dodwell supposes that the author of the *Institutiones Oratoriæ* was consul in the year 117, and others that he held this dignity either before or after this date. Some words of Ausonius and Juvenal have led to this conclusion, but neither of these writers has expressly mentioned the fact.

If it be difficult, however, to ascertain the details of his life, it is easy enough to recognise the eminent merit of his work, forming, as it does, the most complete course of rhetoric which the ancients have left us. Of this work Gibert and Laharpe have both given very ample analyses. The first book treats of the education of the orator; the second, of the art of oratory in general; the following, of invention, arrangement, elocution, memory, and action; the twelfth and last, of the manners and character of the orator, or rather of the advocate. The author loves to descend to details of all sorts, sometimes even to those relating to grammar; and, besides, he intermingles with his precepts so many observations, and, above all, so many facts, that his work is indispensable for acquiring a competent knowledge of the literary history of antiquity. The gravest fault which has yet been detected in the work, consists in the praises lavished upon Domitian; a deformity which, in the eyes of Bayle, Dodwell, and even Gibert, is alike disgusting and inexcusable. In a literary point of view, it may be observed that Quintilian, in citing and contradicting the rhetoricians who have preceded him, particularly Aristotle, does not always seize the true import of their words, and consequently ascribes to them doctrines they never maintained, and precepts they never inculcated. In other respects, if his work be long, it is also full; and all the obscurity we find in it is reduced to some details of which all trace was effaced soon after his time, and which he does not explain sufficiently for us, because they were familiar to his Roman readers. The enumeration which he has made of more than a hundred figures is of more importance than is commonly supposed to the theory of language and of thought. Nevertheless, Rollin took the trouble of abridging this rhetoric, in order to render it more accessible and more useful to youth, and retrenched nearly a fourth of the original work; but, in our opinion, it would be much better to leave classical books as they are, especially when they inspire only pure tastes and virtuous sentiments.

In point of style, the work of Quintilian has no pretensions to equal or be compared with the treatises of Cicero on the art of oratory; but it is nevertheless written with much sagacity and elegance. Severe censors have thought that the preface of the sixth book savours of declamation. The author therein deplores the loss of his second son, which he had just sustained, and retraces the recollections of another son, and of a young wife, whom death had also removed. But, to say the truth, the expression of his grief is not so simple or so natural as could be wished; and, in the concluding part, we perceive almost as much of the rhetorician as of the father. This preface, however, is read with interest, and has no resemblance to the Declamations, of which a long and useless collection has been published under the name of Quintilian. They are distinguished into great and small; the former, nineteen in number, and the latter, a hundred and forty-five, being all that remain of three hundred and eighty-eight. Philelphus, Vives, and especially Erasmus, have shown that the nineteen great declamations could not have proceeded from the pen of Quintilian. In fact, there are manuscripts which assign them to M. Florus; and a text of Trebellius Pollio would authorize the belief that they were the work of Postumus the younger, one of the thirty tyrants: "Postumus...ita in declamationibus disertus, ut ejus controversiæ Quintiliano dicantur insertæ." Notwithstanding the authority of several manuscripts, and that of Lactantius, Ennodius, and Vincent de Beauvais, we cannot discover in them a trace of Quintilian. The difference is too sensible, even in the diction; he never could have written *dilectio, discretio, impœnitens, lenocinamentum*, and other expressions belonging to a class which he must have strongly condemned. As to the hundred and forty-five smaller declamations, if they were really his, they might have been extracts from his pleadings, collected by the tachygraphers. Perhaps they belonged to his father or his grandfather, or some other person of the same name; perhaps they were the productions of different authors and different ages, which the inequalities observed in them seem almost to indicate. But the circumstance which has most puzzled the learned, is the distinction of these pieces into two kinds; the *coloratæ*, and the *tractatæ*. May not this second qualification have been applied to those the subjects of which had really been treated, and the first to such as invested imaginary themes with all the colours of rhetorical embellishment? or, if another supposition be admissible, may not the *tractatæ* have been the simple expositions of causes, whilst the *coloratæ* were such as admitted of embellishment?

A production, however, which would do much more honour to Quintilian, were he really the author of it, is the dialogue *De Causis corruptæ Eloquentiæ*. He had certainly composed a treatise bearing this title; for, in the preface to the sixth book of his Institutions, he expressly mentions the fact; but on referring to the same treatise at the end of the eighth, he says that he has there spoken more at large of tropes, and particularly of hyperbole, which is not in accordance with the dialogue, the interlocutors in which are Aper, Maternus, Julius Secundus, and Vipsanius Messala. Pierre Pithou, Colomies, Dodwell, and many other learned men, have preferred ascribing it to Tacitus; and one of the grounds on which this opinion rests is the character of the political observations scattered throughout this little work. Besides, in several manuscripts, Tacitus is distinctly pointed out as its author. But it may not be the production either of the one or of the other. It has sometimes been ascribed to Suetonius, who, in his ascertained writings, has not the same force of thought and expression; and, in Fitzosborne's Letters, a very strong case has been made out in favour of Pliny the younger, although the latter has produced nothing under his own name which can be compared with this admirable dialogue. The treatise which Quintilian had composed on the causes of the corruption of eloquence, is not the only one of his productions which has perished. We have also lost his elementary rhetoric, in two books; and there remains no other authentic work of his but the Institutions, which had themselves nearly disappeared. This treatise existed in the middle ages, when it was known to and cited by Cassiodorus, Isidore of Seville, Loup de Ferrière, and Vincent de Beauvais. The manuscript which Petrarch consulted appears to have been in several respects defective; but that which, in 1419, Poggio discovered in the Abbey of Saint Gall, restored Quintilian to the light of day. Amongst the eminent services which Poggio rendered to letters, the discovery in question is not one of the least important. It is beyond a doubt, however, that the literati of the fifteenth century possessed at least defective copies of Quintilian; in proof of which we may refer to that letter of Leonardo Aretino, where he speaks with so much emphasis of the new apparition of this classic, at the same time declaring that he had long read and admired the half of the *Institutiones Oratoriæ*. These two manuscripts of Saint Gall and Leonardo Aretino were the sources of all those since made, as well as of the copies printed.

The first two editions of the Institutions of Quintilian appeared at Rome in 1470, the one printed by Udalricus Gallus, the other by Sweynheym and Pannartz, and both in folio. The fifteenth century produced ten others; and amongst the great number of the sixteenth may be distinguished, at Venice, those of the Alduses, 1514, in 4to, and at Paris, those of Vacosan, 1538, in folio; of Simon de Colines, 1541, in 4to; of Robert Etienne, 1542, in 4to; and of Mamert Patisson, 1580, in 8vo. This last was revised by Pierre Pithou, who added to it various readings, notes, and the hundred and forty-five small Declamations, of which there had yet appeared only a hundred and thirty-six. Schrevelius, and after him J. Frederic Gronovius, took charge of the edition which appeared at Leyden and Rotterdam, 1665, in 8vo, *cum notis variorum*. Here all the Declamations are joined to the Institutions, as in that of Strasbourg, which appeared in 1698, in 4to. In 1715, Rollin published his Quintilian abridged, Paris, *apud* the Etiennes, in two vols. 12mo. In the edition of 1720, which appeared at Leyden, in two vols. 4to, Peter Burmann profited by the labours of his predecessors on this author, including the *Annales Quintilianei* of Dodwell. Capronnier published at Paris, 1725, an edition in folio, with a selection of notes, and some critical observations, which offended Burmann, who replied, with all the intemperance of an enraged grammarian. But the edition of Mathias Gesner, Göttingen, 1738, in 4to, is more esteemed than either of the two preceding. Then followed that of Barbou, 1769, in 12mo; that of Deux-Ponts, 1784, in four vols. 4to; and that of Leipzig, 1719–1815, in four vols. 8vo, under the care of G. L. Spalding. The Institutions have been translated into the principal modern languages of Europe; into French, first by the Abbé de Pure, and second by Gédoyn; into Italian by Orazio Toscanella; into English, first by Guthrie, and next by Pastal; into German by Henke; into Spanish by two professors of the Charitable Schools in Madrid; and into Danish by Schlegel. Of the dialogue *De Causis corruptæ Eloquentiæ* there are also several translations, all of them French. The principal notices to be consulted respecting the life and works of Quintilian are, the *Annales Quintilianei* of Dodwell; Bayle's Dictionary; Fabricius, *Bibliotheca Latina*; Gibert, *Jugements des Savants sur les Rhéteurs*; and the *Lycée of Laharpe*. (A.)

QUINTILIANS, a sect of ancient heretics, who were so called from their prophetess Quintilia. In this sect the women were admitted to perform the sacerdotal and episcopal functions. They attributed extraordinary gifts to Eve for having first eaten of the tree of knowledge; and told great things of Mary the sister of Moses, as having been a prophetess; adding, that Philip the deacon had four daughters, who were all prophetesses, and were of their sect. In these assemblies it was usual to see the virgins entering in white robes, and personating prophetesses.

QUINTIN MATSYS, called also the *Farrier of Antwerp*, famous for being transformed, by the force of love, from a blacksmith to a painter. He had followed the trade of a blacksmith and farrier for nearly twenty years; when, falling in love with a painter's daughter who was very handsome, and disliked nothing but his trade, he quitted it, and betook himself to painting, in which he made very great progress. He was a diligent and careful imitator of ordinary life, and succeeded better in representing the defects than the beauties of nature. Some historical performances of this master deserve commendation, particularly a Descent from the Cross, in the cathedral at Antwerp; but his best known picture is that of the two Misers in the gallery at Windsor. He died in the year 1529.

QUINTUS CALABER, a Greek poet, who wrote a large supplement to Homer's Iliad, in fourteen books, in which a relation is given of the Trojan war from the death of Hector to the destruction of Troy. It is conjectured, from his style and manner, that he lived in the fifth century. Nothing certain can be collected either concerning his person or country. His poem was first made known by Cardinal Bessarion, who discovered it in St Nicholas's Church, near Otranto, in Calabria; and hence the author was named Quintus Calaber. It was first published at Venice by Aldus, but it is not stated in what year.

QUIRIA, a province of Immeritia, in Asia, which stretches along the shores of the Black Sea. It appears, from the ruins which are everywhere seen, to have been once a flourishing province.

QUIRINALIA, in *Antiquity*, a feast celebrated amongst the Romans in honour of Romulus.

QUIRITES, in Roman antiquity. In consequence of the agreement entered into by Romulus, and Tatius king of the Sabines, Rome was to retain its name, and the people were to be called *Quirites*, from Cures, the principal town of the Sabines. Dionysius of Halicarnassus says that each particular citizen was to be called *Romanus*, and the collective body *Quirites;* yet it appears by the ancient form of words used at funerals, *Ollus Quiris letho datus est*, that each private citizen was also called *Quiris*. The origin of the word *Quirites* has been much sought for; and the most probable account antiquity gives us of it is, that the word *Quir*, or *Quiris*, signified in the Sabine language a dart and a warlike deity armed with a dart. It is uncertain whether the god gave name to the dart, or the dart to the god.

QUIRK, in a general sense, denotes a subtile or artful distinction.

QUIRK, in building, is a piece of ground taken out of any ground-plot or floor.

QUITO, or EQUATOR, one of the three republics of South America which formerly constituted Colombia.[1] Its territory chiefly comprehends the ancient Spanish viceroyalty of Quito, extending from 2° of north to 6° of south latitude, and from 76° 30′ to 80° 40′ of west longitude. Its limits, however, in the direction of Brazil have not been definitely fixed, so that it may extend to the east considerably beyond 76° 30′. On the south it borders upon Peru and Brazil; the latter country forms its eastern boundary; on the north its limits are New Granada; and the whole of its territory on the west is washed by the Pacific Ocean. Quito is intersected by both chains of the Andes, and consequently presents great diversity of surface and of climate. These parallel mountain ranges, by uniting at Loxa, at Asuay, at Chisinche, and at Los Pastos, constitute what have been called mountain knots; and again opening up, they form the table-lands of Cuença, Hambato, and Quito. The circles of snow-covered mountains by which they are surrounded have a few passes opening to the west coast, or to the low plains on the east; but they are so rugged and wild as to be scarcely practicable. These elevated valleys, although immediately under the equator, yet, on account of their great height, enjoy a climate in the highest degree mild, and a temperature which seldom varies. They are extremely fruitful, and would be the most charming places in the world, were it not for the destructive earthquakes and volcanic eruptions which are not unfrequently experienced. There are in Quito sixteen volcanoes, which, although they discharge no lava, often throw up immense quantities of ashes, water, sludge, and fragments of rocks, along with columns of smoke and flame; and these eruptions are always accompanied by undulations of the earth. From the line to 1° 41′ of south latitude, stretching from north to south in the eastern portion of the valley of Quito, are Catocache, 15,402 feet; Cayambe Urcu, 18,330 feet; Antisana, 17,958 feet; Sinchulahua, 15,420 feet; and Cotopaxi, 17,712 feet above the level of the sea. In the west of the same valley are situated Pinchincha, 15,036 feet; Corazon, 14,820 feet; and Yliniza, 16,302 feet in height. In the second group, under 1° of south latitude, lying in a direction from north to south, are the volcanoes of Carguirazo, 14,700 feet, and Chimborazo, 20,158 feet, above the level of the Pacific. The latter mountain is usually covered with snow and ice, 4800 feet below the summit. In the vicinity of these, and about 16,000 feet in height, are the volcanoes of Tunguragua, Capac Urcu, and Sangai. But the most formidable of them all is Cotopaxi, the rocks thrown up by which would of themselves form a mountain chain of no inconsiderable size. Its eruptions have been numerous and destructive. In the year 1738 it projected upwards a column of fire nearly three thousand feet in height. In 1744 the subterranean sounds which it gave forth were heard at a distance of six hundred miles. One of the most frightful earthquakes which ever took place in this region, unhappily too celebrated for such visitations, was that of 1797, in which a tract of country one hundred and thirty miles in length by one hundred miles in breadth moved in undulatory billows like a stormy sea; many towns and villages were overthrown, and forty thousand human beings perished in a moment.

The mountain chain of the Andes throws out a number of lateral ridges to the east, the country gradually subsiding into a vast plain extending along both sides of the Marañon, covered with majestic forests, and watered by innumerable streams. A number of rivers descend the western declivities of the Andes, and flow into the Pacific Ocean; others join the large streams of Cauca and Magdalena on the north; and the most important class consists of those that are tributaries of the Rio Negro and Marañon, which last river forms the boundary of the republic on the south. A portion of the territory of Quito on the east and north-east is watered by the Orinoco. Into this river fall the Atabapo and Guaviare, which at the same time form the line of separation between Cundinamarca and this republic. The Putumayo, Napo, Tigre, Pastaza, Marona, and Rio St Jago, which are large streams, besides many others of inferior note, all of which flow from the north-west to the south-east, fall into the Amazons, and irrigate the flat eastern territory of Quito. The Andes of Quito also contain lakes of no inconsiderable dimensions, amongst which may be mentioned those of San Pablo and Cuicocha. In the level land on the east, many of the streams form lagunes during part of their course.

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[1] In the year 1831, the republic then called Colombia separated into three independent states, the names of which are New Granada, Venezuela, and the Equator or Quito. The limits of each state have not been accurately settled, but an arrangement as to the amount of the national debt which was to fall to the share of each was completed at Bogota on the 23d of December 1834.

Many of the ravines, quebradas, and valleys of Quito have a very warm atmosphere; indeed, in some parts the heat is so oppressive as to render them uninhabitable. Other valleys which are more elevated are remarkably healthy, extremely productive, and delightful as places of residence. The valley of Quito is allowed to be the finest table-land in all America. It is enclosed, as we have said, between the two parallel ranges of the loftiest Andes, having an average breadth of thirty miles, but extending longitudinally much farther. In soil and climate it possesses every advantage. The climate is remarkably equable and agreeable; the indication of winter being the fall of rain, and the absence of rain marking the summer. The temperature is so benign that vegetation never ceases, the country all around the city of Quito exhibiting the beauty of perpetual spring. Hence it has been called *siempre verde* Quito, and also *eterna primavera*, both which epithets it may be said to deserve; for its native trees are all evergreens, and the fields on the slopes of the mountains never lose their verdure. The European sees with astonishment the plough and the sickle at once in equal activity; the green blade of grain and the yellow ear waving in the same breeze; one flower drooping, and its companion just beginning to "dedicate its beauty to the sun." In short, here the seasons of spring, summer, and autumn all go on at once, and the tints and varied beauties peculiar to each blend together in the same landscape. Mr Stevenson draws a glowing picture of these delightful valleys. They are, he says, "principally under cultivation, and bless the husbandman with a continued succession of crops; for the uninterrupted sameness of the climate in any spot is such as to preclude the plant as well as the fruit from being damaged by sudden changes in the temperature of the atmosphere, changes which are in other countries so detrimental to the health of the vegetable world. The fertility of some of these valleys exceeds all credibility, and the veracity of the description would be doubted, did not the knowledge of their localities, and the universal descriptions of the equability and benignity of these climates, insure the probability. One of these, called Pomasqui, is about five leagues from Quito, where sugar-cane arrives at a state of maturity in three years, and where many of the intertropical fruits attain the greatest perfection. This luxury is enhanced by the proximity of other situations possessing all the variety of climates known in the world. In the course of three hours a person may experience the rigidity of the poles, the oppressive heat of the equator, and all the intermediate temperatures."

An enumeration of all the different vegetable productions of this remarkable region is rendered unnecessary by the general view here given. It is sufficient to state, that grain, pulse, fruits, esculents, and horticultural vegetables are produced in the greatest abundance, and of an excellent quality, as well as all kinds of butcher-meat and poultry. The breeding of cattle and sheep, especially the latter, is extensively carried on in the high valleys. Excellent timber, fitted for ship or house building, and for every purpose of the cabinet-maker, abounds in many districts of the country. The soil is for the most part so productive of everything which usually occupies the attention of the husbandman and farmer, that butter, cheese, wax, mules, oxen, Peruvian bark, cacao, cotton, tobacco, grain, and other staples, form important exports. Sugar, wine, coffee, molasses, rum, and other spirits, are also amongst the products. Gold and silver are comprised in the metallic riches of the mountain territory. Some manufactures are carried on in different places.

According to the new constitution, this republic consists of the following provinces, viz. Quito, Chimborazo, Imbabura, Guayaquil, Monabi, Cuença, Loja del Archipelago, and Galopagos or Turtle Island.

Quito, the capital of the republic, is one of the finest and largest cities in the New World. It was founded in the year 1534, by Sebastian Benalcasar, with the dedicatory title of San Francisco, and in 1541 was created a city by Charles V. It stands in a ravine, at an elevation of more than 9000 feet above the level of the sea, in longitude 78° 45′ 17″ west from Greenwich, and in latitude 0° 13′ 17″ south. The mountain of Pinchincha lies on its west side, and on the east there is a range of hills called Chimbacalle. To the south is the plain of Turupampa or Turubamba, and to the north the plain of Anaquito, generally called Egido. The streets, which run north and south, stand on a pretty level plain, and are broad, handsome, and well paved; but those which cross them and climb the skirts of Pinchincha, descending on the east side of the city towards the small river of Machangara, are crooked and irregular. Quito has two universities, and it has always enjoyed celebrity for the great number of students by whom they are attended. There are a number of other seminaries of education in this city; indeed it is considered as comparatively a sort of American Athens. It is the seat of the congress, the president, and the highest offices of state, and enjoys a very extensive trade in cotton, silk, leather, gold, and silver. The commerce of Quito may be conveniently divided into two kinds, that of home and that of foreign manufactures. The former consists of cotton and woollen cloths, baizes, sugars, flannels, pouches, and other minor articles. The stock of foreign goods is composed of all kinds of European manufactures, including those of iron, steel, and some other raw materials. The articles most in demand are English broad cloths, kerseymeres, coloured broad flannels, calicoes, &c.; all kinds of hardware and cutlery, and foreign silk velvets, satins, as well as English ribbons and silks. The population amounts to about seventy-five thousand souls, and has been divided into three classes of nearly equal numbers; the whites, mestizos, and Indians. Here there are very few negroes, or descendants of that race, the Indians being generally engaged in domestic service.

Some remarkable monuments of the former sway of the Incas are found scattered at intervals in these delightful valleys. The ruins near Cayambe may be pronounced superb. Those of the palace of Callo present one of the most perfect examples of the ancient architecture of the Peruvians, which throughout the vast extent of the empire are marked by the most striking similarity. It forms a square, each side of which is one hundred feet in length. Four gates and eight interior apartments may be distinctly traced. The gates resemble those of the Egyptian temples; and the niches, of which there are eighteen in each division, are distributed in a very symmetrical manner. The remains of spacious porphyry palaces are found also at Autun, Canar, and some other places. The ruins of fortified places, called pucuras, still exist, and some of them are of considerable extent.

The province of Chimborazo, so called from the majestic mountain which overlooks its valleys, is distinguished for its breed of mules. Barley, potatoes, and maize are cultivated by the Indians in various parts, and some sugar-cane in the bottoms of the ravines. Riobamba, the capital of the province, was completely destroyed by the earthquake of 1797; and, with very few exceptions, the whole population, amounting to about twenty thousand, were buried under the ruins, or engulphed in the earth. Some idea of the terrible nature of the convulsion in this quarter may be gathered from the fact, that part of the ruins situated on the acclivities on each side of the valley where the new town now stands are pointed out as having once formed portions of one edifice, although now separated from each other a league and a half. The new town is built upon a sandy plain, much below the level of the surrounding elevated plains called *paranios*. Its climate is very agreeable, and adapted for producing all kinds of European fruits. Sheep-farming is extensively carried on, about four thousand quintals of sheep's wool being produced annually, and manufactured into different kinds of cloth. At Tescan, in the neighbourhood, there is a large sulphur-work; and here are seen part of those remains of hewn stones which run along the mountains almost to Cuzco, at a height of 13,800 feet above the level of the sea. This is called the road of the Incas, and, no doubt, was the means of communication between the two capitals in the regal days of the "Children of the Sun." Riobamba contains a population of 15,000; Ambato or Hambato, situated between Cotopaxi and Carguirazo, in a very fine region, contains 3000 inhabitants, who trade extensively in cochineal. This place also suffered severely in 1797. The other places in this province are, Alausi, situated in an elevated valley of the same name; Guano, which has a considerable trade with Popayan; Guarando, a dépôt for the trade between Quito and Guayaquil; and Pallactanga, where there are rich gold and silver mines.

The province of Imbabura contains many fine and fruitful valleys, in which there are extensive plantations of sugar-cane, from which the best sugar in the republic is manufactured. The wheat grown in this district is likewise of the finest quality. The capital, called Ibarra, is situated eighteen leagues to the northward of Quito. It is exceedingly well built, having fine streets and a spacious market-place; and it contains 12,000 inhabitants, who are employed to some extent in the weaving of cotton and woollens, and the manufacture of stockings and ponchos. To the south-west of Ibarra is the town of Otavalo, containing 20,000 inhabitants. Large quantities of cattle are bred in the neighbourhood, and cotton and woollens are manufactured here in the same manner as at Ibarra. Esmeraldas is situated near the mouth of a river of the same name, and is one of the few ports of the republic. The surrounding country is extremely fruitful; the sugar-cane grows to above ten feet in height, and the yam root sometimes weighs twenty pounds. Tacames is likewise a haven on the Pacific Ocean. But the great port of Quito is Guayaquil.

The remaining provinces may be briefly described. Loxa affords the finest cinchona, and was long supposed to be the only spot which produced in perfection that precious medicament. The town of Loxa is well built, and contains some fine churches, several well-organized seminaries of education, and a population of 10,000. The capital of Cuença, called St Anna de Cuença, is the seat of a bishop, and possesses a university, several schools and fine churches, with 20,000 inhabitants. The other towns in this quarter worthy of being mentioned are Azogues, where there are quicksilver mines; Zaruma, celebrated for its gold, silver, and lead mines; Beza, once populous, but now decayed to a mere village; and some other places, once of note, but now deserted wastes. The Gallopagos or Turtle Islands, stretching from 3° of south to 2° of north latitude, are celebrated for an uncommon species of land-turtle which they produce, weighing from fifty to three hundred pounds. The largest island is called Albemarle, and may be about sixty miles in length. It contains a good harbour. The whole group is said to be of volcanic origin.

The value of the trade of this republic will be seen from the following statement. In the year 1835 there entered inwards at the port of Guayaquil 123 vessels, of 21,430 tons burden in all, and with cargoes valued at L.221,680. The same number cleared outwards, and the value of their cargoes was L.210,429. The imports consist chiefly of British manufactures, flour, wine, and other necessaries; the exports, of cocoa, timber, and the other products of the country. The number of inhabitants is estimated at 550,000, including 300,000 Indians who dwell in the mountains; but some American accounts fix the population at only 481,966. With regard to the income and expenditure, little correct information is to be obtained. The former has been reckoned at 800,000 piastres, and the latter at about as much; but by the most recent intelligence the minister of finance estimates the outlay as low as 171,086 piastres. By the treaty regarding the national debt, already mentioned, the share which fell to Quito was $21\frac{1}{2}$ per cent., or L.1,464,795 sterling.

On the first of May 1835, the congress of the nation, consisting of forty-five members, agreed to draw up a plan of a constitution for the country; but it does not appear that they have yet (1839) agreed about the details. (R. R. R.)

QUIT-RENT (*quietus redditus*, or quiet-rent) is a certain small rent payable by the tenants of manors, in token of subjection, and by which the tenant goes quiet and free. In ancient records it is called *white rent*, because paid in silver money, to distinguish it from corn-rent, or rent in kind.

QUOIN, or COIN, on board a ship, a wedge fastened on the deck close to the breech of the carriage of a gun, to keep it firm up to the ship's side. Cantic quoins are short, three-legged quoins put between casks to keep them steady.

QUOINS, in *Architecture*, denote the corners of brick or stone walls. The word is particularly used for the stones in the corners of brick buildings. When these stand out beyond the brick-work, their edges being chamfred off, they are called *rustic quoins*.

QUOTIDIAN, anything which happens every day.

QUORUM, a word frequently mentioned in our statutes, and in commissions of justices of the peace and others. It is so called from the words of the commission, *quorum* A B *unum esse volumus*. Where a commission is directed to seven persons, or to any three of them, whereof A B and C D are to be two, in this case they are said to be of the quorum, because the rest cannot proceed without them.

QUOTIENT, in *Arithmetic*, the number resulting from the division of a greater number by a smaller, and which shows how often the smaller is contained in the greater, or how often the divisor is contained in the dividend. The word is formed from the Latin *quoties*, which is as much as to say or ask, how often is such a number contained in such another. See ARITHMETIC.

END OF VOLUME EIGHTEENTH.

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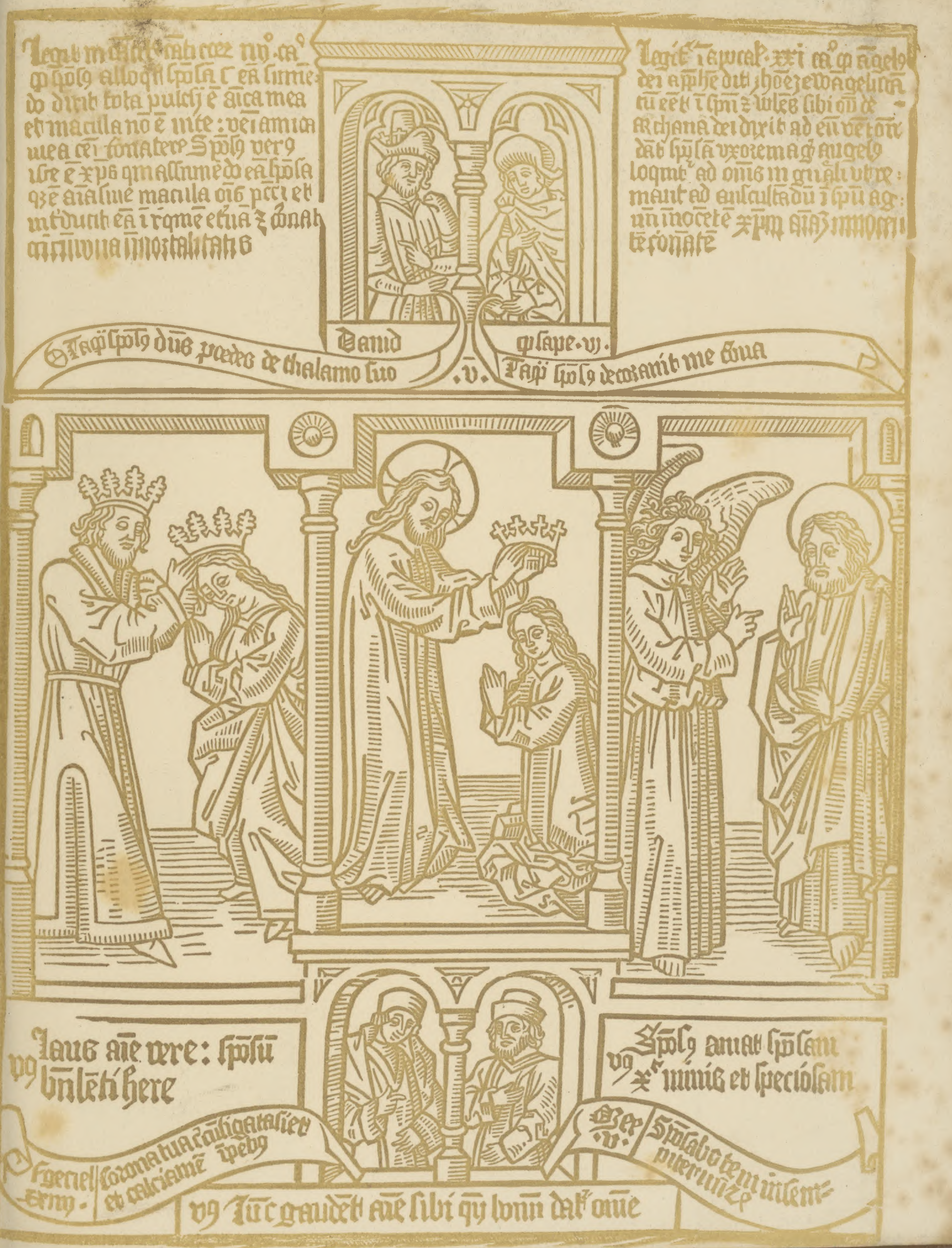

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.v.
Tanquā spōsā decorauit me corona

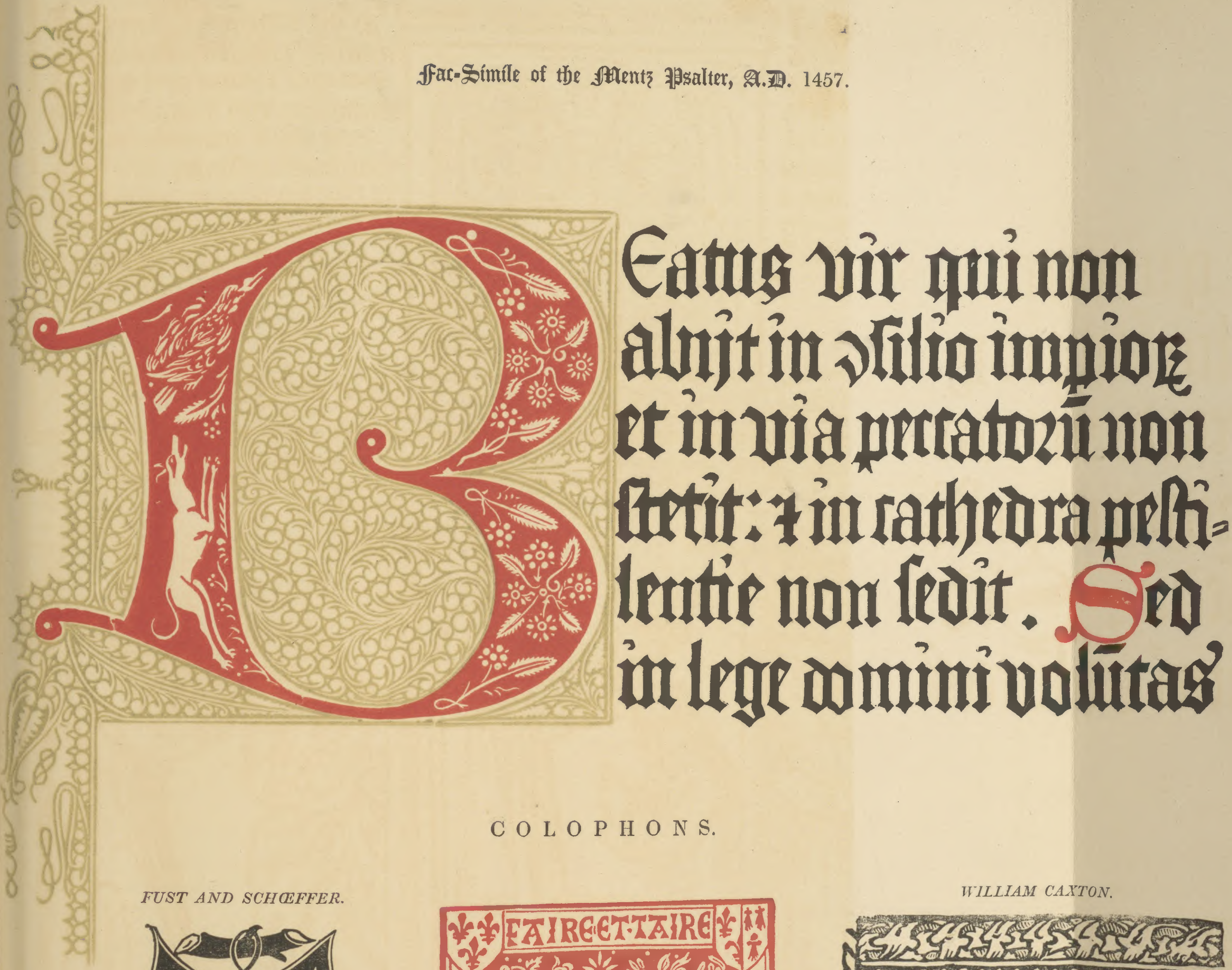
vꝰ Laus aīe vere: spōsū
vnlēti here

vꝰ Spōsꝰ amat spōsam
xͬ animis et speciosam

Ezechiel xxiij.
Corona tua circūligata sit et calciamē i pedibꝰ
Ose .v.
Spōsabo te m̄ i sempiternū

vꝰ Hic gaudet aīe sibi q̄ꝫ bonū dat oīne

Fac-Simile of the Mentz Psalter, A.D. 1457.



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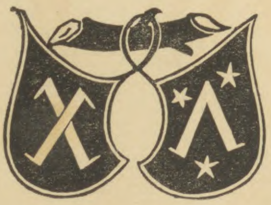

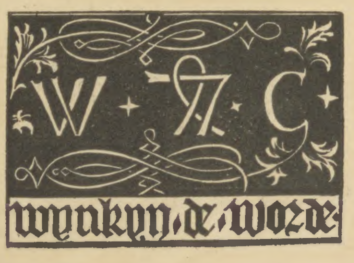

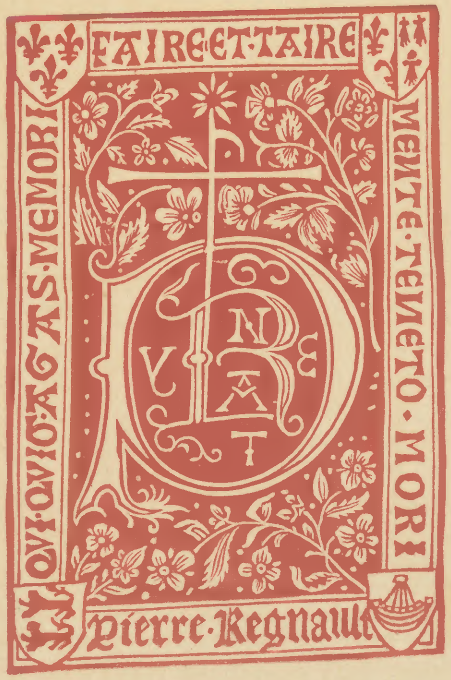

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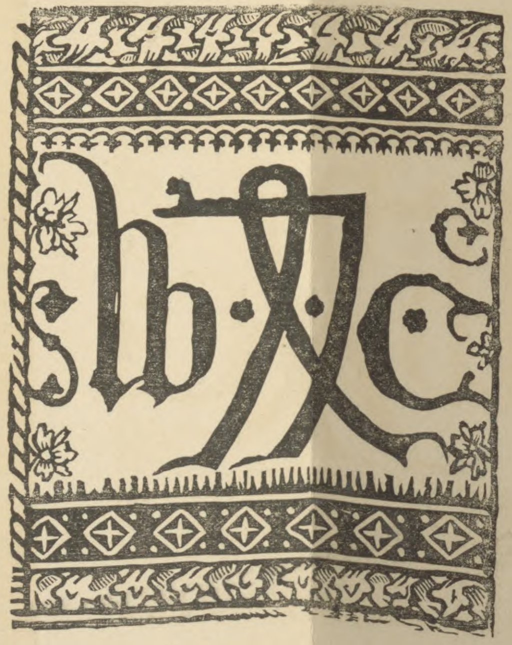

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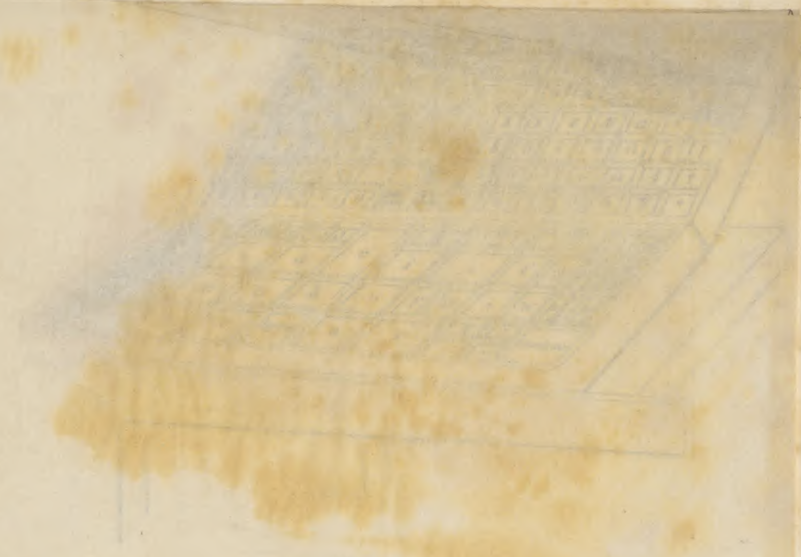
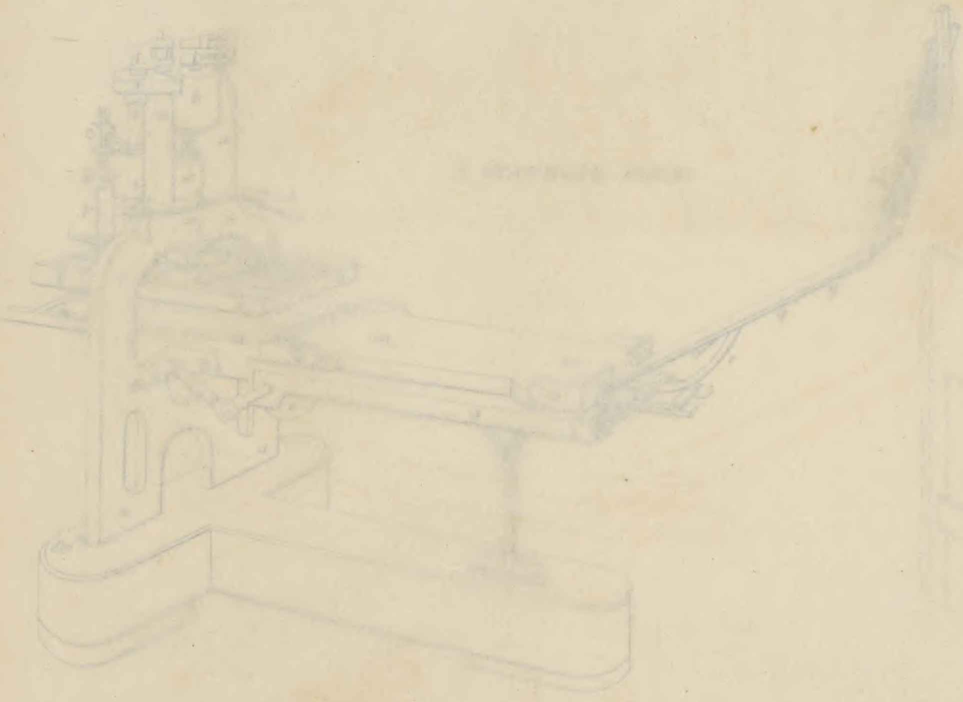
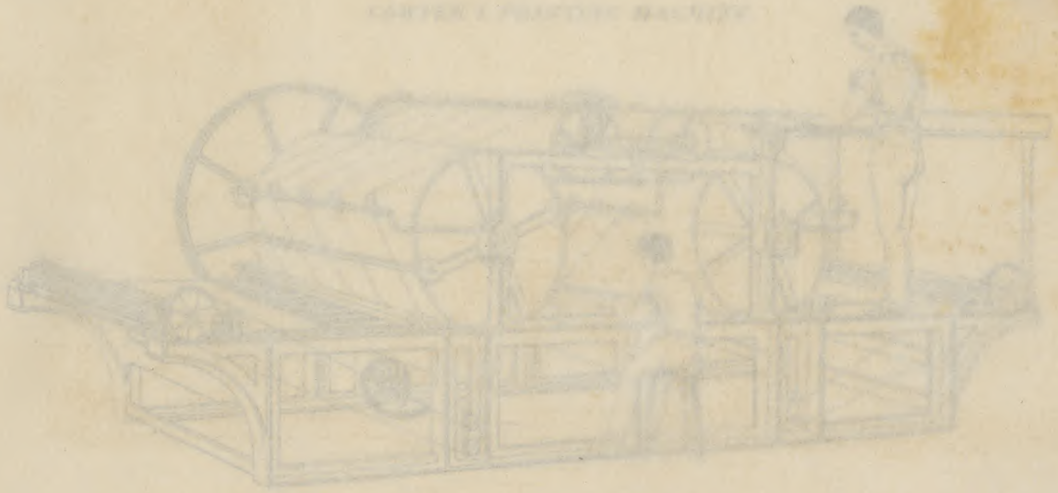






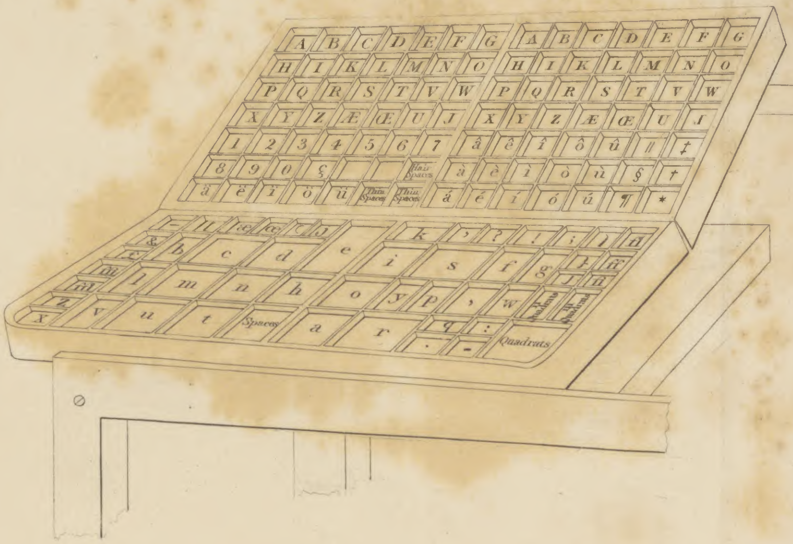
an, Sculp^t.

PRINTING.

PLATE CCCCXV.

Composing-stick.

A Pair of Cases.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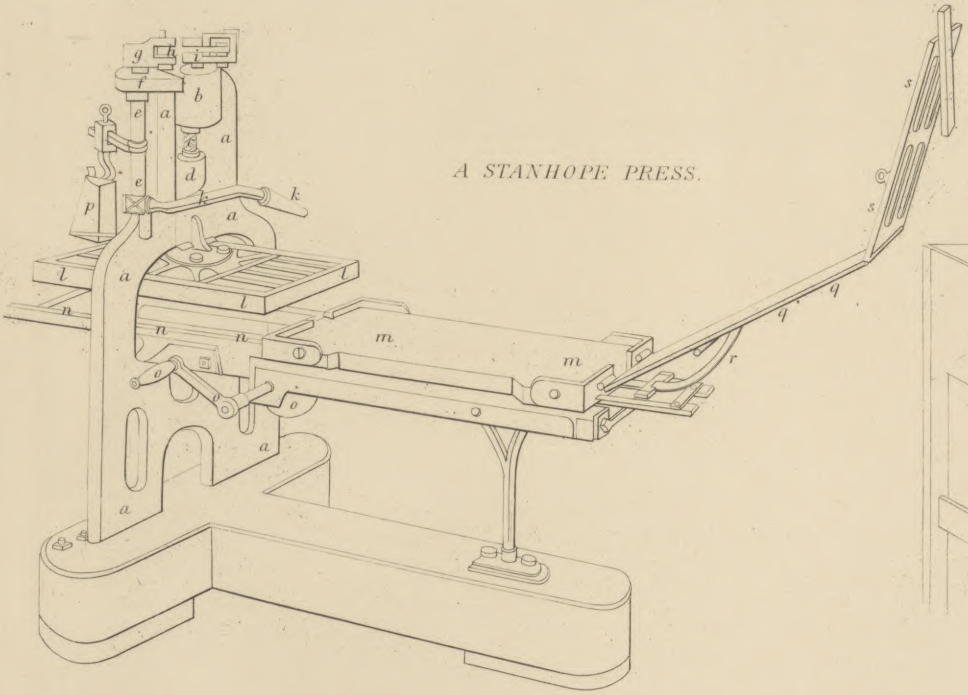
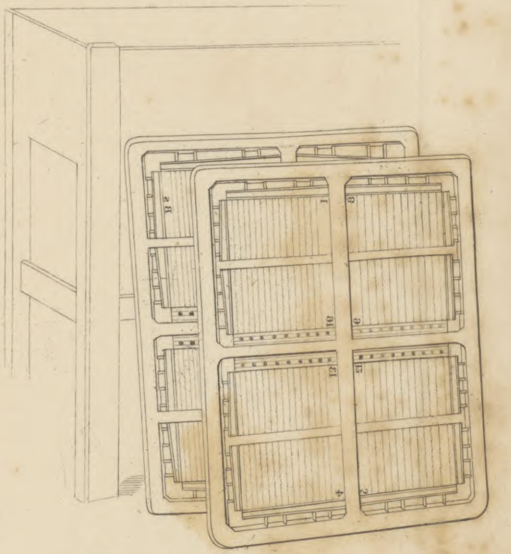
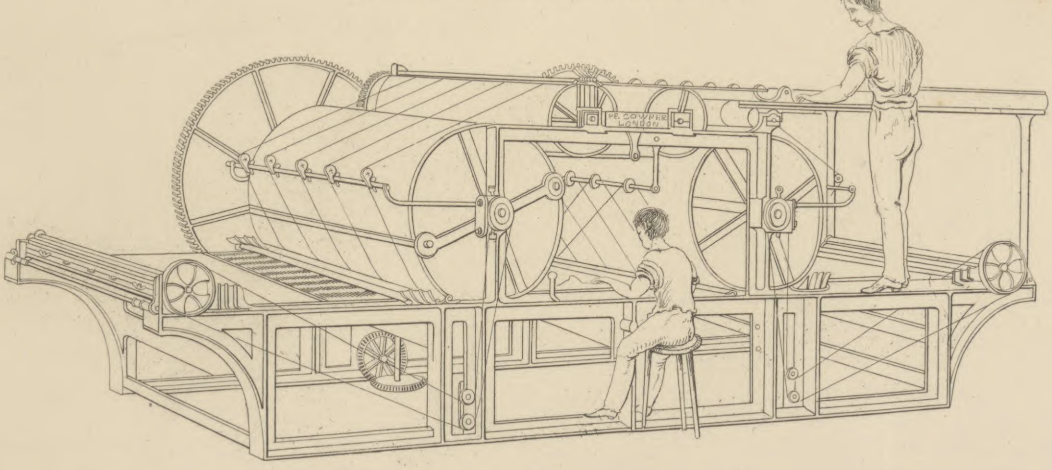
A STANHOPE PRESS.



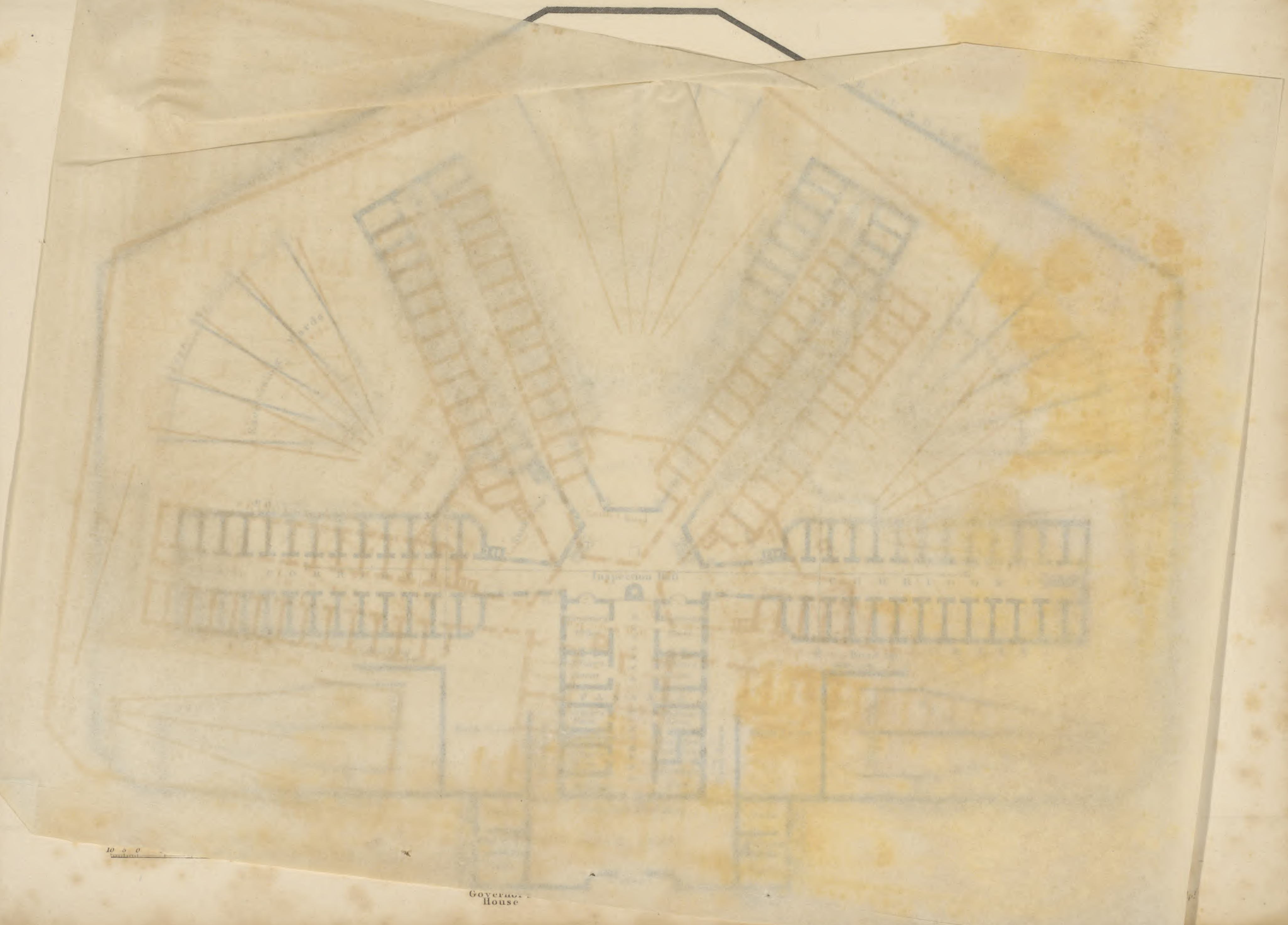
Two forms making one sheet.



COWPER'S PRINTING MACHINE.



Geo. Aikman, Sculpt.


Inspection Hall
Governor's House
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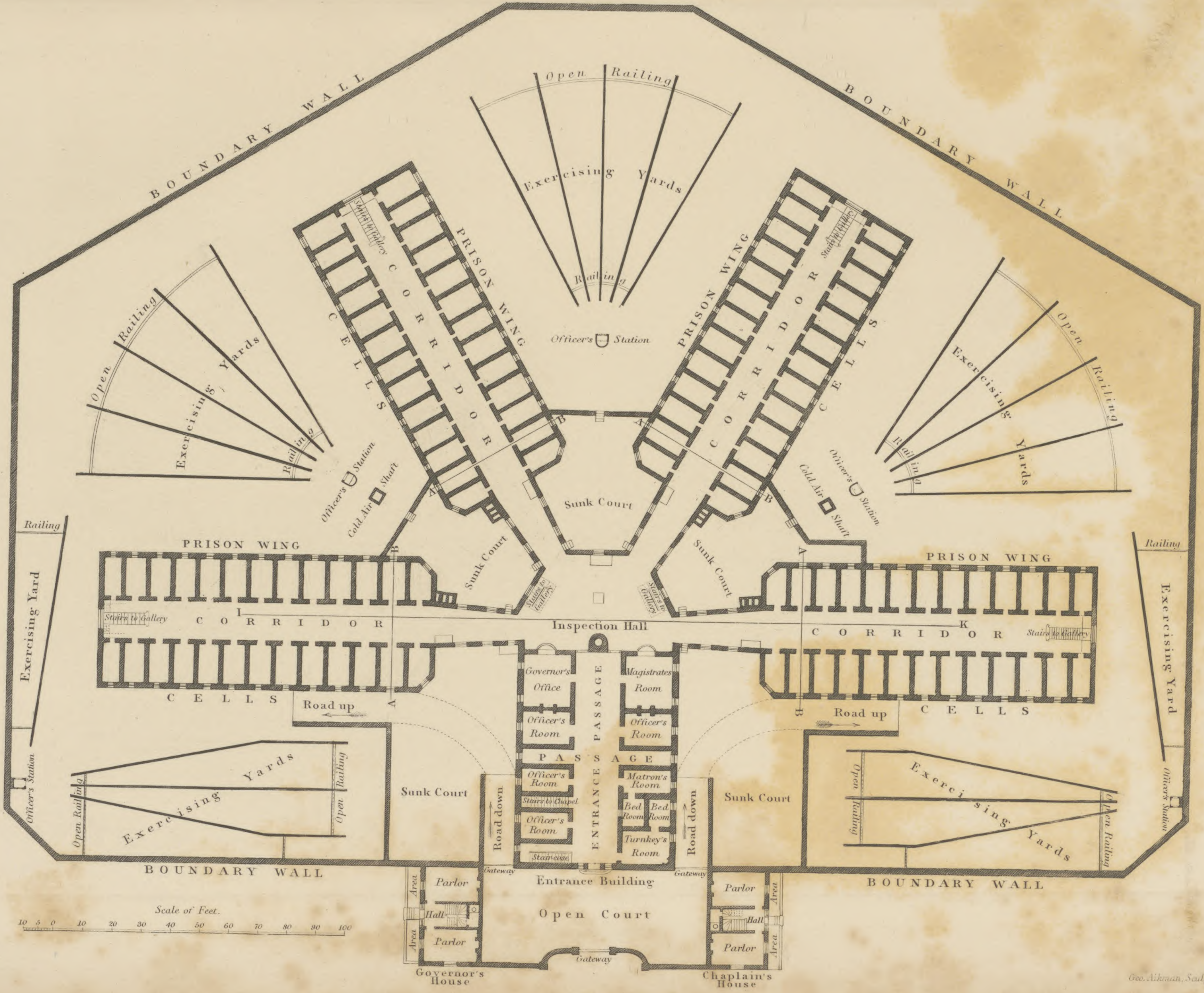
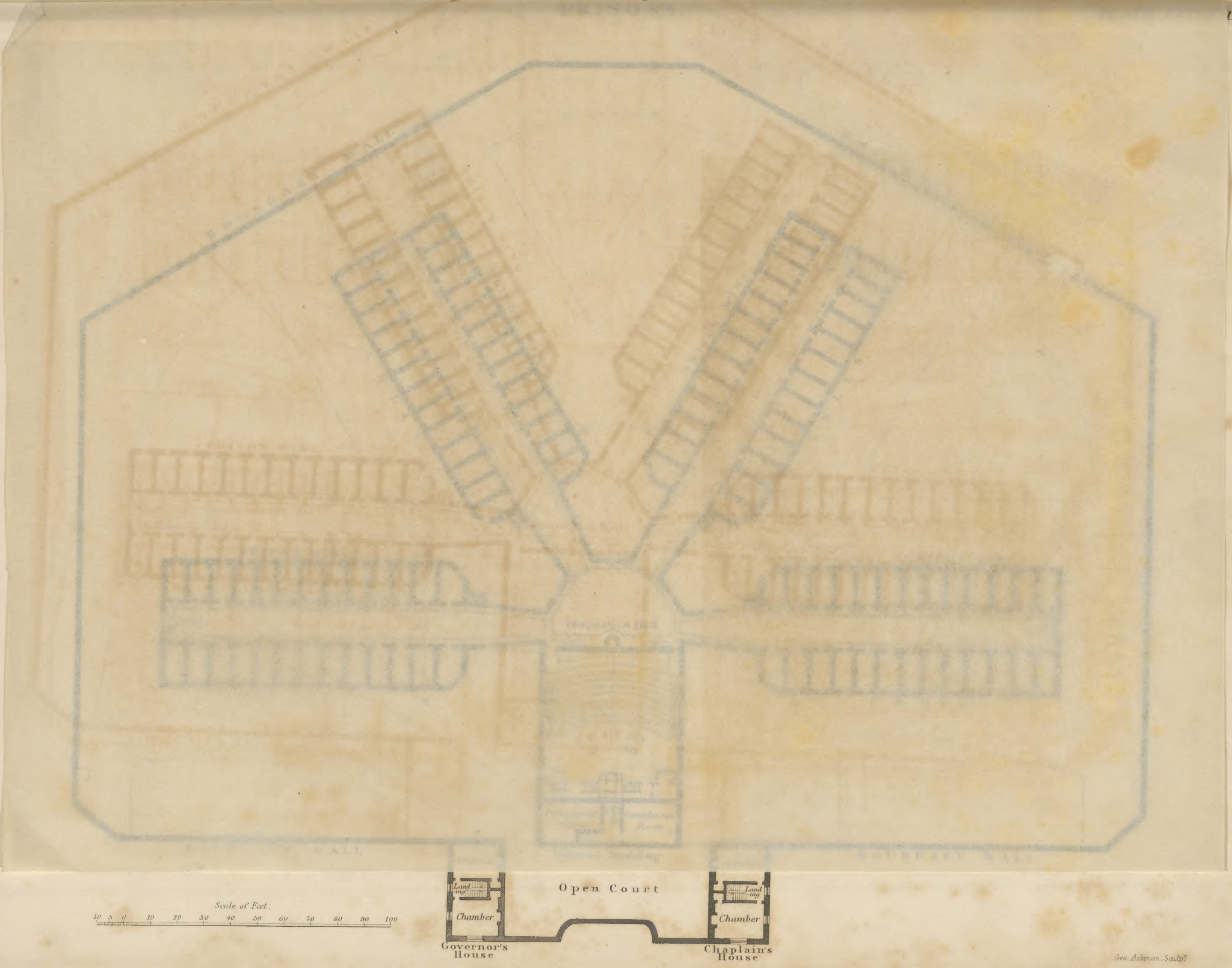
PRISONS.

PLATE CCCCXVI.



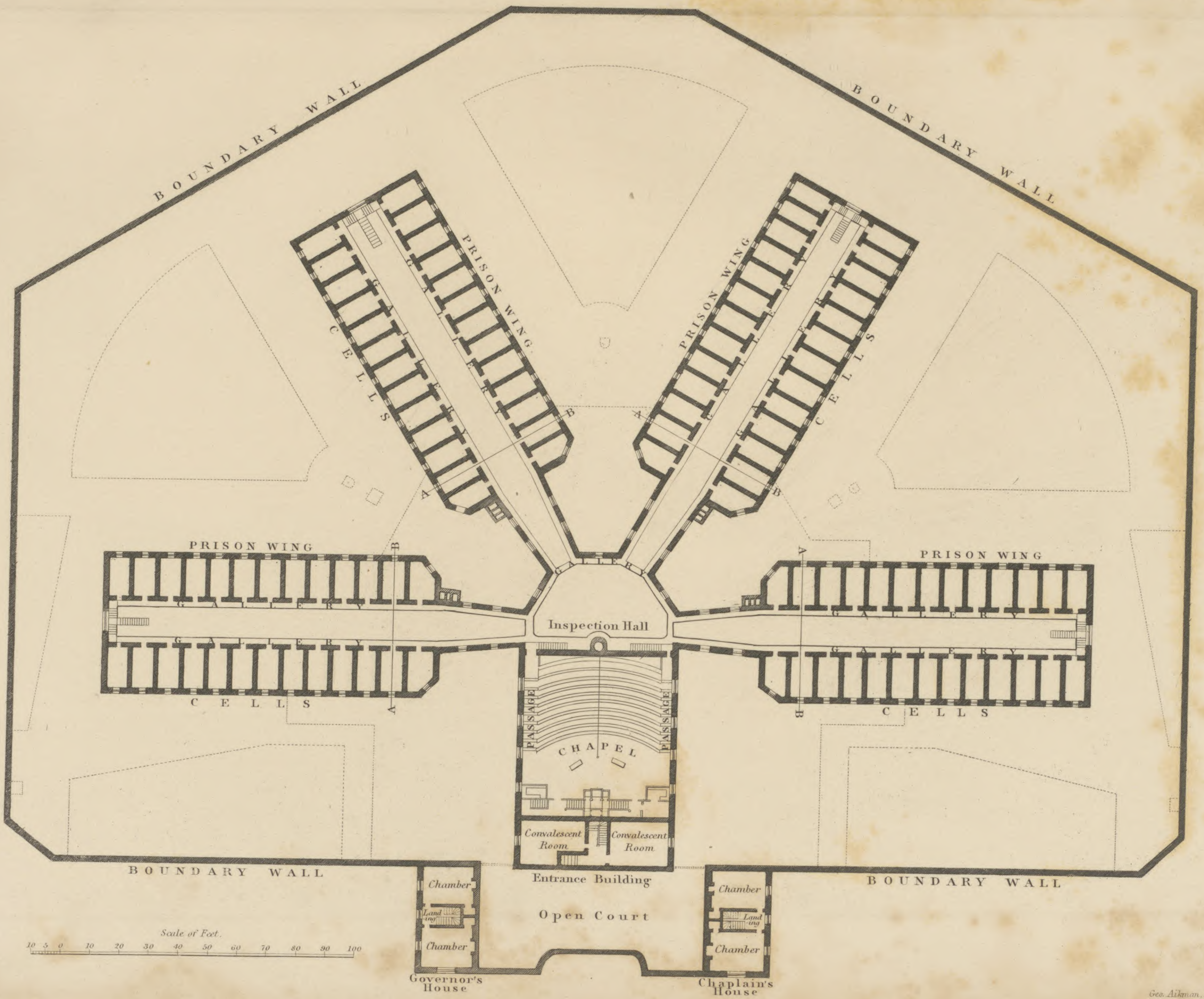
Geo. Aikman, Sculp.

II.

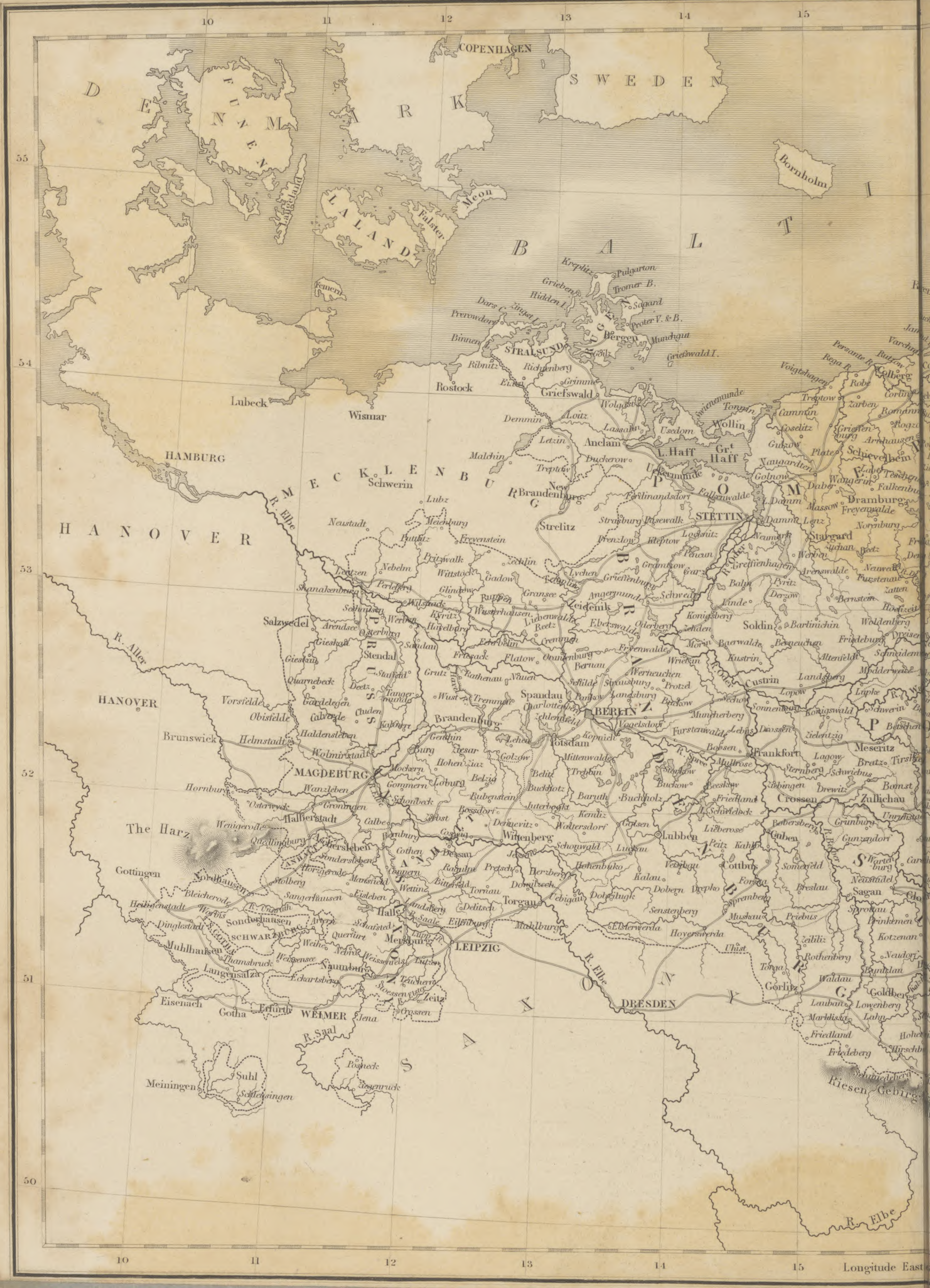


Geo. Aikman, Sculpt.

PRISONS.



Geo. Aikman, Sculpt.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Bergen
STRALSUND
Rostock
Wismar
Lubeck
HAMBURG
Schwerin
M E C K L E N B U R G
New Brandenburg
Strelitz
Griefswald
Anclam
Demmin
Usedom
Wollin
Gr.t Haff
L. Haff
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Naumburg
Merseburg
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LEIPZIG
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Wittenberg
Dessau
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Spandau
Charlottenburg
BERLIN
Potsdam
Frankfort
Custrin
Landsberg
Crossen
Zullichau
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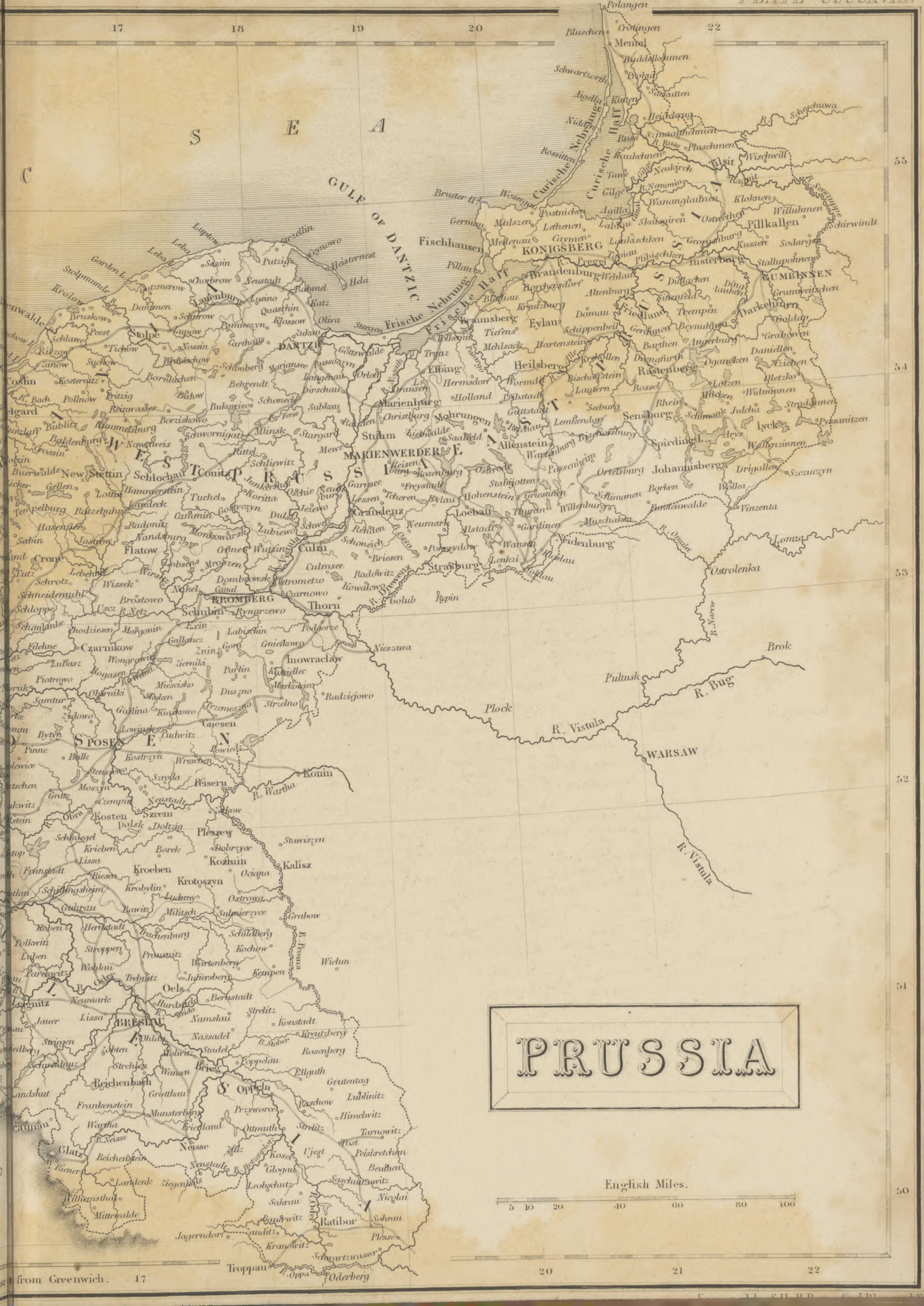
Meseritz
Sagan
Gorlitz
DRESDEN
S A X O N Y
Riesen Gebirge
R. Elbe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Ragnit
Gilge
Labiau
Wehlau
Insterburg
Gumbinnen
Pillkallen
Stallupohnen
Goldap
Darkehmen
Angerburg
Lötzen
Lyck
Rastenburg
Sensburg
Spirding L.
Johannisberg
Ortelsburg
Neidenburg
Soldau
Allenstein
Wartenburg
Bischofsburg
Seeburg
Heilsberg
Bartenstein
Schippenbeil
Friedland
Eylau
Kreutzburg
Domnau
Tapiau
KONIGSBERG
Fischhausen
Pillau
Brandenburg
Braunsberg
Mehlsack
Wormdit
Guttstadt
Liebstadt
Mohrungen
Saalfeld
Holland
Elbing
Tolkemit
Marienburg
Christburg
Stuhm
MARIENWERDER
Rosenberg
Riesenburg
Deutsch Eylau
Löbau
Osterode
Hohenstein
Gilgenburg
Strasburg
Graudenz
Culm
Culmsee
Thorn
Golub
Rypin
Lautenburg
Neumark
Mewe
Marienwerder
Stargard
Dirschau
DANTZIC
Oliva
Zoppot
Putzig
Hela
Neustadt
Lauenburg
Leba
Stolpe
Stolpmunde
Schlawe
Rügenwalde
Pollnow
Bütow
Berendt
Carthaus
Schöneck
Conitz
Schlochau
Tuchel
Schwetz
Neuenburg
Hammerstein
Landeck
Baldenburg
Rummelsburg
Bublitz
Belgard
Coslin
Neu Stettin
Flatow
Krone
Deutsch Krone
Schneidemühl
Wirsitz
Nakel
BROMBERG
Canal
Schubin
Inowraclaw
Strzelno
Gnesen
Wongrowitz
Czarnikow
Filehne
Obornik
Samter
POSEN
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Lissa
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Rawitsch
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Kempen
Wartenberg
Wieluń
Oels
Trebnitz
Namslau
BRESLAU
Ohlau
Brieg
Strehlen
Nimptsch
Schweidnitz
Reichenbach
Frankenstein
Münsterberg
Grottkau
Neisse
Glatz
Habelschwerdt
Landeck
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Oppeln
Falkenberg
Rosenberg
Kreutzburg
Lublinitz
Gross Strehlitz
Tarnowitz
Beuthen
Gleiwitz
Kosel
Leobschütz
Ratibor
Rybnik
Pless
Sohrau
Troppau
Oderberg
Jägerndorf
Plock
Pultusk
Ostrolenka
Lomza
WARSAW
R. Vistula
R. Bug
R. Narew
Brok
Nieszawa
Radziejowo
R. Netze
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R. Neisse
R. Pregel
R. Niemen
R. Russ

PYROMETER.

PYROMETER.

Fig. 1.

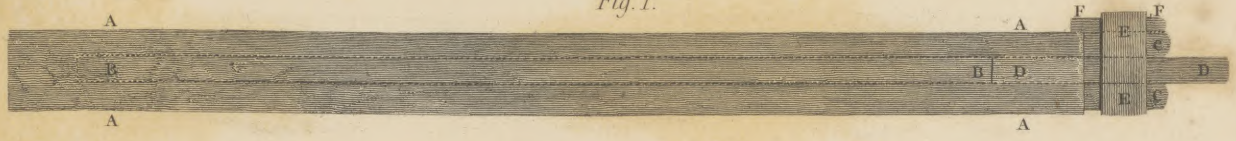


Fig. 2.

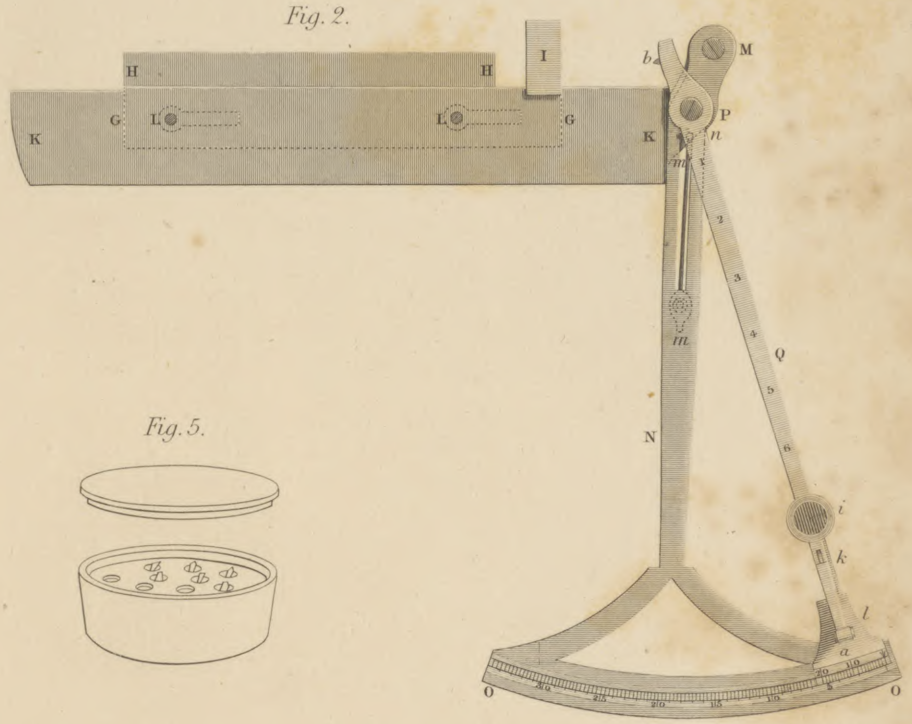


Fig. 3.

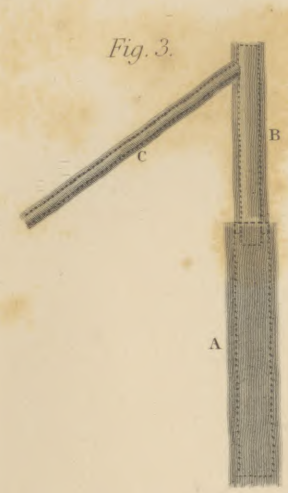


Fig. 5.

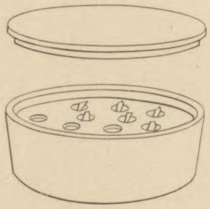
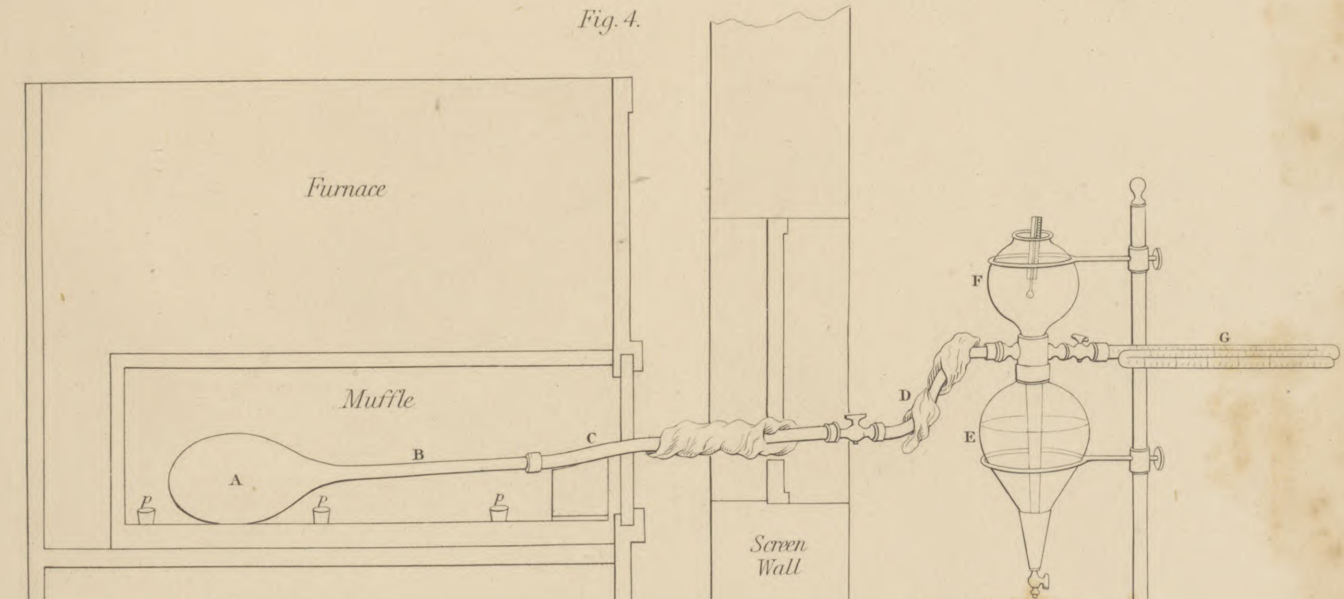


Fig. 4.



Geo. Aikman Sculpt.

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